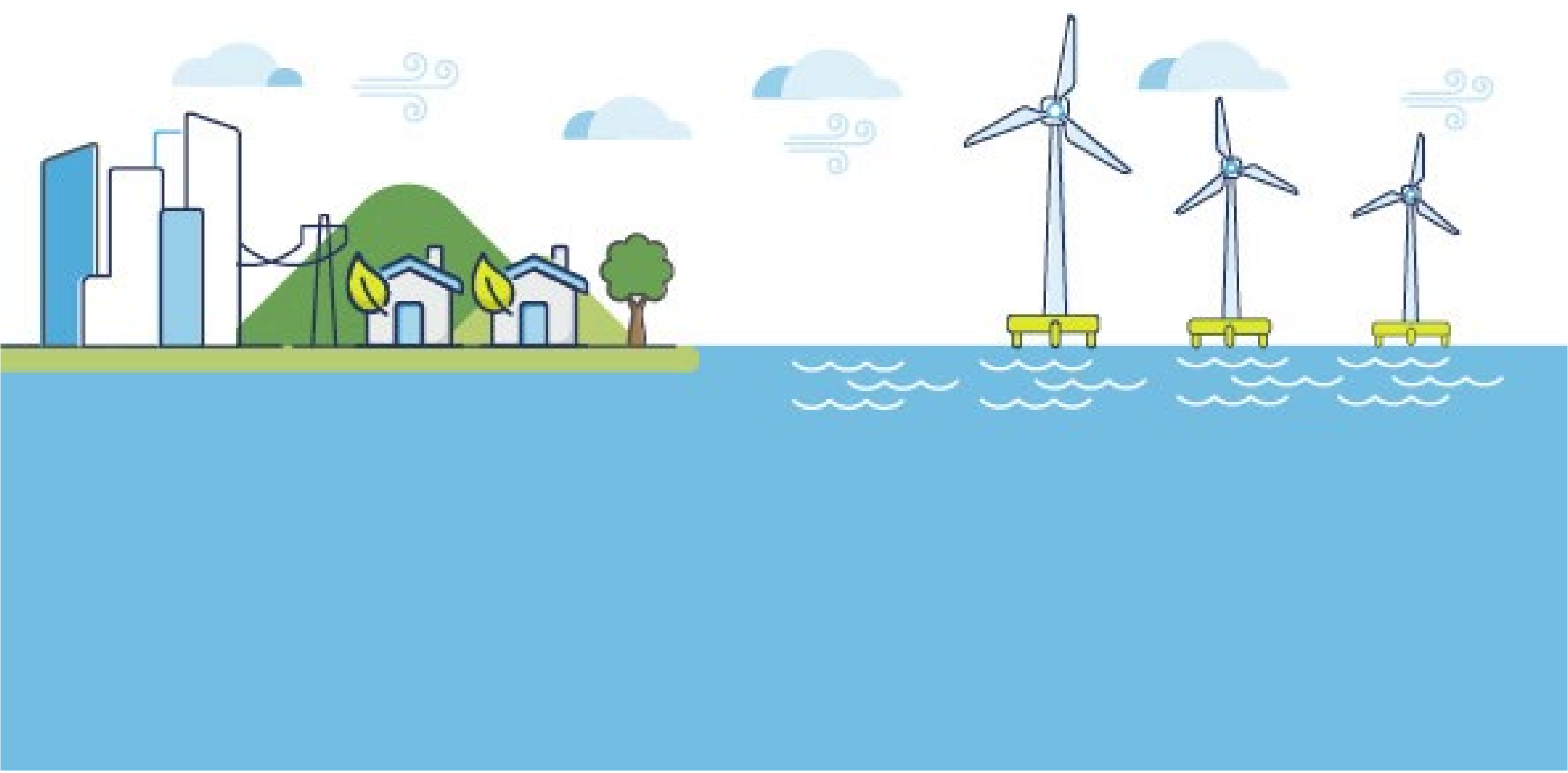
White Cross Offshore Windfarm Environmental Statement

Chapter 13: Offshore Ornithology



WHITE CROSS

Document Code:	FLO-WHI-REP-0002-13	
Contractor Document Number:	PC2978-RHD-ZZ-XX-RP-Z-0148	
Version Number:	0	
Date:	*Issue Date 17/08/2023*	
Prepared by:	*APEM*	*Electronic Signature*
Checked by:	*CB*	*Electronic Signature*
Owned by:	*PT*	*Electronic Signature*
Approved by Client :	*AP*	*Electronic Signature*

Version Number	Reason for Issue / Major Changes	Date of Change
0	For issue	17/08/2023

Table of Contents

Table of Figures

Table of Tables

Appendices

Appendix 13.A Offshore Ornithology Technical Report

Appendix 13.B: Migratory Birds Report

Appendix 13.C: Revised Collision Risk Modelling

Glossary of Acronyms

Acronym	Definition
AEoI	Adverse Effect on Integrity
AEZ	Archaeological Exclusion Zone
ADBA	Archaeological Desk Based Assessment
ADDs	Acoustic Deterrent Devices
AfL	Agreement for Lease
AIS	Automatic Identification System
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
AoS	Area of Search
AQMA	Air Quality Management Area
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
ATBA	Area To Be Avoided
BAS	Burial Assessment Study
BEIS	Department for Business, Energy and Industrial Strategy
BGS	British Geological Society
BMAPA	British Marine Aggregate Producers Association
BoCC	Birds of Conservation Concern
BSI	British Standards Institution
CAA	Civil Aviation Authority
CBRA	Cable Burial Risk Assessment
CCC	Committee on Climate Change
CEA	Cumulative Effect Assessment
Cefas	Centre for the Environment and Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CfD	Contracts for Difference
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
CRM	Collision Risk Model
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EEA	European Economic Area
EEZ	Economic Exclusion Zone
EIA	Environmental Impact Assessment
EMFs	Electromagnetic Frequency
EPS	European Protect Species
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement

Acronym	Definition
ETG	Expert Topic Group
EU	European Union
FWMA	The Flood and Water Management Act
GEART	Guidelines for the Environmental Assessment of Road Traffic
GHG	Greenhouse Gas
GIS	Global Imaging Systems
GIS	Geographical Information System
GPS	Global Positioning System
GT	Gross Tonnage
ha	Hectare
HAT	Highest Astronomical Tide
HMSO	Her Majesty's Stationery Office
HPMA	Highly Protected Marine Areas
HRA	Habitats Regulation Assessment
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAMMWG	Inter-Agency Marine Mammal Working Group
IAQM	Institute of Air Quality Management
ICES	International Council for the Exploration of the Sea
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organization
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
IUCN Red List	The International Union for Conservation of Nature's Red List of Threatened Species
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservancy Committee
km	Kilometre
Km^2	Square kilometre
LAQM	Local Air Quality Management
LCA	Landscape Character Area
LCT	Landscape Character Type
LNR	Local Nature Reserve
LPA	Local Planning Authority
LoWS	Local Wildlife Site
LSE	Likely Significant Effect
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MGN	Marine Guidance Note

Acronym	Definition
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MoD	Ministry of Defence
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MU	Management Units
MW	Megawatts
NAS	Noise Abatement Systems
NATS	National Air Traffic Services
NE	Natural England
NGC	National Grid Company
nm	Nautical Mile
NNR	National Nature Reserve
NRA	Navigational Risk Assessment
NPL	National Physical Laboratory
NOAA	National Oceanic and Atmospheric Administration
NPS	National Policy Statement
NPPG	The National Planning Practice Guidance
NRA	Navigational Risk Assessment
NtM	Notice to Mariners
O&M	Operation and Maintenance
OFTO	Offshore Transmission Owner (OFTO)
ONS	Office for National Statistics
OS	Ordnance Survey
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OSPs	Offshore Substation Platforms
OTNR	Offshore Transmission Network Review
OWF	Offshore Windfarm
OWL	Offshore Wind Ltd
PAD	Protocol for Archaeological Discoveries
PEXA	Practice and Exercise Area
PINS	Planning Inspectorate
PPG	Pollution Prevention Guidelines
PPG	Planning Practice Guidance
PRoW	Public Right of Way
pSPAS	Potential Special Protected Areas
PTS	Permanent Threshold Shift
RIAA	Report to Inform an Appropriate Assessment
RIGS	Regionally Important Geological Sites

Acronym	Definition
RNLI	Royal National Lifeboat Association
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
S.36	Section 36 Consent
SAC	Special Area of Conservation
SAR	Search and Rescue
SCANS-III	Small Cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SCOS	Special Committee on Seals
SELcum	Cumulative Effect from Sound Exposure Level
SELss	Sound Exposure Level for a single strike
SLVIA	Seascape, Landscape and Visual Impact Assessment
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SOLAS	Safety of Life at Sea
SPA	Special Protection Area
SPLpeak	Peak Sound Pressure Level
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
TJB	Transition Joint Bay
TSS	Traffic Separation Scheme
TTS	Temporary Threshold Shift
UK	United Kingdom
UKC	Under Keel Clearance
UKHO	UK Hydrographic Office
UXO	Unexploded Ordnance
VMS	Vessel Monitoring Systems
WCPS	West Coast Palaeolandscapes Survey
WPD	Western Power Distribution
WTG	Wind Turbine Generator
WWT	Wildfowl and Wetlands Trust
ZoI	Zone of Influence
ZTV	Zone of Theoretical Visibility

Glossary of Terminology

Defined Term	Description
Agreement for Lease	An Agreement for Lease (AfL) is a non-binding agreement between a landlord and prospective tenant to grant and/or to accept a lease in the future. The AfL only gives the option to investigate a site for potential development. There is no obligation on the developer to execute a lease if they do not wish to.
Applicant	Offshore Wind Limited
Bio-seasons	Bird behaviour and abundance is recognised to differ across a calendar year dependent upon the biological seasons (bio-seasons) that may be applicable to different seabird species. Separate bio-seasons are recognised in this ES chapter in order to establish the level of importance any seabird species has within the offshore ornithology study area during any particular period of time.
Cumulative effects	The effect of the Offshore Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Offshore Project.
Department for Business, Energy and Industrial Strategy (BEIS)	Government department that is responsible for business, industrial strategy, science and innovation and energy and climate change policy and consent under Section 36 of the Electricity Act. However, the energy policy responsibilities of BEIS have now been taken over by the Department for Energy Security and Net Zero as of February 2023.
Project Design Envelope	A description of the range of possible components that make up the Offshore Project design options under consideration. The Offshore Project Design Envelope, or 'Rochdale Envelope' is used to define the Offshore Project for Environmental Impact Assessment (EIA) purposes when the exact parameters are not yet known but a bounded range of parameters are known for each key project aspect.
Development Area	The area comprising the Onshore Development Area and the Offshore Development Area
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.

Defined Term	Description
Export Cable Corridor	The area in which the export cables will be laid, either from the Offshore Substation or the point at which the inter-Windfarm Site cables converge (if no offshore substation), to the WPD Onshore Substation comprising both the Offshore Export Cable Corridor and Onshore Export Cable Corridor.
Inter-Windfarm Site cables	Cables which link the wind turbines to each other and the Offshore Substation Platform, or the point at which the inter-Windfarm Site cables converge (if no offshore substation)
Landfall	Where the offshore export cables come ashore (up to MHWS)
Mean high water springs	The average tidal height throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean low water springs	The average tidal height throughout a year of two successive low waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean sea level	The average tidal height over a long period of time.
Mitigation	Mitigation measures have been proposed where the assessment identifies that an aspect of the development is likely to give rise to significant environmental impacts and discussed with the relevant authorities and stakeholders in order to avoid, prevent or reduce impacts to acceptable levels. For the purposes of the EIA, two types of mitigation are defined: • Embedded mitigation: consisting of mitigation measures that are identified and adopted as part of the evolution of the project design, and form part of the project design that is assessed in the EIA. Additional mitigation: consisting of mitigation measures that are identified during the EIA process specifically to reduce or eliminate any predicted significant impacts. Additional mitigation is therefore subsequently adopted by OWL as the EIA process progresses.
NGC Onshore Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of the electrical transformers.
Offshore Development Area	The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-Windfarm Site cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the Offshore Project that is the focus of this application and Environmental Statement and the parts of the Offshore Project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
Offshore Export Cables	The cables which bring electricity from the Offshore Substation Platform or the inter-Windfarm Site cables junction box to the Landfall
Offshore Export Cable Corridor	The proposed offshore area in which the export cables will be laid, from Offshore Substation Platform or the inter-Windfarm Site cables junction box to the Landfall
Offshore Infrastructure	All of the offshore infrastructure including wind turbine generators, substructures, mooring lines, seabed anchors, Offshore Substation Platform and all cable types (export and inter-Windfarm Site). This

Defined Term	Description
	encompasses the infrastructure that is the focus of this application and Environmental Statement and the parts of the Offshore Project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
Offshore Substation Platform	A fixed structure located within the Windfarm Site, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore
Offshore Transmission Assets	The aspects of the Offshore Project related to the transmission of electricity from the generation assets including the Offshore Substation Platform (as applicable)) or offshore junction box, Offshore Cable Corridor to MHWS at the landfall
Offshore Transmission Owner	An OFTO, appointed in UK by Ofgem (Office of Gas and Electricity Markets), has ownership and responsibility for the transmission assets of an offshore windfarm.
Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all components offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-Windfarm Site cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required).
Safety zones	A marine zone outlined for the purposes of safety around a possibly hazardous installation or works / construction area
Service operation vessel	A vessel that provides accommodation, workshops and equipment for the transfer of personnel to turbine during OMS. Vessels in service today are typically up to 85m long with accommodation for about 60 people.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water
Transition bay	Underground structures at the Landfall that house the joints between the offshore export cables and the onshore export cables
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure
White Cross Onshore Substation	A new substation built specifically for the White Cross project. It is required to ensure electrical power produced by the offshore windfarm is compliant with WPD electrical requirements at the grid connection at East Yelland.
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-Windfarm Site cables will be present
Works completion date	Date at which construction works are deemed to be complete and the windfarm is handed to the operations team. In reality, this may take place over a period of time.

13. Offshore Ornithology

13.1 Introduction

1. This chapter of the Environmental Statement (ES) presents the potential impacts of the White Cross Offshore Windfarm Project (hereafter referred to as 'the Offshore Project') on offshore ornithological features. Specifically, this chapter considers the potential impact of the Offshore Project and associated mitigation during its construction, operation and maintenance, and decommissioning phases.

2. The ES has been finalised with due consideration of pre-application consultation to date (see **Chapter 7: Consultation**). The ES will accompany the application to the Marine Management Organisation (MMO) on behalf of the Secretary of State for Business for The Department for Business, Energy and Industrial Strategy (BEIS) for Section 36 Consent and relevant Marine Licenses under the Marine and Coastal Access Act (MCAA) 2009.

3. This chapter should be read in conjunction with the Offshore **Project Description** provided in **Chapter 5**, **Chapter 10: Benthic Ecology** and **Chapter 11: Fish and Shellfish Ecology** which provides further information regarding the potential impacts on prey species, as well as the **Report to Inform Appropriate Assessment (RIAA)** (**Appendix 6.A**) which provides specific assessment of the impacts on the national site network. This chapter is also supported by the following annexes:

   - **Appendix 13.A: Offshore Ornithology Technical Report**
   - **Appendix 13.B: Migratory Birds Report**
   - **Appendix 13.C: Revised Collision Risk Modelling.**

4. This chapter describes:

   - The legislation, planning policy and other documentation that has informed the assessment (**Section 13.2**: Statutory and policy context)
   - The scope of the assessment for offshore ornithology and assessment methods used for the ES (**Section 13.3**: Assessment methodology)
   - The outcome of consultation undertaken to date, including how matters relating to offshore ornithology within the Scoping Opinion and responses have been addressed (**Section 13.3.5**: Consultation and engagement)
   - The methods used for the baseline data gathering (**Section 13.4**: Existing Environment)
   - The current and projected future baseline environments (**Section 13.4**: Existing environment)

- The relevant maximum design scenario and embedded environmental measures relevant to offshore ornithology (**Section 13.3.4**: Realistic worst-case scenario and **Section 13.3.5**: Mitigation measures)
- The assessment of potential impacts on offshore ornithology (**Sections 13.6 to 13.12** and **Section 13.13**: Cumulative effects)
- Consideration of inter-related effects (**Section 13.11**: Inter-related effects)
- Consideration of transboundary effects (**Section 13.12**)
- A summary of effects for offshore ornithology (**Section 13.14**: Summary of effects).

13.1.1 Updates since application

5. Since the original application on 14th March 2023, the Project have compiled the following supplementary information to further support and justify the conclusion made within the ES:

- In line with the request from Natural England to consider the potential impact of the Project upon migratory birds, the Applicant has also undertaken modelling of migratory CRM. Results of this modelling are presented in **Appendix 13.B: Migratory Birds Report**. A summarisation of the conclusions drawn from the additional modelling are provided within **Section 13.8.2.11**.
- The Applicant has undertaken revised collision risk modelling (CRM) using the updated recommended input parameters presented within Natural England's interim guidance on collision risk modelling avoidance rates (Natural England, 2023). The results of this updated CRM are presented within **Appendix 13.E: Revised Collision Risk Modelling** and includes summarisation of any implications the revised modelling has on the conclusions made within the ES.

13.2 Statutory and policy context

6. **Chapter 3: Policy and Legislative Context** describes the wider policy and legislative context for the Offshore Project. The principal policy and legislation used to inform the assessment of potential impacts on offshore ornithology for the Offshore Project are outlined in the following sections.

13.2.1 Legislation

7. There are a number of international and national laws that need to be considered, regarding the protection of wildlife and the marine environment with respect to offshore ornithology receptors.

8. In undertaking this assessment, international legislation has been taken into account, including:

- The Conservation of Habitats and Species Regulations 2017, the Conservation of Offshore Marine Habitats and Species Regulations 2017, and the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.
- Ramsar Convention on Wetlands of International Importance 1971.

9. Within the UK, the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (known as the 'Habitats Regulations') came into force at the end of the EU-UK transition period on 31 December 2020, providing amendments to the 2017 Habitats Regulations. The 2019 Habitats Regulations transfer functions from the European Commission to the appropriate authorities in England and Wales, with all the processes or terms unchanged. The 2019 Habitats Regulations transpose aspects of the Birds Directive and the Habitats Directive into national law, covering all environments out to 12nm.

10. The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) (known as the 'Offshore Marine Regulations') provide similar provisions to the 2017 Habitats Regulations in the offshore environment beyond 12 nm throughout the UK.

11. The Wildlife and Countryside Act 1981 operates in conjunction with the Habitats Regulations and is the principal mechanism for the legislative protection of wildlife in the UK. The Wildlife and Countryside Act 1981 has also been amended following EU withdrawal so that species of wild birds found in or regularly visiting either the UK or the European territory of a Member State will continue to be protected on land and in intertidal areas down to Mean Low Water Springs (MLWS).

13.2.2 Policy

12. The Offshore Project will comprise an Windfarm Site of offshore Wind Turbine Generators (WTGs) with an overall capacity up to 100 Megawatts (MW) and therefore requires Section 36 consent (within the Electricity Act 1989).

13. Alongside Section 36 consent, Marine Licences are also required from the MMO, an executive agency of the Department for Environment, Food and Rural Affairs (Defra). These Licences are required for depositing articles or materials in the sea/tidal waters, including the placement of construction material or disposal of waste dredging material. Further information relating to Marine Licences for the Offshore Project is detailed in **Chapter 3: Policy and Legislative Context**.

14. For the Onshore Project, planning permission is also needed for the development of the Onshore Project and a planning application will be made to the local authority **Chapter 3: Policy and Legislative Context**.

15. Guidance in relation to assessing potential impacts for offshore renewables is set out within National Policy Statements (NPSs), which are the principle decision-making documents for Nationally Significant Infrastructure Projects (NSIPs). Although the Offshore Project is not an NSIP, the following NPSs would still be contextually relevant:

    - Overarching NPS for Energy (EN-1; DECC 2011a)
    - NPS for Renewable Energy Infrastructure (EN-3, DECC 2011b).

16. The specific assessment requirements for offshore ornithology are set out within the overarching National Policy Statement (NPS) for Energy (EN-1) and NPS for Renewable Energy Infrastructure (EN-3) and summarised in **Table 13.1**. As noted above, we acknowledge that the Offshore Project is not an NSIP however due to the scale of the Offshore Project it has been determined that assessing in line with these requirements would be an appropriate approach The draft version

of the updated EN-3 (BEIS, 2021a) is also considered in the table (except where the draft represents minor wording changes). Updates to EN-1 (BEIS, 2021b) were not related to ornithology and are, therefore, not relevant to the offshore ornithology assessmentFurther guidance on the issues to be assessed for offshore renewables energy developments has been obtained through reference to: The UK Marine Policy Statement (HM Government, 2011) and the Welsh National Marine Plan (Welsh Government, 2019).

13.2.3 Guidance

17. In addition to the NPS, there are a number of pieces of guidance applicable to the assessment of offshore ornithology. Therefore, this ES chapter has been prepared with reference to the following relevant guidance for undertaking impact assessment:

- The Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (as amended)
- Institute of Environmental Management and Assessment (IEMA) (2017) Delivering Proportionate Environmental Impact Assessment (EIA): A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice
- Planning Inspectorate (PINS) (2019) - Advice Note Seventeen: Cumulative Effects Assessment
- Guidance documents for the assessment of offshore windfarm (OWF) impacts on offshore ornithology receptors produced by Natural England (Parker et al., 2022)
- Headroom in Cumulative Offshore Windfarm Impacts for Seabirds: Legal Issues and Possible Solutions (The Crown Estate and Womble Bond Dickinson, 2021).

18. Attention has also been paid to the latest guidance notes relating to displacement analysis and collision risk modelling, which are detailed in **Appendix 13.B** and **Appendix 13.C**.

Table 13.1 Summary of National Policy Statement EN-1 and EN-3 provisions relevant to offshore ornithology

Policy Description	Relevance to Assessment
EN-1 National Policy Statement (NPS) for Energy (DECC, 2011a) and Draft Overarching NPS EN-1 (BEIS, 2021b)	
"the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity." - **EN-1 Paragraph 5.3.3**	Protected sites assessed within this Chapter are presented in **Section 13.10**. Assessment of the potential effects of the Offshore Project on the features of these protected sites is provided in **Section 13.10**. Further consideration and assessment for designated sites with potential connectivity to the Offshore Project is presented in the RIAA.
the IPC "should take account of the context of the challenge of climate change: failure to address this challenge will result in significant adverse impacts to biodiversity." It also notes that "the benefits of nationally significant low carbon energy infrastructure development may include benefits for biodiversity and geological conservation interests and these benefits may outweigh harm to these interests. The IPC [the Secretary of State] may take account of any such net benefit in cases where it can be demonstrated." **- EN-1 Paragraph 5.3.6 and Draft EN-1 Paragraph 5.4.5**	Climate change is a significant threat to bird biodiversity interests (Pearce-Higgins & Crick 2019). The Offshore Project will contribute a significant amount of renewable energy, to the UK Government's target of producing 40GW of renewable energy from offshore wind by 2030 and achieving net zero by 2050 (BEIS 2020).
"development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives… where significant harm cannot be avoided, then appropriate compensation measures should be sought." **- EN-1 Paragraph 5.3.7 and Draft EN-1 Paragraph 5.4.6**	The Offshore Project has been designed to avoid significant harm to biodiversity interests through the site selection process. Further details are provided in **Chapter 4: Site Selection and Assessment of Alternatives**.
"the IPC [the Secretary of State] should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment." - **EN-1 Paragraph 5.3.8 and Draft EN-1 Paragraph 5.4.7**	The potential for effects on designated sites classified as a pSPA, SPA and / or Ramsar sites is considered in detail in the RIAA. Assessment of the potential effects on other protected sites is provided in **Section 13.10**.
"the most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Regulations provide statutory	The potential for effects on designated sites classified as a pSPA, SPA and / or Ramsar sites is considered in

Policy Description	Relevance to Assessment
protection for these sites but do not provide statutory protection for potential Special Protection Areas (pSPAs) before they have been classified as a Special Protection Area. For the purposes of considering development proposals affecting them, as a matter of policy the Government wishes pSPAs to be considered in the same way as if they had already been classified. Listed Ramsar sites should, also as a matter of policy, receive the same protection." **- EN-1 Paragraph 5.3.9 and Draft EN-1 Paragraph 5.4.8**	detail in the RIAA. These designated sites are also accounted for in the summary of valued ornithological receptors and potential impacts in **Table 13.15**.
"Development proposals provide many opportunities for building-in beneficial biodiversity or geological features as part of good design. When considering proposals, the [the Secretary of State] should maximise such opportunities in and around developments, using requirements or planning obligations where appropriate." **- EN-1 Paragraph 5.3.15**	The Applicant has explored, developed and created suitable opportunities for building-in beneficial biodiversity and geological features as part of good design for the Offshore Project, as detailed in the commitments listed in **Section 13.3.5**.
"many individual wildlife species receive statutory protection under a range of legislative provisions." **- EN-1 Paragraph 5.3.16 and Draft EN-1 Paragraph 5.4.15**	Statutory protection afforded to bird species has been considered as part of this assessment, outlined in **Section 13.3**.
"other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and thereby requiring conservation action. The IPC [the Secretary of State] should ensure that these species and habitats are protected from the adverse effects of development by using requirements or planning obligations. The IPC [the Secretary of State] should refuse consent where harm to the habitats or species and their habitats would result, unless the benefits (including need) of the development outweigh that harm. In this context the IPC [the Secretary of State] should give substantial weight to any such harm to the detriment of biodiversity features of national or regional importance which it considers may result from a proposed development." **- EN-1 Paragraph 5.3.17 and Draft EN-1 Paragraph 5.4.16**	The Offshore Project is committed to minimising potential impacts on biodiversity, and embedded environmental measures are described in **Section 13.3.5**. The Applicant has ensured that these species and habitats are protected from the potentially adverse effects of the Offshore Project by accepting the need for requirements as part of the consenting process, as detailed in the commitments listed in **Section 13.3.5**. Any residual impacts are assessed within this ES and described in **Section 13.3**.
"EIAs should include effects on and opportunities to enhance and mitigation for biodiversity" **- EN-1 Paragraph 5.3.18**	Potential effects and mitigation in relation to offshore ornithology have been incorporated into the assessment process where applicable. Embedded environmental measures and commitments are outlined in **Section 13.3.5**.

Policy Description	Relevance to Assessment
EN-3 NPS for Renewable Energy Infrastructure (DECC, 2011b) and Draft Overarching NPS EN-3 (BEIS, 2021a)	
"assessment of offshore ecology and biodiversity should be undertaken by the applicant for all stages of the lifespan of the proposed OWF" and in accordance with the appropriate policy for OWF EIAs. - **EN-3 Paragraph 2.6.64 and Draft EN-3 Paragraph 2.24.5**	Assessment of potential effects on offshore ornithology across all stages of the lifetime of the Offshore Project have been described and considered within **Sections 13.7** to **13.12**.
"Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate." **- EN-3 Paragraph 2.6.65 and Paragraph 2.24.6 of the Draft EN-3**	Agreement on the assessment approach and survey methods has been sought through discussions with the MMO and other statutory consultees through the Evidence Plan process (**Section 13.3.5**).
"the IPC [the Secretary of State] should consider the effects of a proposal on marine ecology and biodiversity [and the physical environment] taking into account all relevant information made available to it." - **EN-3 Paragraph 2.6.68 and Paragraph 2.24.18 of the Draft EN-3**	The offshore ornithology aspects of marine ecology and biodiversity have been described and considered within this ES chapter for the Offshore Project.
"the designation of an area as Natura 2000 site [a protected site] does not necessarily restrict the construction or operation of offshore windfarms in or near [or through] that area." **- EN-3 Paragraph 2.6.69 and Paragraph 2.24.19 of the Draft EN-3** "However, where adverse effects on site integrity/conservation objectives are predicted, in coming to a decision, the Secretary of State should consider the extent to which the effects are temporary or reversible and the timescales for recovery."- **Paragraph 2.24.19 of the Draft EN-3**	The Offshore Project has been designed to avoid and/ or mitigate potential adverse effects on the national site network, as described in the RIAA.
"offshore windfarms have the potential to impact on birds through: • collisions with rotating blades • direct habitat loss • disturbance from construction activities such as the movement of construction/decommissioning vessels and piling • displacement during the operational phase, resulting in loss of foraging/roosting area	Potential impacts on offshore ornithology are assessed in **Sections 13.7** to **13.12**.

Policy Description	Relevance to Assessment
• impacts on bird flight lines (i.e. barrier effect) and associated increased energy use by birds for commuting flights between roosting and foraging areas. • [impacts upon prey species and prey habitat • [protected sites (e.g. SPAs)." **- EN-3 Paragraph 2.6.101 and Paragraph 2.29.1 of the Draft EN-3**	
"Currently, cumulative effect assessments for ornithology are based on the consented Rochdale Envelope parameters of projects, rather than the 'as-built' parameters, which may pose a lower risk to birds. The Secretary of State will therefore require any consents to include provisions to define the final 'as built' parameters (which may not then be exceeded) so that these parameters can be used in future cumulative effect assessments. In parallel we will look to explore opportunities to reassess ornithological impact assessment of historic consents to reflect their 'as built' parameters. Any ornithological 'headroom' between the effects defined in the 'as built' parameters and Rochdale Envelope parameters can then be released. We will also consider the potential applicability of these principles to other consent parameters." **- Paragraph 2.29.2 of the Draft EN-3**	This assessment sets out cumulative effects for the expected as-built parameters for this project which, as per consent conditions, would not be exceeded. Estimated cumulative effects are described in **Section 13.13** and post-construction monitoring plans would be drafted subject to consent agreement.
"the scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor, [taking into consideration baseline and monitoring data from operational windfarms]." **- EN-3 Paragraph 2.6.102 and Paragraph 2.29.3 of the Draft EN-3**	Baseline survey methods have been presented to and agreed with Natural resources Wales (NRW), Natural England (NE), Joint Nature Conservation Committee (JNCC) and the Royal Society for the Protection of Birds (RSPB) through the consultation process (see **Section 13.3.5** & **Appendix 13.A**).
"any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational OWF should be referred to where appropriate." **- EN-3 Paragraph 2.6.66** "relevant data from operational OWFs should be referred to in the applicant's assessment." **- EN-3 Paragraph 2.6.103**	Relevant data from other operational OWFs both within the same region and from further afield have been referred to in the Offshore Project ES and RIAA. The use of relevant data presented within published literature is also considered throughout this ES chapter to inform the impact assessment process.

Policy Description	Relevance to Assessment
"it may be appropriate for assessment to include collision risk modelling for certain bird species." **- EN-3 Paragraph 2.6.104** "collision risk modelling, as well as displacement and population viability assessments must be undertaken for certain bird species." **- Paragraph 2.29.4 of the Draft EN-3**	Collision risk modelling and displacement analysis has been undertaken using parameters that have been agreed with SNCBs through the consultation process, and is presented in **Appendix 13.B** and **Appendix 13.C**.
"aviation and navigation lighting be minimised [and/or on demand] to avoid attracting birds, taking into account impacts on safety." **- NPS EN-3 Paragraph 2.6.107 Paragraph 2.29.5 of the Draft EN-3**	The Offshore Project has been designed with consideration of and within the limits of, lighting requirements for aviation and navigation purposes, to minimise lighting in order to avoid attracting birds, taking into account potential impacts on safety. Further consideration to the effects of lighting is given in **Section 13.3.7.1**
"subject to other constraints, wind turbines should be laid out within a site, in a way that minimises collision risk, where the collision risk assessment shows there is a significant risk of collision." **- NPS EN-3 Paragraph 2.6.108 and Paragraph 2.29.6 of the Draft EN-3**	The design of the Offshore Project will be carefully considered where feasible, in order to minimise collision risk.
"construction vessels associated with offshore windfarms should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods." **- NPS EN-3 Paragraph 2.6.109 and Paragraph 2.29.7 of the Draft EN-3**	Construction vessels associated with the Offshore Project will, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods.
"the exact timing of peak migration events is inherently uncertain. Therefore, shutting down turbines within migration routes during estimated peak migration periods is unlikely to offer suitable mitigation." **- NPS EN-3 Paragraph 2.6.110 and Paragraph 2.29.8 of the Draft EN-3**	Embedded measures for offshore ornithology have been considered within the Offshore Project assessment process where relevant (**Section 13.3.5**).

13.3 Assessment Methodology

13.3.1 Study Area

19. The Offshore Project is a demonstration scale Floating Offshore Windfarm (FLOW) development. The Offshore Project is being developed by Offshore Wind Ltd (OWL) a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd. An overview of the Offshore Project is outlined in **Chapter 5: Project Description.**

20. The Windfarm Site is located in the Celtic Sea, approximately 52km off the North Cornwall and North Devon coast (west-north-west of Hartland Point). The Windfarm Site covers approximately 50km^2.

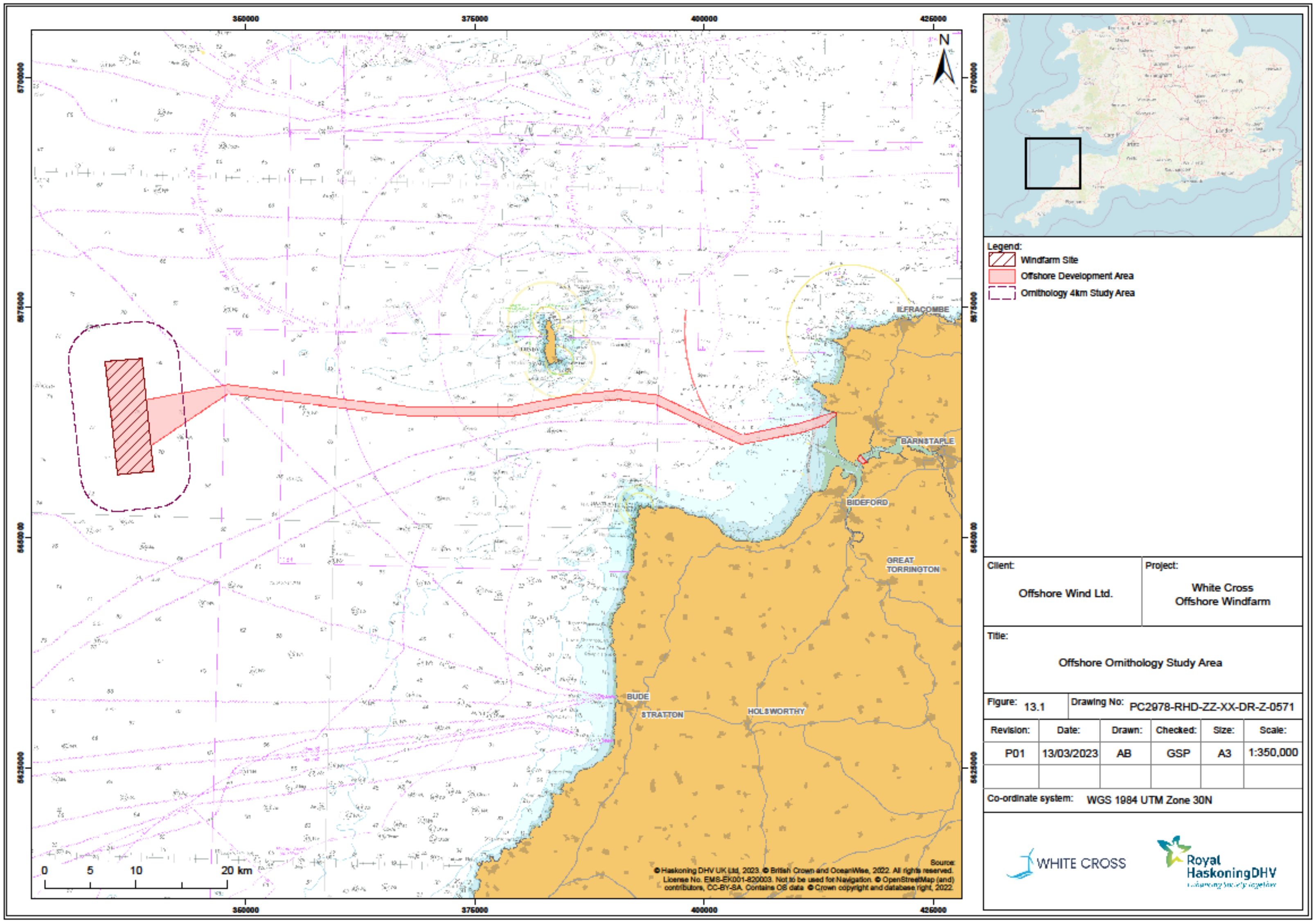
21. The Offshore Export Cable will connect the Offshore Substation Platform to shore. The Export Cable will make landfall at Saunton Sands on the North Devon coast and then be routed underground to the Onshore Substation, where it connects into the National Grid Distribution Network. The Offshore Export Cable will be approximately 70km (maximum potential length of 94km) and will sit within a maximum cable corridor width of 50m.

22. The Offshore Ornithology Study Area is defined as the Offshore Development Area together with the Zone of Influence (ZOI) for offshore ornithology. It is based on an area which is considered to represent a realistic maximum spatial extent of potential impacts on offshore ornithological receptors. The study area for the offshore ornithology assessment includes the Windfarm Site area (hereafter referred to as the Windfarm Site) with a 4km buffer, along with the Offshore Export Cable Corridor (plus a buffer). The extent to which the Offshore Ornithology Study Area is covered by the Aerial Digital Survey Study Area is outlined in the **Section 13.4.4**.

23. Details of the location of the Offshore Project and the offshore components (including the WTG sites operational footprint, Windfarm Site layout, inter-Windfarm Site cables and associated protection, and the spatial footprints of the construction or decommissioning works) are set out within **Chapter 5: Project Description.**

24. The study area for offshore ornithology is presented in **Figure 13.1**.

Figure 13.1 Offshore Ornithology Study Area



13.3.2 Temporal scope

25. The temporal scope of the assessment of offshore ornithology is consistent with the period over which the Offshore Project would be present and therefore covers the construction, operational and decommissioning periods. The exact dates are unknown at this stage, but it is assumed that construction will begin in 2026, in order that the windfarm is fully operational by 2027; the anticipated operational lifetime of the windfarm is a minimum of 25 years. The duration for decommissioning is not currently known. A decommissioning plan will be prepared during detailed design and developed and refined during the Offshore Project's lifetime and as decommissioning approaches. For the purposes of this assessment, is it assumed that the decommissioning activities will take a minimum of two years.

13.3.3 Worst-Case Scenario

26. An Impact Assessment using a parameter-based design envelope approach means that the assessment considers a worst-case scenario that considers the design that may cause the maximum impacts to a particular receptor. It is considered a conservative approach to impact assessment but retains a necessary degree of design flexibility. The assessment of the maximum adverse scenario for each receptor establishes the maximum potential adverse impact. As a result, impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 5: Project Description**) to that assessed within this Chapter be taken forward in the final scheme design.

27. In accordance with the assessment approach to the Project Design Envelope (PDE) or 'Rochdale Envelope' set out in **Chapter 6: EIA Methodology**, the impact assessment for offshore ornithology has been undertaken based on a realistic worst-case scenario of predicted impacts. The PDE for the Offshore Project is detailed in **Chapter 5: Project Description**.

28. In accordance with Natural England's guidance regarding evidence and data standards for OWF assessments (Parker *et al.*, 2022), **Table 13.2** presents the realistic worst-case scenario components relevant to the assessment of impacts on offshore ornithology receptors in all project phases.

29. The worst-case scenarios for indirect effects (**Sections 13.3.4**) are as presented for disturbance / habitat loss impacts in **Table 11.7** of **Chapter 11 Fish and Shellfish Ecology**.

Table 13.2 Realistic worst-case scenario details relevant to the assessment of impacts on offshore ornithology receptors

Parameter	Value
Latitude (decimal degrees)	51.10
Windfarm Site (km^2)	49.4
Windfarm Site + 2km buffer (km^2)	127.2
Windfarm Site + 4km buffer (km^2)	230.2
Maximum width of Windfarm Site (km)	7.9
Length of offshore construction period (years)	18 Months
Length of operational period (years)	25
Number of turbines	7
Number of blades	3 per turbine
Maximum blade width (m)	7.00
Average blade pitch at mean predicted wind speed (degrees)[1]	236
Rotor radius (m)	118.0
Average rotation speed at mean predicted wind speed (rpm)[1]	8.40
Hub height relative to Highest Astronomical Tide (HAT) (m)	140.0
Tidal offset (m)	0.00 (not required for floating turbines)
[1]Uses mean annual wind speed predicted at 151m above mean sea level. Mean rotation speed during generic breeding season months April to August would be 5.20 rpm (12.3% decrease). This rotation speed was not used in the assessment but would result in collision risk reducing by approximately 1.5% during these months.	

13.3.4 Mitigation measures

30. As part of the Offshore Project design process, a number of embedded mitigation measures have been adopted to reduce the potential for adverse effects on offshore ornithology receptors.

Table 13.3 Relevant embedded environmental measures for offshore ornithology

Component/Activity	Mitigation embedded into the design of the Offshore Project
Continuous monitoring of Project substructures for the presence of ALDFG and other potential entanglement hazards	Annual monitoring of anchor/moorings will be undertaken during the lifetime of the Offshore Project. Remotely operated vehicles (ROVs) will be used to identify any entanglement hazards such as ALDFG snagged on Project substructures.

31. These measures typically include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing requirements. The Offshore Project is committed to implementing these mitigation measures, as they form part of the design. Where other mitigation measures are proposed, these are detailed in the impact assessment

13.3.5 Consultation

13.3.5.1 Overview

32. Consultation has been a key part of the development of the Offshore Project. Consultation regarding offshore ornithology has been conducted throughout the EIA. An overview of the project consultation process is presented within **Chapter 7: Consultation**.

33. A summary of the key issues raised during consultation specific to offshore ornithology is outlined below in **Table 13.4**, together with how these issues have been considered in the production of this ES.

Table 13.4 Scoping Opinion and Consultee responses to Scoping Report – Offshore ornithology

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
MMO	14/03/2022 Scoping opinion, section 6.6.1	**Displacement and barrier effects due to the presence of turbines and infrastructure, as well as disturbance and displacement covering work activity, vessel movements and lighting – construction, decommissioning** "The Applicant states "Disturbance and displacement is likely to occur due to the presence of working vessels and the movement, noise and light associated with these. This impact is expected to be similar in nature and magnitude to the corresponding impact occurring during the construction phase." The MMO note that there is currently no justification for proposing to scope these matters out of the assessment. However, given that disturbance/displacement and barrier effects due to the presence of turbines and other infrastructure are discussed in paragraphs 465 to 469 for construction, and paragraph 482 for decommissioning then the MMO considers these matters should be scoped in for the construction and decommissioning phase assessments."	As presented within **Section 13.8** and **13.9**, the Offshore Project has been assessed against the potential for disturbance and displacement effects, which includes any potential impacts due to barrier effects, during the construction and decommissioning phase as recommended in Natural England's best practice advice for evidence and data Standards (Parker *et al.*, 2022).
MMO	14/03/2022 Scoping opinion, section 6.6.2	**Collision Risk – construction, decommissioning** "Paragraph 477 of the Scoping Report states that collision risk from the proposed WTGs and other offshore infrastructure is proposed to be scoped in for the operational phase of the Proposed Development. No justification for scoping this matter out of the construction and decommissioning phase assessment is currently provided.	With respect to the appropriate development stages for assessment of collision risk, the Offshore Project has been assessed during the Operational and Maintenance phase only, as recommended in in Natural England's best practice advice for evidence and data standards (Parker *et al.*, 2022).

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		Furthermore, the potential for collision risk and disturbance associated with vessel movements during the construction and decommissioning phases has not been addressed in the Scoping Report. On this basis, the MMO considers that insufficient evidence has been presented in the Scoping Report to agree to scope this matter out of assessment at this stage; this should therefore be assessed in the ES where significant effects are likely to occur."	Consideration of vessel movements and subsequent displacement within the Offshore Project are considered within **Section 13.7** during the construction phase and **Section 13.8** during decommissioning. With respect to vessel collision, due to the slow speeds at which vessels would be travelling within the Offshore Project, it is considered there is no potential for collisions with vessels.
MMO	14/03/2022 Scoping opinion, section 6.6.3	**Entanglement - construction, decommissioning** No justification for proposing to scope these matters out of the assessment during construction and decommissioning is provided. However, in paragraph 478 of the Scoping Report the Applicant states "During operation, there is a possibility that lost fishing equipment can become caught around mooring lines and cables associated with the Offshore Project. This could pose an entanglement risk to diving offshore ornithology receptors. Due to a lack of data this risk is currently considered difficult to quantify. However, the assessment will consider any information on the subject that can be identified."	Currently Natural England's best practice guidance on consideration of marine renewable impacts on offshore ornithology receptors does not include consideration of entanglement as a potential impact, however the Applicant has considered the potential for entanglement on a precautionary basis for the operational and maintenance phase. As presented within **Section 13.8.4**, with respect to potential for entanglement during the operational and maintenance phase, the overall magnitude of impact was concluded as negligible. When considering the potential for entanglement during the construction and decommissioning phase, due to a lesser number of mooring lines being installed for ghost fishing gear to

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
			become snagged on, combined with the disturbance from the associated activities with these development phases causing the likelihood of diving seabirds regularly foraging within the Windfarm Site to be low during these phases, a potential significant effect can confidently be ruled out for the construction and decommissioning phases.
MMO	14/03/2022 Scoping opinion, section 6.6.4	**Potential impacts** "The following are potential impacts during the construction, operation and/or the de-commissioning phases, that need to be assessed, and mitigated for, where required: • Bird strike • Disturbance displacement from feeding, loafing or roosting areas (at sea and on land) • Barrier effect • Damage to habitats that are important to seabirds' food source (fish prey) and waterbirds (inter-tidal) • Pollution • Invasive Non-Native Species (mammalian predators). The proposal includes construction and operational use of a corridor running past Lundy Island where an island restoration project was carried out and the islands are now free of invasive mammalian predators. The route of the connection should consider the potential swimming distances of rodents to ensure the island avoids exposure	As presented within **Sections 13.7** to **13.9**, the Applicant has assessed the potential for collision risk (Bird strike), Disturbance and displacement (including consideration of potential barrier effects) and indirect effects through effects on prey species (Damage to habitats that are important to seabirds' food source (fish prey)) in accordance with Natural England's best practice advice for evidence and data standards (Parker *et al.*, 2022). The Applicant has specifically considered the effects of light pollution on Manx shearwater as requested, the details of which are provided in **Section 13.3.7**. As requested, the Applicant has also considered the potential for impacts

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		to accidental re-introduction. Therefore, a biosecurity plan should be agreed with RSPB / Landmark Trust to ensure adequate biosecurity and response measures are in place to prevent or resolve any re-incursions, as a result of the proposal during all phases. • Cumulative effects The potential impact of the Proposed Development on the spawning and nursery grounds (and their associated habitats) of key seabird prey species including sand eel, sprats and herring, must be assessed, particularly cumulative effects as a result of displacement of other activities such as fisheries. "	from the Offshore Project specifically on Lundy Island SSSI. With respect to the potential for Invasive Non-Native Species (mammalian predators) impacts a bio-security plan would be implemented should the Offshore Project be consented. The potential impact of the Proposed Development on the spawning and nursery grounds (and their associated habitats) of forage fish is both alone and cumulatively is detailed within **Chapter 11: Fish and Shellfish**. Any subsequent impact on seabirds is considered within **Sections 13.7** to **13.9**.
RSPB	14/03/2022 Scoping opinion, section 6.6.5	Balearic shearwater regularly occurs within the Celtic Sea, and the number of seabirds (including Manx shearwater) that reach the qualifying figure for SPA designation on Lundy should be addressed as part of the impact assessment process. The RSPB should be contacted for further information on this.	Consideration of Balearic shearwater connectivity with the Offshore Project site is presented in **Section 13.4.3**.
MMO/ RSPB	14/03/2022 Scoping opinion, section 6.6.6	"The MMO notes the RSPB raised a range of concerns relating to the range of species assessed, the desktop survey information, the survey methodology and its ability to assess some of the likely impacts. The MMO advises that a detailed discussion is had with ornithologists from NE, RSPB and with other experts who have carried out relevant studies who would help inform the evidence and monitoring plan and to discuss current	The approach to offshore ornithology baseline characterisation for the Offshore Project as presented within **Appendix 13.A**, follows Natural England's best practice advice for baseline characterisation surveys (Parker *et al.*, 2022). Baseline Characterisation surveys are also supplemented by relevant desk-based

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		surveys and work that could be commissioned using existing and new data, as well as future monitoring and mitigation measures. This could include Steve Votier (Gannets) Heriot-Watt University; Tim Guilford (Manx shearwaters) Oxford University; Tim Birkhead and Steve Votier (Guillemots) Sheffield University; Niall Burton and Chris Thaxter (Lesser black-backed gull) British Trust for Ornithology; Matt Wood (seabird populations) University of Gloucestershire. In addition, these discussions should consider the research needs incumbent on a demonstration scheme that would support the development of a more robust evidence base to understand the implications of floating wind in the Celtic Sea. "	studies for species assessed as detailed in **Section 13.4**, ensuring assessments are robust and evidence-led.
RSPB	14/03/2022 Scoping opinion, section 6.6.7	"The RSPB raised that Lundy 2017/18 Manx shearwater survey and the 2021 Cliff nesting survey identified that Lundy now supports over 27,000 seabirds including 5,504 pairs of Manx shearwater, which also exceeds the published international importance threshold for this species. Based upon boat surveys within the Celtic Sea, concentrations of Balearic shearwater (Annex 1, Globally threatened species) have been identified. This species should be included in the assessment and surveys considered to support this."	Specific consideration of impacts Apportioned to Lundy Island SSSI is presented in **Section 13.10**. The potential for the Offshore Project to impact Balearic shearwater is considered in **Section 13.4.3**. The RPSB have also been responded to directly on this matter.
RSPB	14/03/2022 Scoping opinion, section 6.6.8	Regarding light pollution, the RSPB have advised that Manx shearwaters are known to be attracted to light, and so should be considered within the assessment.	The potential for lighting effects on Manx shearwater are considered in **Section 13.7**.
RSPB	14/03/2022 Scoping	"There is a lack of evidence presented for Balearic shearwater and storm petrel and the potential impacts of the scheme on these two species.	The potential for the Offshore Project to impact Balearic shearwater and

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
	opinion, section 6.6.9	Please contact the RSPB to access the information on populations of cliff nesting seabirds on Lundy from 2021, which is not yet published. It should also be noted that evidence for the importance of the Celtic Sea for some species (e.g. Wakefield *et al.*, 2017 which covered four species: kittiwake, shag, guillemot and razorbill) should be used with caution based on the age of the colony data used in the modelling. Where modelling is based upon old datasets (e.g. Seabird 2000), and where the populations of seabirds at colonies such as Lundy have changed significantly, re-modelling should be undertaken to use the latest census data. The RSPB advises that the origin of seabirds using the Celtic Sea is not well known, and only a limited number of species have been tracked. The origin of species observed within the site should be well evidenced and this is not the case for all species. For example, the foraging ranges provided for breeding Manx shearwater from Lundy are only for the chick rearing period and do not include the incubation period when foraging flights may differ spatially and temporally from those during chick rearing. In other instances, there is speculation over the origin of the birds in the documentation so further work may need to be commissioned."	storm petrel are considered in **Section 13.7**. Specific consideration of impacts Apportioned to Lundy Island SSSI is presented in **Section 13.10**.
MMO	14/03/2022 Scoping opinion, section 6.6.10	"As a demonstration site, some areas that should be considered to be addressed by studies include: • The detectability and identification of some species using air-based monitoring e.g. storm petrel,	Subject to consent, a project monitoring plan would be drafted in consultation with the relevant stakeholders.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		Balearic shearwater, auks, gulls, etc needs to be clarified • Nocturnal and crepuscular monitoring • Evidencing the origin of the seabirds Collision damage monitoring and concerns over theoretical modelling and the lack of studies"	
RSPB	14/03/2022 Scoping opinion, section 6.6.12	"The RSPB recently commissioned desktop work focussing on 11 species of forage fish, including Sandeel, Sprat and Herring which are key food prey items for seabirds. This report (and associated spatial data) provides information on the foraging fish community in Welsh and surrounding waters, including the Irish and Celtic Seas and the western English Channel. Given that several forage fish (prey) species in the northeast Atlantic have shown major changes in distribution and abundance, up-to-date information on their recent distribution patterns is vital. The evidence-base for some food prey species such as sand eel, sprats or herring is either old or there is a lack of data (sprats and herring) and RSPB therefore recommend that appropriate surveys of these species are included within the site or areas where cumulative effects could occur. "	Consideration of potential indirect effects on offshore ornithology features with respect to indirect effects upon forage fish (prey species) is assessed within **Sections 13.7** to **13.9.**
Natural England	09/05/2022 Offshore Ornithology ETG	Uncertain about the preferred cable route (route across Braunton Burrows), but yet to provide a formal response to the short list report. Will confirm which model (deterministic/ stochastic) should be used for the CRM.	Braunton burrows corridor route is no longer being considered. Details and agreements on appropriate methods for collision risk modelling is provided within **Appendix 13.C: Revised Collision Risk Modelling.**

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
Devon Wildlife Trust	09/05/2022 Offshore Ornithology ETG	Not supportive of the preferred cable route option through Braunton Burrows.	Braunton burrows corridor route is no longer being considered.
RSPB	09/05/2022 Offshore Ornithology ETG	Reconsider survey efforts for certain species, particularly species hard to detect, such as Balearic shearwater, storm petrels. Also consider surveys for nocturnal species, as this is a test and trial site, rather than just doing the standard methods, you should be thinking about more opportunities to use alternative methods. Consider if the modelling can be redone with up to date data, that should give a better idea of the importance of the area rather than using Seabird 2000 data. Ensure biosecurity measures are in place in respect of Lundy. Look at year round data for onshore/intertidal assessment.	Further consideration of storm petrels and Balearic shearwater is presented within **Section 13.4.3**. As detailed in **Section 13.3.5**, the Applicant's Project Environmental Management Plan (PEMP) will be agreed prior to the start of construction which will include biosecurity measures.
Natural England	02/05/2023	Clarifications were sought from Natural England on: • the input parameters and planned approach to be used for any future Collision Risk Modelling that may be required; and • the Applicant's interpretation of Natural England's best practice guidance on apportionment, which was used to justify screening out North Sea Special Protection Areas (SPAs) from assessment within the Report to Inform Appropriate Assessment (RIAA). The following response was provided was received from Natural England via email on 30/06/2023:	The Applicant has undertaken revised collision risk modelling (CRM) using the updated recommended input parameters presented within Natural England's interim guidance on collision risk modelling avoidance rates (Natural England, 2023). The results of this updated CRM are presented within **Appendix 13.C: Revised Collision Risk Modelling** includes summarisation of any implications the revised modelling has on the conclusions made within the ES.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		"**Collision Risk Modelling** Regarding the Collision Risk Modelling Approach, Natural England's current advice is to use the interim guidance which is attached separately to this response. The CRM guidance is referenced in Table 2 of the clarification note supplied by APEM and so there is no need to also model another set of parameters (e.g. Table 1 in the note, which looks to come from an older version of Natural England's phase 3 best practice advice). A joint SNCB Collision Risk Modelling guidance note is currently in the final stages of production. While NE cannot guarantee that no changes will be made to the advice provided in this interim note, it is considered unlikely. NE advise that these parameters are used for the PIER and any updates should then be reflected in the Environmental Statement submission, if necessary. **Review of NE's Best Practice Guidance** The review of interpretation of the Best Practice Advice within the Clarification note regarding the screening of North Sea Special Area's of Conservation has highlighted a lack of clarity in the example quoted which NE will work to address. While it is true that 8 of 10 SPAs are screened in for connectivity, it appears this decision was not based on geographic location of those SPAs. Table 14, Appendix A of Furness (2015) confirms that two of the SPAs do not contribute adult birds to the relevant seasonal BDMPS population. Those SPAs are designated based on numbers of breeding individuals. This is the basis for screening those SPAs out for connectivity.	In line with the request from Natural England to consider the potential impact of the Project upon migratory birds, the Applicant has also undertaken modelling of migratory CRM. Results of this modelling are presented in **Appendix 13.B: Migratory Birds Report**. A summarisation of the conclusions drawn from the additional modelling are provided within **Section 13.8.2.11**.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		It is Natural England's advice that Likely Significant Effect should be treated as a coarse screening filter to identify all instances of qualifying features with potential protected site connectivity and an impact pathway. If any Likely Significant Effect cannot be excluded on the basis of objective information without extensive investigation, further assessment should be presented in an Appropriate Assessment. Natural England understands it is likely that impacts on North Sea SPAs at White Cross OWF will be small, however due to the in-combination Adverse Effect on Integrity already identified for features of Flamborough and Filey Coast SPA (e.g., kittiwake) it is appropriate to properly quantify these risks to enable an informed consideration of them, to better understand whether White Cross could make a meaningful contribution to the in-combination total."	

13.3.6 Scope

34. **Table 13.5** presents the impacts that have been scoped out from further assessment, as they were determined as not having the potential to lead to a significant adverse effect (MMO, 2022). An indication is also given whether the scope has evolved since Scoping.

Table 13.5 Summary of impacts scoped out relating to offshore ornithology

Potential Impact	Justification
Collision risk during construction and decommissioning phases	Collision risk is only considered to be a risk once turbines are operational.
Entanglement during construction and decommissioning phases	Entanglement is a risk from the start of installation of turbines during the construction phase until the end of removal during the decommissioning phase. For brevity, and to avoid repeating information, the operational phase assessment takes into account this timeframe. It is noted that the risk of entanglement will be greatest during the operational phase when all turbines are *in situ* and therefore any risk in the construction and decommissioning phase will be lower.
Lighting Effects (Pollution)	See justification below.

13.3.6.1 Potential Lighting Effects

35. As requested by the MMO/RSPB (detailed within **Table 13.4**) the applicant has considered the impact of lighting effects on ornithological receptors, with particular reference to Manx shearwaters.

36. There is the potential for some species of birds to be attracted to or deterred by artificially illuminated structures in the offshore environment, such as oil and gas platforms, during the hours of darkness or poor weather conditions which result in restricted visibility. Impact effects maybe positive; as they may provide opportunities for extended feeding periods, shelter and resting places or navigation aids for some migrating birds, or negative; causing change in course direction during migration and increased energy expenditure or displacement during nocturnal foraging. Predicting behavioural changes to artificial lighting may also require consideration of species, age and season.

37. The majority of offshore evidence on lighting effects is compiled from studies from oil and gas platforms (reviewed in Ronconi *et al.*, 2015), however, WTGs are not as extensively lit or intensively lit, compared to oil and gas platforms which may also include gas flares. It is, therefore, unlikely that any benefits relating to increased

provision of foraging opportunities or negative disorientation effects during the hours of darkness are unlikely to be of the same magnitude at WTGs. Any benefits of lighting from OWFs, however, may be outweighed by increased risks of collision with rotating blades of WTGs for species that fly at the rotor swept height of WTGs.

38. Disturbance effects of lighting may derive from changes in orientation, disorientation and attraction or repulsion from the altered light environment, which in turn may affect foraging, migration and communication (Longcore and Rich, 2004). These behavioural effects tend to be reported predominantly in poor visibility i.e., impacting flight behaviours when visibility is low during overcast nights with drizzle and fog. At these times lighting is enhanced because the moisture droplets in the air refract the light and greatly increase the illuminated area (Hill *et al.*, 2014). Therefore, the likelihood of behavioural effects from lighting should consider the occurrence of glare and not simply its intensity. The hours of darkness in which intense illumination has the greatest effect is the period after nautical twilight when the horizon is no longer clearly visible, and structures cannot be seen against a contrasting background. Therefore, the extent to which nocturnally active seabirds such as shearwaters and storm-petrels are at risk to artificial lighting depends on the frequency and duration of the conditions that effect behaviour which may vary considerably between seasons, i.e., mid-winter vs mid-summer and their geographical location.

39. When considering shearwater and petrel species at potential risk from artificial lighting from the Offshore Project, Manx shearwater is the predominant species to be considered. Aerial digital surveys recorded this species from March to September with numbers peaking during the breeding season. Vulnerability of Manx shearwaters to lighting at OWFs will be dependent on the time spent at sea during the hours of darkness, which varies considerably during the months they are present during the breeding season in UK waters. Female Manx shearwaters during their pre-laying exodus spend a protracted period travelling extensive distances to productive feeding grounds, during the brooding period parents return to the nest at least every two days, whilst it is not until the post-brooding period that parents spend longer periods at sea.

40. Manx shearwaters may gather in dense flocks on the sea (rafting behaviour) in the vicinity of breeding colonies from late afternoon, before coming ashore after nightfall to avoid being preyed on by predatory species (e.g. peregrine falcons). Birds tend to roost on the sea within 20 km of the colony prior to landfall and resume roosting on the sea adjacent to the colony after their visit (Dean *et al.*, 2013). The maximum extent of rafts of birds from Skomer was 4 km, which would suggest local

birds are not usually in the vicinity of the Offshore Project during the hours of darkness. Although foraging has been reported to occur at night (birds from a colony on the west coast of Ireland, (Kane, 2020)), foraging activities for Manx shearwaters at Skomer occurred almost entirely within daylight, whilst birds roosted on the water during the evening and at night (Dean *et al.*, 2013). Manx shearwaters from colonies with connectivity to the Offshore Project, such as Skomer Island, constrain their dives to daylight hours which corresponds to the diurnal diel movements of their primary prey at that colony, clupeid fish (Shoji *et al.*, 2016; Dean, 2012).

41. There is considerable uncertainty regarding nocturnal behaviours of seabirds such as their avoidance rate, attraction and flight heights on approach to illuminated structures, making potential impact consequences highly speculative. Manx shearwater is considered to have low collision risk as it usually flies less than 20 m above sea level; below blade tip height (Furness *et al.*, 2013, Bradbury *et al.*, 2014). Flight height data for Manx shearwater is based on aerial or ship-based at-sea surveys, which take place during daylight and in relatively calm weather. Although there is less certainty if this may represent the behaviour of Manx shearwaters under all conditions, the species engages in slope-soaring and birds are likely to remain low to the sea surface where the wind shear is strongest (Spivey *et al.*, 2014), despite weather conditions or visibility.

42. Evidence of light-induced disorientation for Manx shearwaters is derived from effects of brightly lit coastal structures and buildings on adults returning to burrows during the breeding season or specifically to grounding or attraction in fledglings. Disorientation of adults to these types of artificial lights on approach to burrow sites was demonstrated to be on birds already in the vicinity or at the colony attempting to land and not attracted from large distances (Guilford *et al* 2019). Studies on light attraction in juvenile birds tend to be restricted to birds on maiden flights (Brown *et al.*, 2023). Furthermore, attraction of fledglings to intensely illuminated structures such as lighthouses is predominantly seen in weather conditions involving very poor visibility (Archer *et al.*, 2015).

43. Therefore, current evidence would suggest the potential for Manx shearwaters to be attracted or disorientated by artificial light is predominantly in low ambient light and poor weather conditions in either adults approaching burrow sites or in fledglings on maiden flights.

44. During operation, OWF sites are marked in accordance with current aviation and navigational lighting guidance and policy. In general aviation and navigational lighting requirements are that peripheral structures such as WTGs, where more than 900m apart, are lit with a single medium intensity (2000 candela) flashing red

aviation light at the top of the nacelle. When visibility exceeds 5 km light intensity is reduced to 10 % (200 candela). Therefore, studies of bird collisions with other anthropogenic structures such as buildings, towers or offshore oil and gas platforms (Ronconi *et al*., 2015) that have been found to cause a high risk of collision may not necessarily reflect the situation at OWFs during their operational phase.

45. Studies on nocturnal flight at colonies to examine the response of adult Manx shearwaters to different intensities, wavelengths and durations of light showed that birds were more responsive to high intensity light, least responsive to red light and longer continuous light durations elicited stronger responses (Syposz *et al*., 2021). This lower sensitivity to red light has been demonstrated at Bardsey lighthouse, which changed to a red flashing light in 2014 and resulted in a huge reduction in collisions of Manx shearwaters (Deakin *et al*., 2022).

46. Outside the breeding season during periods of nocturnal migration, collision risk would be expected to be higher if migratory routes pass through OWF sites, although no studies specifically on Manx shearwaters have been undertaken. However, while artificial light from structures such as lighthouses, communications towers and oil and gas platforms have been reported to attract nocturnal migrating birds, especially passerines, the evidence for this potential impact on nocturnal migratory birds at WTGs is somewhat less than predicted. For example, a radar study at the Nysted offshore wind farm by Desholm and Kahlert (2005) reported a larger proportion of the birds fly within the wind farm at night- compared with the day-time, but counteract this higher risk of colliding with the turbines in the dark by remaining at a greater distance from the individual WTGs. Data from studies conducted at 30 terrestrial wind farms revealed no significant differences between fatality rates of night migrants at WTGs with lights as opposed to WTGs without lighting at the same wind farm (Kerlinger *et al*., 2010). Welcker *et al*., (2017) found nocturnal migrants do not have a higher risk of collision with WTGs than do diurnally active species, but rather appear to circumvent collision more effectively. Observations from these studies are likely to be explained by the type of illumination used at OWFs; intermittent red light. For example, Rebke *et al*., (2019) tested different intensities and wavelengths of light offshore on attraction to nocturnal migrants, which concluded that illuminated structures generally attract nocturnal migrants under adverse weather conditions and red light or intermittent light had the least effect on attraction.

47. There is insufficient evidence from current literature or any existing OWF to suggest any potentially significant effects on Manx shearwater occur as a result of aviation and navigation lighting that is typical for UK OWFs. Light-induced disorientation to

the navigation lights on WTGs based on studies on attraction to lighthouses, buildings, offshore oil and gas platforms or other species' responses is entirely speculative and contrary to evidence on Manx shearwater behaviour to red light or flashing lights. Furthermore, there is a low likelihood of routine nocturnal foraging far offshore and during poor visibility when the species is known to be rafting close to colonies and its low flying characteristics suggest the risk of lighting impacts from OWFs in both the breeding season and migratory seasons would be considered low for Manx shearwater. Therefore, the potential for a significant adverse effect can confidently be ruled out and has therefore been scoped out for consideration.

13.3.6.2 Impact receptors

48. The spatial and temporal scope of the assessment enables the identification of potential receptors which may experience change as a result of the Offshore Project. As presented in **Section 2.7** of the EIA Scoping Report and MMO Scoping Opinion (MMO, 2022), the following potential receptors were identified, based on their presence within the study area during baseline surveys:

- Kittiwake, *Rissa tridactyla*
- Great black-backed gull, *Larus marinus*
- Common gull, *Larus canus*
- Herring gull, Larus argentatus
- Lesser black-backed gull, *Larus fuscus*
- Sandwich tern, *Thalasseus sandvicensis*
- Common tern, *Sterna hirundo*
- Great skua, *Stercorarius skua*
- Guillemot, *Uria aalge*
- Razorbill, *Alca torda*
- Puffin, *Fratercula arctica*
- Fulmar, *Fulmarus glacialis*
- Manx shearwater, *Puffinus puffinus*
- Gannet, *Morus bassanus*.

49. In addition to these seabird species, there is also potential for the Offshore Project to affect non-seabird species passing through the Windfarm Site during migration periods. Recording these potential non-seabird receptors using standard baseline survey methods is extremely complex, given that migratory bird movements are often in short pulses through an area, at night and at high altitude. As such, consideration to migrant seabirds and non-seabirds has been provided in **Section 13.8.2**.

13.3.6.3 Potential impacts

50. Potential impacts and the level of any subsequent effect on potential receptors are summarised in **Table 13.6**.

13.3.7 Approach to assessment

51. **Chapter 6: EIA Methodology** provides a summary of the general impact assessment methodology applied to the Offshore Project. The following sections confirm the methodology used to assess the potential impacts on offshore ornithology.

52. The impact assessment has been undertaken in line with the most recent guidance (CIEEM, 2018), and informed by expert opinion where necessary. Key guidance documents on specific areas of the assessment, such as estimating operational phase displacement (SNCBs, 2022), collision risk (Band, 2012; Wright *et al*., 2012; SNCBs, 2014; McGregor *et al*., 2018) and potential population level effects (Searle *et al*., 2019), have been utilised and referred to where appropriate.

53. The assessment approach therefore follows the conceptual 'source-pathway-receptor' model. The conceptual model identifies likely environmental impacts on ornithology receptors resulting from the proposed construction, operation and decommissioning of the offshore infrastructure associated with the Offshore Project. This process provides an easy-to-follow assessment route between recognised potential impact sources and potentially sensitive receptors, ensuring a transparent impact assessment. The parameters of this conceptual model are defined as follows:

    - Source – the origin of a potential impact (noting that one source may have several pathways and receptors) e.g. an activity such as cable installation and a resultant effect such as re-suspension of sediments
    - Pathway – the means by which the effect of the activity could impact a receptor e.g. for the example above, re-suspended sediment could settle and smother the sea bed
    - Receptor – the element of the receiving environment that is impacted e.g. for the above example, seabirds which are unable to forage effectively due to a reduction in benthic prey availability.

Table 13.6 Potential impacts and effects on offshore ornithology receptors

Potential Impact	Project Phase			Potential Effect
	C	O/M	D	
Disturbance, displacement covering work activity, vessel movements and lighting, as well as barrier effects due to presence of turbines and infrastructure (from erection of first turbines)	✓	✓	✓	Construction activities within the Windfarm Site associated with foundations, WTGs and the export cable installation may lead to disturbance and displacement of species within the Windfarm Site, within the EEC and potentially within the surrounding buffers to a lower extent. Disturbance and displacement reduce the amount of functional habitat available for foraging, resting and other activities and may therefore reduce survival or reproductive fitness of the birds involved.
Indirect effects through effects on habitats and prey species	✓	✓	✓	Turbine, OSP and Windfarm Site cable installation would lead to temporary disturbance of the seabed leading to an increase in suspended sediments (e.g. during installation of cables). These may alter the distribution, physiology or behaviour of bird prey species. It may also make it harder for foraging seabirds to locate their prey in the water column. These mechanisms could potentially result in less prey being available in the area adjacent to active construction works to foraging seabirds. Installation of turbine foundations, OSP foundation, scour protection, Windfarm Site cabling and non-burial cable protection would lead to original habitat loss for bird prey species. Maintenance activities may lead to temporary seabed disturbance and the production of suspended sediments that may alter the distribution, physiology or behaviour of bird prey species. This may also make it harder for seabirds to see their prey in the water column. These mechanisms could potentially result in less prey being available to foraging seabirds.

Potential Impact	Project Phase			Potential Effect
	C	O/M	D	
				A reduction in prey availability may reduce the survival or reproductive fitness of the birds involved.
Displacement and barrier effects due to presence of turbines and infrastructure, as well as disturbance and displacement covering work activity, vessel movements and lighting	✓	✓	✓	The presence of the Windfarm Site could create a barrier to movements of breeding seabirds during foraging or migration. A barrier effect increases energy expenditure involved in foraging or migratory movement and may reduce parental provisioning of dependent chicks. This may therefore reduce survival or reproductive fitness of the birds involved.
Collision risk	x	✓	x	Birds flying through the Windfarm Site during the operational phase of the Offshore Project may be at risk of collision with WTGs during both migration or foraging flights. Collisions are assumed to be fatal.
Entanglement with mooring lines	x	✓	x	Derelict/lost fishing gear could entangle in mooring lines with the potential for diving seabirds to become entangled.
Cumulative effects	✓	✓	✓	There is potential for the impacts from the Offshore Project to interact with those from other projects, plans and activities, resulting in a cumulative effect on offshore ornithology
Transboundary impacts	✓	✓	✓	Some of the offshore ornithology receptors considered within the Offshore Project alone and cumulative effect assessments may also potentially encounter OWFs and other projects located outside UK territorial waters.

Key:
✓ Impact scoped in
✗ Impact scoped out

54. For each effect, the assessment identifies receptors sensitive to that effect and implements a systematic approach to understanding the impact pathways and the level of impacts on given receptors.

13.3.7.1 Evaluating potential receptors

55. The conservation value of a species is used to provide additional context to the impact assessment and may be used to refine predictions, as appropriate. It is not a key input into the impact assessment process, as there is a tendency to underestimate potential impacts on receptors with a lower conservation value (Box *et al.*, 2017). Conservation value and sensitivity are not necessarily linked for a particular impact. Therefore, each receptor's conservation value is considered using reasoned judgement when determining their overall sensitivity to any potential impact or effect. For example, a receptor could be of high conservation value (e.g. all qualifying feature of a Special Protection Area (SPA)) but have a low or negligible physical / ecological sensitivity to an effect (or vice-versa). Such reasoned judgement is an important part of the overall narrative used to determine potential impact significance and is used, where relevant, as a mechanism for modifying the sensitivity of an effect assigned to a specific receptor.

56. The conservation value of ornithological receptors is based on the population from which individuals are predicted to be drawn, reflected in the current understanding of the movements of bird species. Ranking, therefore, corresponds to the degree of connectivity predicted between the Offshore Project and protected populations. Using this approach, the conservation importance of a species seen at different times of year may fall into any of the defined categories. Population status is also taken into account in the assessment. For example, effects on a declining species may be of more concern than those on an increasing species.

57. Example definitions of the conservation value levels for ornithology receptors are given in **Table 13.7**. These are related to connectivity with populations that are protected as qualifying species of SPAs, proposed SPAs (pSPAs) or Ramsar sites, all of which are internationally designated sites carrying strong protection for populations of qualifying bird species.

Table 13.7 Conservation values of offshore ornithology receptors

Value	Definition
High	A species listed as a qualifying feature of an internationally designated site (e.g. SPA or Ramsar). Species populations present with sufficient conservation importance to meet criteria for SPA selection.

Value	Definition
	For example, a receptor population for which all individuals at risk can be clearly connected to a particular conservation site of international or national importance.
Medium	A species listed as a notified feature of a nationally designated site (e.g. SSSI). Species populations present with sufficient conservation importance to meet criteria for SSSI selection. For example, a receptor population for which individuals at risk may be drawn from a mixture of conservation sites of international, national importance and other populations which may also contribute to individuals at risk.
Low	A species occurring within SPAs, Ramsar sites and SSSIs, but not crucial to the integrity of the site. Species populations present falling short of SSSI selection criteria but with sufficient conservation importance to likely meet criteria for selection as a local site. For example, a receptor population for which individuals at risk have no known connectivity to conservation sites of international or national importance. Other species of conservation concern, including species listed as being of Principal Importance under The Environment (Wales) Act (2016), and those included on the fifth review of UK Birds of Conservation Concern (BoCC5) Red and Amber Lists (Stanbury *et al.*, 2021).
Negligible	All other species that are widespread and common and which are not present in locally important (or greater) numbers and which are of low conservation concern (e.g. UK BoCC5 Green List species; Stanbury *et al.*, 2021).

58. The assessment of potential receptors identified in **Table 13.15** considered the importance of the Offshore Project Windfarm Site for the species recorded within the site-specific surveys. To illustrate the rationale of this approach, whilst a receptor could be considered of high conservation importance using the criteria in **Table 13.7**, the importance of the Offshore Project Windfarm Site to this species is considered limited if only a single sighting of the receptor within the Windfarm Site has been identified in the baseline.

59. As such, while the conservation value of the species is considered, the number of individuals of that species using the Offshore Project Windfarm Site, and the nature and level of this use, is also considered as detailed in **Table 13.15**. An assessment is then made of the importance of the Offshore Project to the species in question.

13.3.7.2 Characterising potential impacts

60. The sensitivity of a receptor is an expression of the likelihood of change when a pressure (i.e. a predicted impact) is applied. It is defined by the tolerance (or lack thereof) to a particular impact, along with the capacity for recovery of the receptor. The judgement takes account of information available on the responses

of birds to various stimuli (e.g. predators, noise and visual disturbance) and whether a species' ecology makes it vulnerable to potential impacts. For example, bird species that typically fly at heights that overlap with the rotor-swept area are considered to be more sensitive to collision risk with the moving blades of WTGs than species that avoid the rotor-swept area.

61. Sensitivity can differ between similar species and between different populations of the same species. Thus, the behavioural responses of offshore ornithology receptors are likely to vary with both the nature and context of the stimulus and the experience of the individual bird. Sensitivity also depends on the activity of the bird.

62. In addition, individual birds of the same species will differ in their tolerance depending on the level of human disturbance that they regularly experience in a particular area, and have become habituated to (e.g. individuals that forage within close proximity to an area with high human activity levels are likely to have a greater tolerance than those that occupy remote locations with little or no human presence).

63. Definitions of tolerance are presented in **Table 13.8**, whilst capacity for recovery definitions are presented in **Table 13.9**. A matrix showing how the definitions for tolerance and recovery can be combined to estimate receptor sensitivity is provided in **Table 13.10**. The majority of seabirds have a low capacity for recovery, given that they are long lived species with extensive maturation periods, low natural adult mortality levels and low fecundity. Approximate definitions for overall sensitivity are provided in **Table 13.11**, using the example of disturbance due to construction activity.

Table 13.8 Definition of tolerance for an offshore ornithology receptor

Tolerance	Definition
High	No or minor adverse change (which may not be detectable against existing variation) in key functional and physiological attributes through direct effects, because the receptor can avoid / adapt to / accommodate it.
Medium	Moderate decline in key functional and physiological attributes through direct mortality, reduced reproductive success, or other effects impacting receptor fitness. The receptor is less able to avoid / adapt to / accommodate the pressure.
Low	Substantial decline in key functional and physiological attributes through direct mortality, reduced reproductive success, or other effects impacting receptor fitness. The receptor is not able to avoid / adapt to / accommodate the pressure.

Table 13.9 Definition of recovery levels for an offshore ornithology receptor

Capacity	Definition
High	Short-lived receptor (up to five years), first breeding within approximately one year, high natural annual adult mortality (>25%), high annual reproductive output (> five chicks per pair).

Capacity	Definition
Medium	Moderately short-lived receptor (approximately five to ten years), first breeding within two to three years, moderate natural annual adult mortality (15 to 25%), moderate annual reproductive output (two to five chicks per pair).
Low	Long-lived receptor (more than ten years), first breeding in excess of three years, low natural annual adult mortality (<15%), low annual reproductive output (< two chicks per pair).

Table 13.10 Matrix for the determination of sensitivity of offshore ornithology receptors

	Low tolerance	Medium tolerance	High tolerance
Low recovery	High	Medium	Low
Medium recovery	Medium	Medium	Low
High recovery	Low	Low	Low

Table 13.11 Example definitions of different levels of behavioural sensitivity for an offshore ornithology receptor

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

64. Species assessed for potential impacts are those which were recorded during the site-specific surveys and which are considered to be at potential risk either due to their abundance, conservation importance and / or potential sensitivity to OWF impacts. However, where appropriate, the assessment considers species which were not recorded during baseline surveys but are considered likely to use the Offshore Project and the habitats surrounding it (e.g. migratory birds).

65. Consideration of the level of behavioural sensitivity with regards to individual ornithology receptors is one of the core components of the assessment of potential impacts and their effects. The sensitivity of each offshore ornithological receptor to a given impact pathway has been estimated by information identified by literature review. The overall confidence in the information used to define the sensitivity of each seabird receptor has also been qualitatively assessed. This is

a method adapted from Pérez-Domínguez *et al* (2016) and considers three aspects of an evidence base:

- Quality of information: highest quality information from peer-reviewed papers (either observation or experimental), or grey literature from reputable sources. Heavier reliance on grey literature and / or expert judgement is considered to represent a lower quality evidence base
- Applicability of evidence: evidence based on the same impacts, arising from similar activities, on the same species, in the same geographical area, is considered to have the highest associated confidence, followed by similar pressures / activities / species in other areas, followed by proxy information
- Concordance: situations where available evidence is in broad agreement in terms of magnitude and sensitivity of impact results in a higher confidence compared to a situation where evidence is only in partial agreement, or not in agreement at all.

66. Using expert judgement (CIEEM, 2019), both the conservation value (**Table 13.7**) and behavioural sensitivity (**Table 13.11**) of a receptor are used to determine their overall sensitivity in the assessment.

13.3.7.3 Impact magnitude

67. Impacts on receptors are judged in terms of their magnitude. Magnitude refers to the scale of an impact and is determined on a quantitative basis where possible. This may relate to the area of habitat lost to the development footprint in the case of a habitat feature or predicted loss of individuals in the case of a population of a species of bird. Magnitude is assessed within four levels, as detailed in **Table 13.12**.

Table 13.12 Definitions of impact magnitude for an offshore ornithology receptor

Sensitivity	Definition
High	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short to long-term and to alter the long-term viability of the population and/ or the integrity of the protected site. Recovery from that change predicted to be achieved in the long-term (i.e., more than five years) following cessation of the development activity.
Medium	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/ or the integrity of the protected site. Recovery from that change predicted to be achieved in the medium-term (i.e., no more than five years) following cessation of the development activity.
Low	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific

Sensitivity	Definition
	protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/ population. Recovery from that change predicted to be achieved in the short-term (i.e., no more than one year) following cessation of the development activity.
Negligible	Very slight change from the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Recovery from that change predicted to be rapid (i.e., no more than c. six months) following cessation of the development activity.
No change	No positive or negative change is predicted.

68. Knowledge of how rapidly the population or performance of a species is likely to recover following loss or disturbance (e.g., by individuals being recruited from other populations elsewhere) is also used to assess impact magnitude, where such information is available.

13.3.7.4 Determining significance

69. The CIEEM guidelines (2019) use only two categories to classify effects: "significant" or "not significant". The significance of an effect is determined by considering the overall importance (defined here as the overall sensitivity) of the receptor and the impact magnitude (see **Chapter 6 EIA Methodology** for further details) using a matrix-based approach (**Table 13.12**) and applying professional judgement as to whether the integrity of the feature will be affected. Definitions of each level of significance are provided in **Table 13.14**Table 13.14This method is employed for this assessment and is guided by the matrix approach presented in **Table 13.12**, where determination of the level of any significance of effect is initially identified through the matrix and the use of expert judgement. Where a range of significance of effect is presented in **Table 13.12**, the final assessment for each effect is also based upon expert judgement.

70. The use of expert judgement is an important element of the impact assessment process as the matrix approach to determining the significance of any potential effects should only be used as a framework to aid understanding of how a judgement has been informed and reached for each specific receptor to any given impact being assessed.

71. Wherever possible and practical, the assessments within this chapter for offshore ornithology are based upon quantitative and accepted criteria as well as methods and guidance from SNCBs (e.g. for collision risk modelling and analysis of displacement). Together, these practices provide for a balanced approach, alongside with the use of expert and value judgement and to allow for meaningful interpretation to establish to what extent an impact is significant for the Offshore Project.

72. The term integrity is used here in accordance with the definition adopted by the Office of the Deputy Prime Minister ('ODPM') Circular 06/2005 on Biodiversity and Geological Conservation whereby designated site integrity refers to "…coherence of ecological structure and function…that enables it to sustain the habitat, complex of habitats and/or levels of populations of species for which it was classified". Integrity, therefore, refers to the maintenance of the conservation status of a population of a species at a specific location or geographical scale.

73. Effects are more likely to be considered significant where they affect ornithological features of higher overall sensitivity or where the magnitude of the effect is high. Effects not considered to be significant would be those where the integrity of the feature is not threatened, effects on features of lower overall sensitivity, or where the magnitude of the impact is low.

Table 13.13 Significance of impact- resulting from each combination of receptor sensitivity and the magnitude of the effect upon it

		Adverse Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 13.14 Definitions of impact magnitude for an offshore ornithology receptor

Sensitivity	Definition
Major	Large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore, no change in receptor condition.

74. Potential impacts identified within the assessment as 'major adverse effect' or 'moderate adverse effect' are regarded as 'significant effects' in terms of the EIA regulations. Potential impacts are described using impact significance, followed by a statement of whether the impact significance is significant in terms of the EIA regulations, e.g. "*minor adverse effect, not significant in EIA terms*" or

"*moderate adverse effect, significant in EIA terms*". Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall impact in order to determine a residual impact upon a given receptor.

13.3.7.5 Cumulative effects assessment (CEA) methodology

75. The CEA considers other plans, projects and activities that may impact offshore ornithology receptors cumulatively with the Offshore Project. As part of this process, the assessment considers which of the residual impacts assessed for the Offshore Project on its own have the potential to contribute to a cumulative effect, the data and information available to inform the cumulative assessment and the resulting confidence in any assessment that is undertaken. **Chapter 6: EIA Methodology** provides further details of the general framework and approach to the CEA.

76. For offshore ornithology, these activities include other OWFs, marine aggregate extraction areas, oil and gas exploration and extraction, subsea cables and pipelines and commercial shipping.

13.3.7.6 Transboundary impact assessment methodology

77. The transboundary assessment considers the potential for transboundary effects to occur on offshore ornithology receptors as a result of the Offshore Project; either those that might arise within the Exclusive Economic Zone (EEZ) of European Economic Area (EEA) states or arise on the interests of EEA states. **Chapter 6: EIA Methodology** provides further details of the general framework and approach to the assessment of transboundary effects.

78. For offshore ornithology the potential for transboundary effects has been identified in relation to potential linkages to non-UK protected sites and sites with large concentrations of breeding, migratory or wintering birds (including the use of available information on tagged birds).

13.3.8 Evaluation of potential receptors and impacts

79. The assessment of impacts in this ES follows CIEEM guidelines (CIEEM, 2019) with regards to the emphasis being on "significant effects rather than all ecological effects". Therefore, potential receptors which are determined to be of low or negligible value are not considered further in this assessment. Significant effects on these species are not predicted given their infrequent occurrence in the survey area and/or low conservation status. The Applicant's justification for scoping in or out ornithological receptors is provided in **Table 13.15**.

Table 13.15 Summary of Valued Ornithological Receptors and Potential Impacts

Potential receptor	Behaviour Sensitivity Rationale (Table 13.6; Bradbury *et al*., 2014; Furness *et al*., 2012; Joint SNCB (SNCBs, 2022)		Conservation Value Rationale (Table 13.7)	Conservation value (Table 13.7)	Overall value (Table 13.7 & Table 13.11)	Peak abundance within Windfarm Site / Windfarm Site plus 4 km buffer (individuals)	Frequency of months recorded within Windfarm Site / Windfarm Site plus 4 km buffer	Potential Impacts								
								Collision risk			Disturbance, displacement, and barrier effects			Entanglement		
	Disturbance and Displacement	Collision Risk						C	O/M	D	C	O/M	D	C	O/M	D
Kittiwake	Low	High	Individuals recorded within the Offshore Project are likely be a mix of qualifying features of different designated sites within foraging range (SPAs, Ramsar sites) and individuals not associated with designated sites. Species afforded special protection under Schedule 1 / Annex 1 and are either BoCC5 amber or red-listed (Stanbury *et al*., 2021).	Medium	Medium	427/ 1,500	15/ 18	× a	✓	× a	× b	× b	× b	× a	× c	× a
Great black-backed gull	Low	High	Individuals not a qualifying feature of any designated site within species foraging range but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-listed (Stanbury *et al*., 2021).	Low	Medium	18/ 258	2/ 7	× a	✓	× a	× b	× b	× b	× a	× c	× a
Common gull	Low	High		Low	Low	0/ 16	0/ 1	× a	× d	× a	× b	× b	× b	× a	× c	× a
Herring gull	Low	High		Low	Medium	9/ 916	1/ 7	× a	✓	× a	× b	× b	× b	× a	× c	× a
Lesser black-backed gull	Low	High	Individuals not a qualifying feature of any designated site within species foraging range and recorded infrequently but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-listed (Stanbury *et al*., 2021).	Low	Low	9/ 932	3/ 10	× a	✓	× a	× b	× b	× b	× a	× c	× a
Sandwich tern	Low	Medium	Migratory Individuals unlikely to be a qualifying feature of any designated site within species foraging range and recorded infrequently but afforded species protection under Schedule 1 / Annex 1 and/ or BoCC5 amber or red-listed (Stanbury *et al*., 2021).	Low	Low	0/ 8	0/ 1	× a	× e, d	× a	× b	× b	× b	× a	× c	× a
Common tern	Low	Medium		Low	Low	70/ 68	1/ 1	× a	× e, d	× a	× b	× b	× b	× a	× c	× a
Great skua	Low	Medium		Low	Low	0/ 8	0/ 1	× a	× e, d	× a	× b	× b	× b	× a	× c	× a
Guillemot	Medium	Low	Individuals recorded within the Offshore Project are likely be a mix of qualifying features of different designated sites within foraging range (SPAs, Ramsar sites) and individuals not associated with designated sites. Species afforded special protection under Schedule 1 / Annex 1 and are either BoCC5 amber or red-listed (Stanbury *et al*., 2021).	Medium	Medium	1,444/ 6,209	18/ 20	× a	× f	× a	✓	✓	✓	× a	✓	× a
Razorbill	Medium	Low		Medium	Medium	357/ 918	9/ 17	× a	× f	× a	✓	✓	✓	× a	✓	× a
Puffin	Medium	Low		Medium	Medium	43/ 163	2/ 7	× a	× f	× a	✓ g	✓ g	✓ g	× a	✓	× a
Fulmar	Low	Low		Medium	Low	120/ 598	7/ 15	× a	× f	× a	×i	×i	×i	× a	× c	× a

Potential receptor	Behaviour Sensitivity Rationale (Table 13.6; Bradbury *et al.*, 2014; Furness *et al.*, 2012; Joint SNCB (SNCBs, 2022)		Conservation Value Rationale (Table 13.7)	Conservation value (Table 13.7)	Overall value (Table 13.7 & Table 13.11)	Peak abundance within Windfarm Site / Windfarm Site plus 4 km buffer (individuals)	Frequency of months recorded within Windfarm Site / Windfarm Site plus 4 km buffer	Potential Impacts								
								Collision risk			Disturbance, displacement, and barrier effects			Entanglement		
	Disturbance and Displacement	Collision Risk						C	O/M	D	C	O/M	D	C	O/M	D
Manx shearwater	Low	Low	Individuals recorded within the Offshore Project are likely be a mix of qualifying features of different designated sites within foraging range (SPAs, Ramsar sites) and individuals not associated with designated sites. Species afforded special protection under Schedule 1 / Annex 1 and are either BoCC5 amber or red-listed (Stanbury *et al.*, 2021).	Medium	Medium	8,544/ 27,301	10/ 13	× a	× f	× a	✓ j	✓ j	✓ j	× a	× c	× a
Gannet	Low	Medium	Individuals recorded within the Offshore Project area are likely be a mix of qualifying features of different designated sites within foraging range (SPAs, Ramsar sites) and individuals not associated with designated sites. Species afforded special protection under Schedule 1 / Annex 1 and are either BoCC5 amber or red-listed (Stanbury *et al.*, 2021).	High	Medium	82/ 429	17/ 23	× a	✓	× a	✓ g	✓ g	✓ g	× a	✓	× a

Notes: Species taken through to assessment are shown in bold. a. As valued ornithological receptors will be displaced during the construction phase and operational and maintenance phase of the Offshore Project, collision risk and entanglement have not been included for these phases as they are unlikely to occur. b. Classified as having low to very low vulnerability to disturbance and displacement.; (Furness *et al.*, 2012; Bradbury *et al.*, 2014).; c. non-deep diving species therefore not at risk of underwater entanglement due to its foraging behaviour.; d. Recorded in negligible numbers; therefore, the level of potential impact would be indistinguishable from natural fluctuations in BDMPS baseline mortality rate.; e. Recorded in limited number of months and only and likely only present on migration, therefore limited risk of monthly collision risk. Species is however considered within migratory collision risk assessment in Section 13.8.2; f. Species flight behaviour indicates as very low risk of collision (Bradbury *et al.*, 2014); g. Despite species being classified as low vulnerability to disturbance and displacement (Joint SNCB, 2022) and recorded in low numbers within the Windfarm Site, screened in on a precautionary basis; h. Collision risk will be considered within this report in a qualitative manor during migration only as a precautionary measure; i. species is classified as low vulnerability to disturbance and displacement (Joint SNCB, 2022), has a mean max foraging range of 542.3km and was recorded in relatively low numbers within the Windfarm Site. Based on these factors combined, it can be confidently concluded that there will be no significant adverse effect with respect to disturbance and displacement in any project phase with respect to fulmar. J Disturbance and displacement will be considered as a precautionary measure based on density recorded within the Windfarm Site, despite being classified as low vulnerability to disturbance and displacement (Joint SNCB,2022).

13.4 Existing Environment

80. Baseline data collection has been undertaken to obtain information across the study area described in **Chapter 5: Project Description**. This has been accomplished through the completion of a desk study and a programme of site-specific aerial digital surveys.

13.4.1 Desk study

81. In addition to the site-specific aerial digital survey data, a desk study considering all known and relevant literature has been undertaken to ensure a comprehensive baseline has been characterised for use in the impact assessments. Data sources that have been collected and used to inform this offshore ornithology assessment are referenced where applicable and summarised in **Table 13.16**.

13.4.2 Offshore site surveys

82. In order to provide site-specific and up-to-date data on which to base the impact assessment, site characterisation using aerial digital survey methods of the study area were completed. The aerial digital surveys occurred once per month for 24 months, commencing in July 2020 and concluded in June 2022. The methodology employed was an aerial digital survey capturing high-resolution photographic still imagery, undertaken by APEM Ltd. The survey method used a grid-based survey design with nine transects spaced 1.4km apart, flown at 1,300ft (396m) resulting in a 1.5cm ground sampling distance (GSD). The surveys achieved approximately 40% captured coverage with a subset of data analysed that resulted in approximately 10% coverage.

83. Imagery was used to assess the abundance and distribution of offshore ornithology receptors within the study area. Information on species distribution, flight height and flight direction were also recorded.

84. Further information on the survey methodology and programme is provided in **Appendix 13.A Offshore Ornithology Technical Report**.

Table 13.16 Data sources used to inform the offshore ornithology ES assessment

Title	Source	Date	Author	Summary	Coverage of Study Area
Trektellen Migration counts and captures	Trektellen (online)	2023	Trektellen	Database of migration, seawatch counts and ringing results.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale, in relation to potential connectivity to Balearic shearwater and storm petrel.
Post consent studies	ORJIP and Aberdeen Offshore Wind Farm Limited	2023 and 2018	Skov *et al.* 2014; Tjørnløv *et al.* 2023	Bird collision and avoidance studies.	Information relating to the EIA process for offshore ornithology.
A path forward in the investigation of seabird strandings attributed to light attraction	Conservation Science and Practice	2023	Brown *et al.*	Published, peer reviewed scientific literature on potential lighting effects.	This source contains information which can be drawn upon when considering potential lighting effects.
White Cross OWF – aerial digital survey data	APEM Ltd.	July 2020 to June 2022	APEM Ltd.	Aerial digital surveys conducted by APEM Ltd. On a monthly basis between.	The Southwest England Survey Area comprising the White Cross OWF Site and a surrounding 4 km Buffer Zone – a total 'Survey Area' of 336 km^2.
Joint SNCB Interim Displacement Guidance Note	JNCC	2022	JNCC *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF.	Generic information applicable to the Offshore Project's ornithological receptors.

Title	Source	Date	Author	Summary	Coverage of Study Area
eBird Status and Trends	ebird (online)	2022	Fink *et al.*	An online database of bird observations providing scientists, researchers and amateur naturalists with real-time data about bird distribution and abundance.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale, in relation to potential connectivity to Balearic shearwater and storm petrel species.
Wetland Bird Survey (WeBS) Annual Report and Report Online interface	Wetland Bird Survey (WeBS	2021	Frost *et al.*	Data on wetland bird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.
The State of the UK's Birds Report	RSPB	2020	Burns *et al.*	UK-wide information on the abundance and distribution of bird species.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
Summary of evidence of aggregations of Balearic shearwaters in the UK up to 2013	JNCC	2019	Parsons *et al.*	This report provides a summary of evidence from several sources to help identify important marine areas in the UK that are used by aggregations of Balearic shearwater.	This source contains information which can be drawn upon when considering potential connectivity to Balearic shearwater.

Title	Source	Date	Author	Summary	Coverage of Study Area
An Analysis of the Numbers and Distribution of Seabirds within the British Fishery Limit Aimed at Identifying Areas that Qualify as Possible Marine SPAs	JNCC	2018	Kober *et al.*	This report describes an analysis of European Seabirds at Sea (ESAS) data, conducted to identify and delineate seabird aggregations within the British Fishery Limit that might qualify as SPAs.	This source contains information which can be drawn upon when considering potential connectivity to storm petrel species.
Online SPA standard data forms for Natura 2000 sites	JNCC	Multiple years	JNCC	Data on designated sites, including location, size and qualifying features.	UK-wide information on designated sites.
Seabirds and Offshore Wind Farms in European Waters: Avoidance and Attraction	Biological Conservation	2016	Dierschke *et al.*	Summarises evidence of auk displacement obtained from studies of thirteen different European OWF sites that compared changes in seabird abundance between baseline and post-construction.	Information relating to the EIA process for offshore ornithology.
At-Sea Turnover of Breeding Seabirds	Marine Scotland	2015	Searle *et al.*	Data on seabird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.
Non-breeding season populations of seabirds in UK waters:	Natural England	2015	Furness	Data on seabird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.

Title	Source	Date	Author	Summary	Coverage of Study Area
Population sizes for BDMPS					

Title	Source	Date	Author	Summary	Coverage of Study Area
Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review	JNCC	2014	JNCC *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF.	Information relating to the EIA process for offshore ornithology.
Mapping Seabird Sensitivity to Offshore Windfarms	*PLOS ONE* (journal)	2014	Bradbury *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF.	Information relating to the EIA process for offshore ornithology.
Large scale survey data sets	*PLOS ONE;* (journal)	2014 and 2020	Bradbury *et al.*, 2014; Waggitt 2020	Large scale seabird sensitivity mapping as part of the SeaMaST project; Marine Ecosystems Research Programme (MERP) distribution maps of seabird populations in the north-east Atlantic.	UK wide coverage with information that can be drawn upon at a specific scale relevant to the Offshore Project, or a wider regional scale.
Population estimates of birds in Great Britain and the UK	*British Birds* (journal)	2013	Musgrove *et al.*	Data on seabird populations and demographic rates.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
Assessing the risk of offshore windfarm development to migratory birds designated as features of UK SPAs	Strategic Ornithological Support Services	2012	Wright *et al.*	Data on seabird populations and demographic rates for use in assessments.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.

Title	Source	Date	Author	Summary	Coverage of Study Area
Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas	British Trust for Ornithology	2012	Thaxter *et al.*	Data on seabird foraging ranges for use in assessments.	Generic information applicable to the Offshore Project's ornithological receptors
Barriers to movement: Modelling energetic costs of avoiding marine windfarms amongst breeding seabirds	*Marine Pollution Bulletin* (journal)	2010	Masden *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF.	Information relating to the EIA process for offshore ornithology.
An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs	JNCC	2010	Kober *et al.*	Data on seabird populations and demographic rates for use in assessments.	This source contains information which can be drawn upon at a Project-specific scale, or a wider regional scale.
Developing guidance on ornithological cumulative effect assessment for offshore windfarm developers	COWRIE	2009	King *et al.*	Published, peer reviewed scientific literature on bird behaviour and potential impacts from OWF.	Information relating to the EIA process for offshore ornithology.

Title	Source	Date	Author	Summary	Coverage of Study Area
A review of assessment methodologies for offshore windfarms	British Trust for Ornithology	2009	Maclean *et al.*	Published, peer reviewed scientific literature on ornithological impact assessment methodologies for OWF.	Information relating to the EIA process for offshore ornithology.
British Trust for Ornithology (BTO) BirdFacts: profiles of birds occurring in Britain and Ireland.	British Trust for Ornithology	2005	Robinson	Data on seabird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.
Scaling Possible Adverse Effects of Marine Wind Farms on Seabirds: Developing and Applying a Vulnerability Index	Journal of Applied Ecology	2004	Garthe and Hüppop	Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which has been widely applied in OWF EIAs	Information relating to the EIA process for offshore ornithology.
The Migration Atlas	BTO	2002	Wernham *et al.*	Data on migratory bird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.
Atlas of seabird distribution in northwest European waters	JNCC	1995	Stone *et al.*	Data on migratory bird populations and demographic rates.	Generic information applicable to the Offshore Project's ornithological receptors.

13.4.3 Data Limitations

85. The marine environment can be highly variable, both spatially and temporally, meaning that seabird numbers may fluctuate greatly between months, bio-seasons and between different years at any given location, lowering the probability of being able to detect consistent patterns, directional changes or to generate reliable population estimates. Therefore, the site-specific data presented in this ES chapter for the purpose of baseline characterisation of the Offshore Project (that were collected over a 24-month period) and the method used to collect these data (aerial digital still imagery) may be considered to represent a snapshot of each month.

86. However, the most recent survey data used for describing the existing baseline are consistent with data obtained from surveys conducted for other OWF applications in UK waters and are in general agreement with information from the desk study literature and previous surveys conducted within the existing area (Bradbury *et al.,* 2014; Stone *et al.,* 1995; Waggitt 2020). Thus, these data are considered to be representative of the site for the purpose of baseline characterisation and should be considered to reduce any uncertainties within the impact assessment of the Offshore Project.

87. The assessment process contains a wide range of sources of uncertainty. These include the process of estimating seabird density and abundance estimates from baseline survey data, estimated values for seabird flight characteristics used in displacement modelling (e.g. displacement and mortality rates) and collision risk modelling (CRM) (e.g. flight height distributions, avoidance rates, bird size, flight speeds, bird behaviour, and the parameters of the turbines), and demographic rates used in population viability analysis (PVA) (e.g. environmental and demographic variations in survival and productivity). This is not an exhaustive list.

The assumptions and limitations of the assessment are discussed throughout the chapter where applicable.

13.4.3.1 Consideration of storm petrel species

88. As requested by the MMO/RSPB (detailed within **Table 13.4**) further consideration has been made to assess the potential connectivity to the site for storm petrel species.

89. A single unidentified storm petrel species was recorded in May 2021 within the Offshore Project area. The unidentified petrel species is likely to be one of the two species of storm petrel that breed in the UK: Leach's (*Hydrobates leucorhous*) or European (*Hydrobates pelagicus*). Leach's storm petrel do not breed in England or

Wales and, given the breeding season for Leach's storm petrel is from May to mid-October (NatureScot, 2020) and the location of the bird recorded, it would be likely to be on passage to a breeding colony further north.

90. The majority of the UK population of European storm petrel breed in Scotland, with small colonies also found in England confined to the Isles of Scilly and Lundy, and in Wales in Gwynedd and Dyfed with the largest colony at Skokholm. The breeding season for European storm petrel is from mid-May to October (NatureScot, 2020), suggesting that the bird recorded would likely be on passage to a colony further north. There were no other records of storm petrel species from the aerial digital surveys to suggest breeding birds from the nearest colonies were regularly foraging in the area of the Offshore Project.

91. Although there is sparse historical data that covers the Offshore Project area further evidence that infers low usage of the Offshore Project area by storm petrel species is supported by several sources such as ebird relative density range maps (Fink *et al.*, 2022;**Figure 13.2a** and **Figure 13.2b**). This conclusion is further bolstered by Trektellen coastal count data (Trektellen, 2023; **Figure 13.3a** and **Figure 13.3b**) and distribution densities predicted for this area for European storm petrel of <0.1 birds/km^2 by Waggitt *et al.*, (2020). These sources would predict very low occurrence of Leach's storm petrel over the Offshore Project area and only on passage, which would be in agreement with a single record in May 2021 during aerial digital surveys. In the case of European storm petrel it may have been expected to have recorded this species on more than one occasion such as during the breeding season as the Offshore Project area is within the marine maximum plus one standard deviation foraging distance (1346±1018.7km (Woodward *et al.,* (2019)) of colonies in the Isles of Scilly, Lundy and Skokholm. However, available evidence would suggest that areas to the north and south of the Offshore Project are more important foraging areas for this species rather than the Offshore Project itself (**Figure 13.3b**).

92. It can be confidently concluded that the Offshore Project area is not an area of importance to either storm petrel species. Connectivity is considered low for both storm petrel species when considering the results of the site-specific aerial digital surveys and the above additional evidence. Therefore, the potential for a significant adverse effect can confidently be ruled out for any impact and this impact will not be considered further in this assessment.

*Figure 13.2 ebird relative density range maps (Fink et al., 2022), A; Leach's storm petrel and B; European storm petrel. * Approximate location of the Offshore Project*

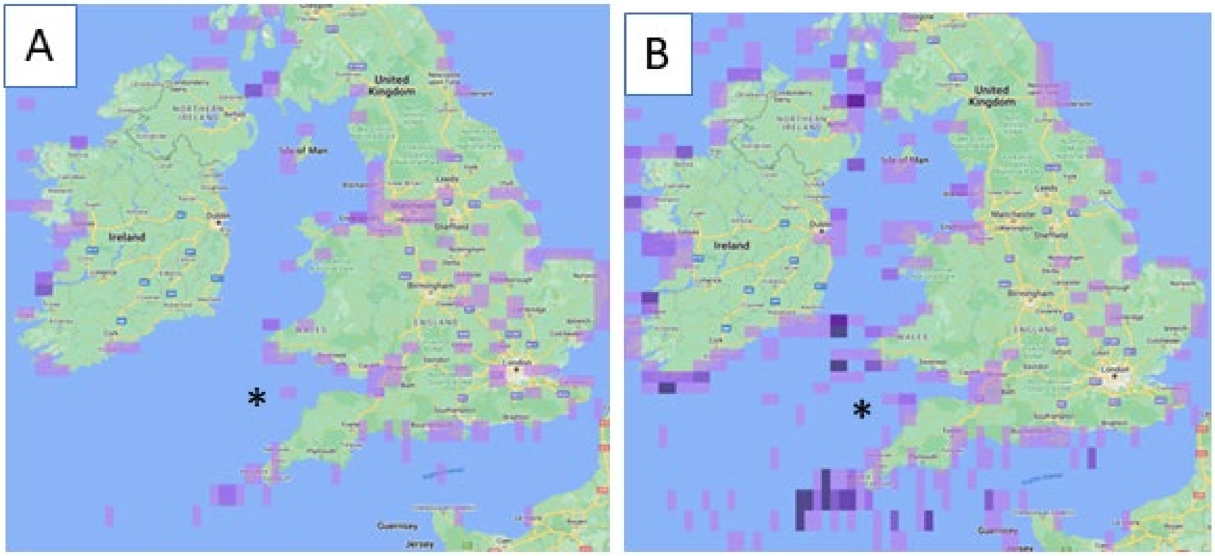
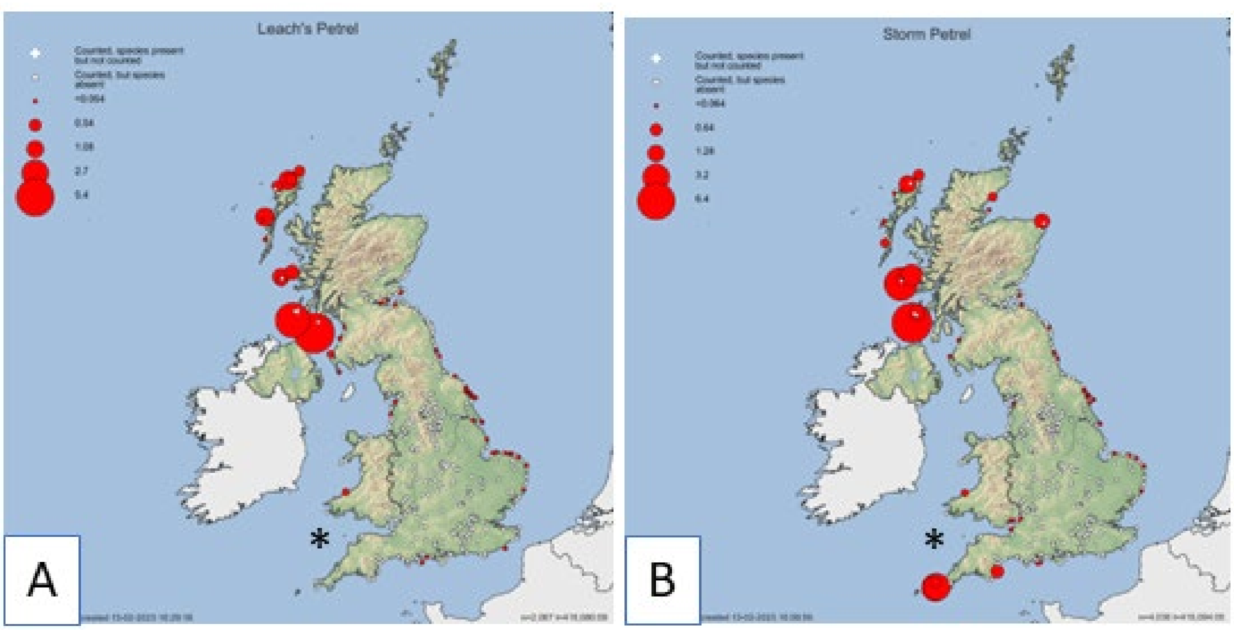


*Figure 13.3 Trektellen coastal counts per hour at sites in the vicinity of the Offshore Project (Trektellen, 2023) are given; A; Leach's storm petrel maximum count of <1 bird/hr and B; European storm petrel, maximum count of ~3 birds/hr. * Approximate location of the Offshore Project*



13.4.3.2 Consideration of Balearic shearwater

93. As requested by the MMO/RSPB (detailed within **Table 13.4**) further consideration has been made to assess the potential connectivity to the site for Balearic shearwater.

94. No Balearic shearwaters (*Puffinus mauretanicus*) were recorded in 24 months of site-specific aerial digital survey data of the White Cross Windfarm Site and a 4 km buffer. However, a raw count of 10 (estimated abundance of 77 individuals) unidentified shearwaters were recorded in October 2020, a period in which Balearic shearwaters are recorded on passage in the wider area (Trektellen 2023; **Figure 13.5c**). This would suggest that Balearic shearwaters may potentially pass through the site in low numbers during the non-breeding season, the only time that they are typically presented in UK waters after breeding around the Balearic Islands in the western Mediterranean. There are no historical records of sightings in the vicinity of the White Cross Offshore Project area, although the area is sparsely covered by ESAS. However, estimated passage rates around southern Cornish headlands to the south of the Offshore Project (approximately 52.5 km distance at the closest point) between July to October range from 0.3 to 2.4 birds per hour based on land survey observations (Parsons *et al.*, 2019). Additionally, recent coastal surveys have recorded up to 3.8 birds per hour. This is compared to ~6,400 bird/hr for Manx shearwater (Trektellen, 2023), though passage rates are not known from the coasts of north Cornwall and Devon, which are more relevant to the Offshore Project area.

*Figure 13.4 ebird relative density range maps (Fink et al., 2022), C; Balearic shearwater and for purposes of context D; Manx shearwater. * approximate location of proposed Offshore Project*

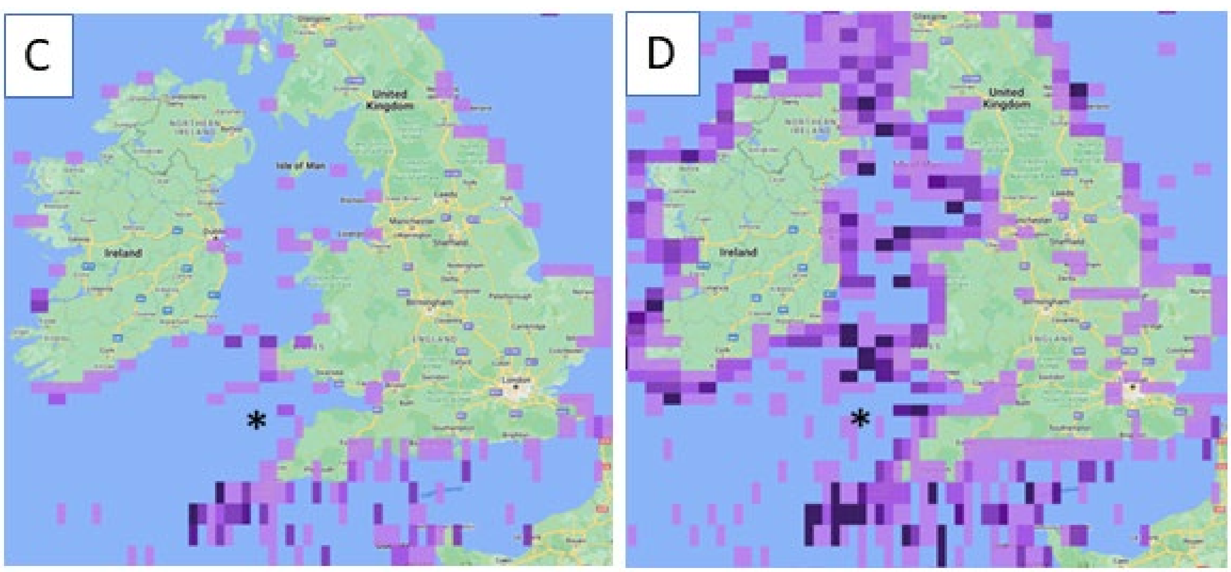
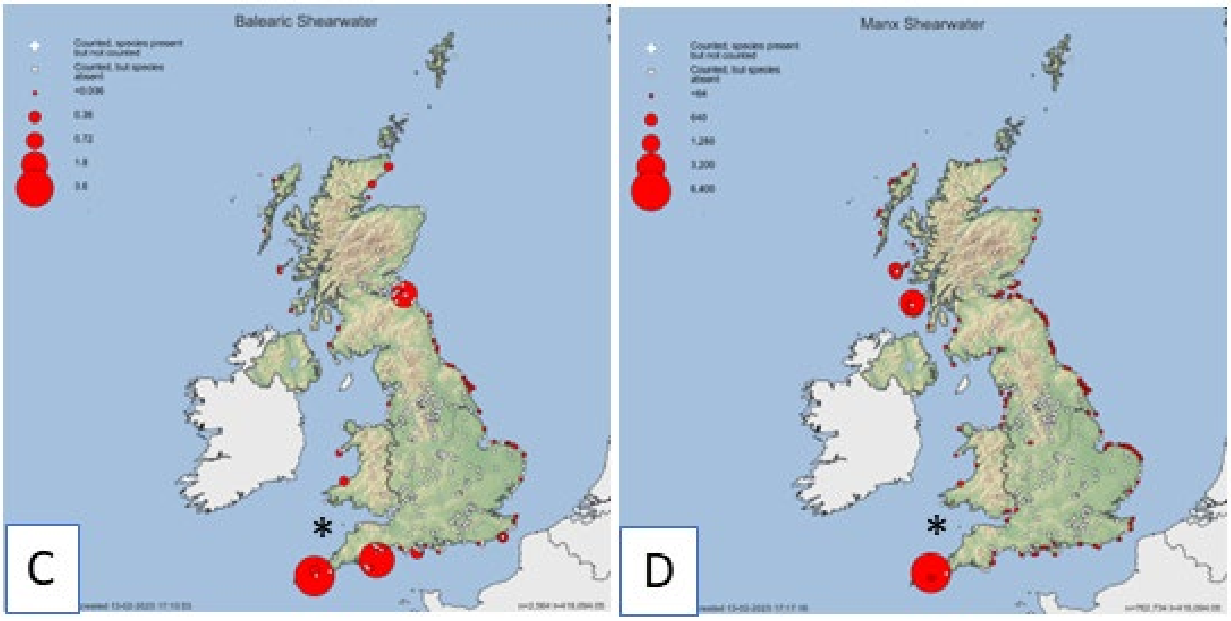


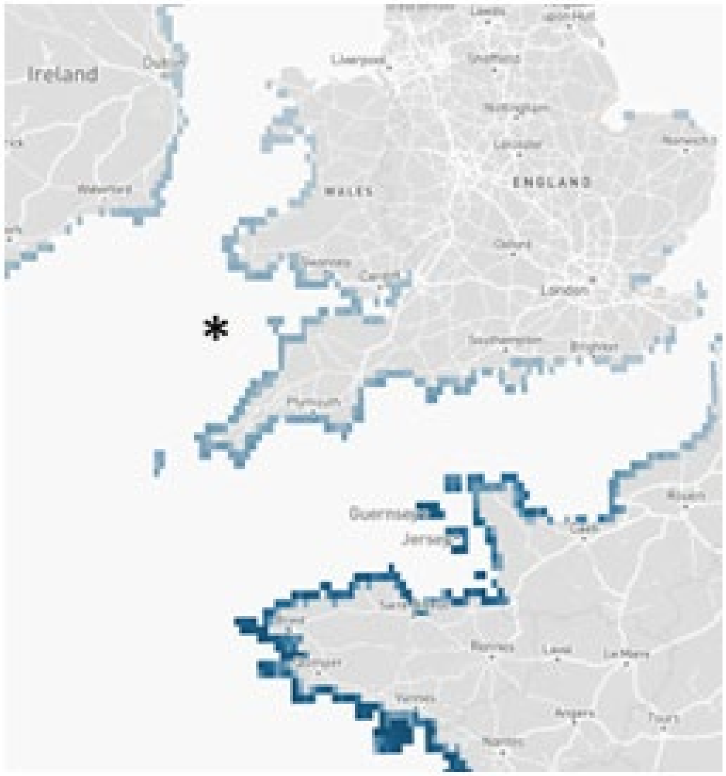
*Figure 13.5 Trektellen coastal counts per hour at sites in the vicinity of the Offshore Project (Trektellen, 2023) are given; C; Balearic shearwater maximum count of ~3 birds/hr and for purposes of context D; Manx shearwater. maximum count of ~6400 birds/hr * approximate location of proposed the Offshore Project*



95. Of the abundance estimate of 77 unidentified shearwaters in October 2020 from the site-specific aerial digital surveys it can be estimated that a small proportion of these birds may be Balearic shearwaters. However, based on the results of unidentified shearwater species apportionment, certainly not all are Balearic shearwaters due to the low numbers of this species that are found in UK waters, especially when compared to other shearwater species. Note that no population estimates for this species in the UK are available due to its scarcity.

96. After the breeding season birds move into Atlantic waters, primarily off Iberia and western France but also into UK waters (mainly along the south and south-west English coasts) during June to October. Peak numbers are usually observed in September to October (Trektellen, 2023). The UK wintering population of Balearic shearwaters is not well known and is difficult to estimate with accuracy. However, it is believed to be relatively small, with year-to-year variations influenced by feeding opportunities and weather patterns (Parsons *et al*., 2019). The species regularly passes along the coastline of north Cornwall and Devon (**Figure 13.6**). However, there are low numbers of records of birds remaining in the area for some time, engaging in feeding or other types of behaviour, suggesting that some sites hold important wintering foraging aggregations (Parsons *et al*., 2019).

*Figure 13.6 ebird non-breeding season relative density map for Balearic shearwater (Fink et al., 2022). * Approximate location of the Offshore Project*



97. Therefore, the evidence would suggest that although a small number of Balearic shearwater may potentially pass through the Offshore Project area, this is likely to be on migration to more important winter foraging areas and numbers are likely to fluctuate considerably from year to year. The Applicant, therefore, remains of the position that there is no requirement to consider Balearic shearwater within this report and so will not be considered further in this assessment due to the species having only limited connectivity to the Offshore Project.

13.4.4 Current baseline

98. The characterisation of the baseline environment has been undertaken based on site-specific baseline surveys and the desk study considering all known and relevant literature. These baseline surveys consisted of a programme of 24-months of high resolution aerial digital surveys, covering the Southwest England Survey Area comprising the Windfarm Site and a surrounding 4km Buffer Zone (the 4km buffer is measured from the boundary of the permanent works area). The Aerial Digital Survey Study Area has been defined on the basis of the types of impacts to be considered by the assessment. Full details of these surveys are presented in **Appendix 13.A Offshore Ornithology Technical Report**.

99. For the Offshore Export Cable Corridor located beyond the aerial digital survey study area, it is standard practice not to carry out site-specific baseline ornithology surveys. This is due to the uncertainty regarding the final location of the Offshore Export Cable Corridor and the ZOI around the Offshore Export Cable Corridor being highly localised typically resulting in negligible impacts. The assessment for this component of the Offshore Project has been carried out with reference to several existing sources of information (Bradbury *et al*., 2014; Furness, 2015; Guilford *et al*., 2008; Phillips *et al*., 2021; and Waggitt *et al*., 2019). The Interlink Cable Corridors are encompassed within the aerial digital survey study area.

100. The following species were recorded by the site-specific baseline surveys between July 2020 and June 2022 (**Table 13.17**). Details of whether they are listed on Annex I of the Birds Directive, and their Birds of Conservation Concern (BoCC) status are also provided in **Table 13.17**. No species recorded during the baseline surveys had a change in status between the 2015 (Eaton *et al*., 2015) and 2021 (Stanbury *et al*., 2021; Johnstone *et al.,* 2022) BoCC studies.

Table 13.17 Summary of nature conservation value of species considered at potential risk of impacts

Common name	Conservation status (Stanbury *et al*., 2021)
Kittiwake	BoCC Red listed, Birds Directive Migratory Species
Great black-backed gull	BoCC Amber listed, Birds Directive Migratory Species
Herring gull	BoCC Red listed, Birds Directive Migratory Species; Species of Principal Importance under The Environment (Wales) Act (2016)
Lesser black-backed gull	BoCC Amber listed, Birds Directive Migratory Species
Guillemot	BoCC Amber listed, Birds Directive Migratory Species
Razorbill	BoCC Amber listed, Birds Directive Migratory Species
Puffin	BoCC Red listed, Birds Directive Migratory Species
Manx shearwater	BoCC Amber listed, Birds Directive Migratory Species
Gannet	BoCC Amber listed, Birds Directive Migratory Species

101. Further details on the seabird species recorded during the baseline surveys are presented in **Appendix 13.A Offshore Ornithology Technical Report**. This includes the seasons in which they were present, the abundance at which they were recorded across the aerial digital survey study area, and the apportioning of seabirds to particular populations, with justification. The latter is essential for the impact assessment presented in **Sections 13.7**, **13.8** and **13.9**, which places predicted

seasonal mortality into context by comparing it to relevant background populations, and the predicted increase in background mortality which may result.

13.4.5 Evolution of the baseline

102. There are currently no known other proposed developments within close proximity likely to influence the Offshore Project's offshore study area. In the absence of significant local impacts, it is likely that the populations of bird species present will evolve in accordance with regional and national trends. The earliest possible date for the start of the offshore construction of the Offshore Project is 2026 with an anticipated operational life of 25 years. Therefore, there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to offshore ornithology usually occur over an extended period. Based on current information regarding reasonably foreseeable events, the baseline would not normally be anticipated to fundamentally change from its current state at the point in time when impacts occur.

103. However, it is acknowledged that there has been reported bird mortality from Highly Pathogenic Avian Influenza (H5N1) during the 2022 breeding season, which has caused impacts that have varied considerably between species and colonies. At present, it is uncertain what the wider population effects are for individual species or at different bio-geographical scales to interpret changes to the baseline for key species in the assessment. However, as determined by a recent Natural England recommendation to DEFRA in relation to baseline characterisation of offshore renewable projects (The Department of Environment, Food and Rural Affairs) on bird flu (Natural England, 2022a) as the baseline data for the Offshore Project were collected prior to the current outbreak of Bird Flu, the assessments within this report remain a valid representation of typical seabird distribution and density, which are also able to be assessed against the baseline populations prior to the outbreak.

104. The baseline environment for operational / decommissioning impacts is expected to evolve on a species-by-species basis, which is described in detail in the impact assessments when population level impacts are considered (mostly at the cumulative level in **Section 13.13**) over the lifetime of the Offshore Project of 25 years. Additional consideration that any changes during the construction phase will have altered the baseline environment to a degree are also set out in this chapter. Changes in populations are highly likely to result from climatic change, other natural phenomena (such as the recent avian influenza epidemic) and anthropogenic activities such as changes in fishing activities indirectly affecting offshore ornithology

receptors. Baseline conditions are therefore not static and are likely to exhibit some degree of change over time, with or without the Offshore Project in place.

13.5 Key parameters for assessment

105. Using a parameter-based design envelope approach to assessment means that the assessment considers a worst-case scenario that considers the design that may cause the maximum impacts to a particular receptor. It is considered a conservative approach to impact assessment but retains a necessary degree of design flexibility. This allows the flexibility to make improvements in the future in ways that cannot be predicted at the time of submission of the Offshore ES Chapter as part of the Marine Licence Application. The assessment of the maximum adverse scenario for each receptor establishes the maximum potential adverse impact. As a result, impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 5: Project Description**) to that assessed within this Chapter be taken forward in the final scheme design.

13.6 Biological seasons, populations and demographics

106. Bird behaviour and abundance is recognised to differ across a calendar year dependent upon the biological seasons (bio-seasons) that may be applicable to different seabird species. Separate bio-seasons are recognised in this ES chapter in order to establish the level of importance any seabird species has within the Offshore Project during any particular period of time. The biologically defined minimum population scales (BDMPS) bio-seasons are based on those in Furness (2015), hereafter referred to as BDMPS bio-seasons or bio-seasons (**Table 13.18**). The bio-seasons are defined within this ES chapter as: return migration, migration-free breeding, post-breeding migration, migration-free winter bio-seasons, breeding and non-breeding bio-seasons. These six bio-seasons can be applied to different periods within the annual cycle for most seabird species, though not all are applicable for all seabird species, with different combinations used depending on the biology and the life history of a species:

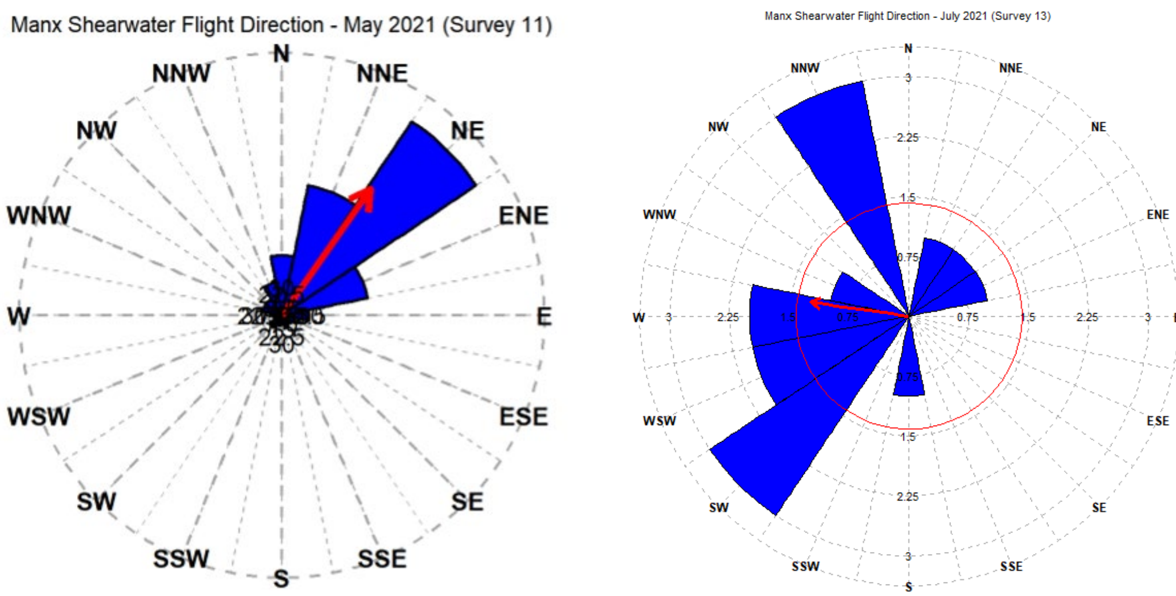
- Return migration: when birds are migrating to breeding grounds
- Migration-free breeding: when birds are attending colonies, nesting and provisioning young
- Post-breeding migration: when birds are either migrating to wintering areas or dispersing from colonies
- Migration-free winter: when non-breeding birds are over-wintering in an area

- Breeding and Non-breeding: For some species, there is significant overlap between migratory, breeding and wintering periods between colonies and individuals, and so the above bio-seasons cannot be appropriately applied. Therefore, two bio-seasons are defined:
  - Breeding from model arrival to the colony at the beginning of breeding to modal departure from the colony
  - Non-breeding from modal departure from the colony at the end of breeding to modal return to the colony the following year.

107. Impacts have been assessed in relation to relevant biological seasons, as defined by Furness (2015), with additional consideration of evidence for any species-specific and / or site-specific variations in line with best practice (Natural England, 2022b). These are presented for relevant offshore ornithology receptors in **Table 13.19**. These seasonal definitions include overlapping months (in some instances) due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). Where the full breeding season overlaps other seasons, impacts are apportioned to the breeding season unless otherwise stated. The use of particular seasons and reference populations varies by species and is discussed below.

108. For Manx shearwater, the use of the full breeding season (April to August) rather than the migration-free breeding season (June to July) is highly precautionary. This is because of a very high abundance recorded in May 2021, which would appear to be a migratory pulse of birds rather than breeding birds. The density of birds recorded far exceeds the density that could be reasonably explained by foraging birds from nearby breeding colonies, and this is further demonstrated by far lower densities in all surveys in the migration-free breeding season. Furthermore, examination of flight directions indicates a very strong uni-directional pattern (**Figure 13.7**), which could only be explained by birds on migration and following the coastline. Such uni-directional flight direction patterns would not be explained by birds commuting, which would be expected to produce a bi-modal distribution of directions with birds flying towards and away from the colony or actively foraging, where no clear pattern would be expected.

Figure 13.7 Manx shearwater rose diagrams of flight direction showing: (left) May 2021 clear directional pattern indicating migration; (right) July 2021 no clear pattern indicating foraging/commuting birds



13.6.1 Calculation of Species Densities and Abundance

109. The methods used to calculate species density and abundance are presented in **Appendix 13.A Offshore Ornithology Technical Report**. Mean peak abundances recorded in the aerial digital survey study area within biologically relevant seasons are provided in **Table 13.19**. The aerial digital survey study area is considerably larger than the Windfarm Site, so the mean peak abundances presented in the table do not feed directly into quantitative components of the assessment. However, this is considered to represent useful background information that demonstrates the peak numbers of offshore ornithology receptors present in the wider area during different seasons.

13.6.2 BDMPS Population Sizes

110. Breeding population sizes are based on colony counts from the national SMP database (JNCC, 2021) for all colonies within mean-max foraging range plus one standard deviation (SD) (Woodward *et al.*, 2019). One apparently occupied nest (AON) was assumed to equal two breeding birds. Where possible, the average count from 2019 and 2020 was used (i.e. corresponding to the same years as the available aerial digital survey data), or the most recent count otherwise.

111. During the breeding season, in addition to birds associated with breeding colonies, there will be immature birds, juvenile birds and "sabbatical" birds (mature birds not breeding in a given year) present within the region. It was assumed that, of the BDMPS population in the bio-season immediately before the breeding season (usually the return migration bio-season), all mature birds return to breeding colonies, but all immature birds remain within the BDMPS.

112. The total regional population within the breeding season is therefore the sum of breeding adults associated with nearby colonies plus the proportion of immature birds from the BDMPS population, this is shown in **Table 13.20**. The bio-seasons, BDMPS population sizes and biogeographic population for each of the key species are provided in **Table 13.21**.

13.6.3 Demographic data

113. The method to assess the potential impact from additional mortality to the population due to the Offshore Project is assessed in terms of any change in relation to the baseline mortality rate for any given species within each of the recognised bio-seasons. Demographic data for species scoped in for assessment for one or more potential impacts are provided in **Table 13.22**. The average mortality across all age classes for each species is presented in **Table 13.22**. The method presented assumes all age classes are at risk to the possible impacts of the proposed development equally and as such the baseline mortality rate is a weighted average based on all age classes. These data (from Horswill and Robinson (2015) have been used to calculate average annual mortality rates across age classes for each species. Each age class survival rate was then multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate converted to an average mortality rate. These are used to assess potential mortality from interactions with the Offshore Project in terms of changes to population mortality rates.

Table 13.18 Biologically relevant seasons for offshore ornithology receptors at the Offshore Project

Species	Breeding	Autumn migration	Winter	Spring migration	Non-breeding	Source
Kittiwake	May – Jul.	Aug. – Dec.	-	Jan. – Apr.	-	Furness (2015)
Common gull	May – Jul.	-	-	-	Aug. – Apr.	Cramp & Simmons (1983)
Great black-backed gull	Apr. – Aug.	-	-	-	Sep. – Mar.	Furness (2015)
Herring gull	Mar. – Aug.	-	-	-	Sep. – Feb.	Furness (2015)
Lesser black-backed gull	Apr. – Aug.	Sep. – Oct.	Nov. – Feb.	Mar.	-	Furness (2015)
Sandwich tern	Apr. – Aug.	Sep.	Oct. – Feb.	Mar.	-	Furness (2015)
Common tern	May – Aug.	Sep.	Oct. – Mar.	Apr.	-	Furness (2015)
Great skua	May – Aug.	Sep. – Oct.	Nov. – Feb.	Mar. – Apr.	-	Furness (2015)
Guillemot	Mar. – Jul.	-	-	-	Aug. – Feb.	Furness (2015)
Razorbill	Apr. – Jul.	Aug. – Oct.	Nov. – Dec	Jan. – Mar.	-	Furness (2015)
Puffin	Apr. – Aug.	-	-	-	Sep. – Mar.	Furness (2015)
Fulmar	Jan. – Aug.	Sep. – Oct.	Nov.	Dec.		Furness (2015)
Manx shearwater	Apr. – Aug.	Sep. – Oct.	Nov. – Feb.	Mar.	-	Furness (2015)
Gannet	Mar. – Sep.	Oct. – Nov.	-	Dec. – Feb.	-	Furness (2015)

Table 13.19 Mean peak abundance estimates (with range of recorded peak values) for species recorded in the aerial digital survey study area, Jul. 2020 to Jun. 2022, by biologically relevant season. Part seasons covered by the survey have been included as full seasons in the mean peak calculations

Species	Autumn migration	Winter	Spring migration	Non-breeding	Breeding
Kittiwake	219 (59 – 658)	-	1,141 (750 – 1,595)	-	100 (32 – 203)
Common gull	-	-	-	8 (1 – 20)	0
Great black-backed gull	-	-	-	0	23 (2 – 35)
Herring gull	-	-	-	546 (70 – 1,633)	16 (2 – 39)
Lesser black-backed gull	12 (2 – 34)	534 (68 – 1,601)	4 (1 – 12)	-	39 (8 – 83)
Sandwich tern	4 (1 – 12)	0	0	-	0
Common tern	0	0	0	-	34 (5 – 95)
Great skua	4 (1 – 12)	0	0	-	0
Guillemot	-	-	-	1,491	5,130
Razorbill	79	464	471	-	74
Puffin	-	-	-	42	95
Fulmar	12 (2 – 31)	0	303 (41 – 741)	-	106 (32 – 224)
Manx shearwater	142 (18 – 460)	0	43 (10 – 93)		18,722 (13,680 – 23,933)
Gannet	178 (81 – 301)	-	115 (15 – 304)	-	339 (145 – 774)

Table 13.20 Calculation of regional population during the breeding season

Species	Breeding population at colonies within mean-max foraging range (JNCC, 2021)	BDMPS return migration population size (Furness, 2015)	Proportion of juvenile, immature and non-breeding individuals (Furness, 2015)	Juvenile, immature and non-breeding individuals	Potential total regional baseline population during breeding bio-season
Gannet	184,802	661,888	0.448	536,129	720,931
Kittiwake	31,219	691,526	0.468	608,543	639,762
Great black-backed gull	716	17,742**	0.558	22,355	23,071
Herring gull	12,733	173,299**	0.522	188,896	201,629
Lesser black-backed gull	52,130	163,304	0.405	111,047	163,177
Guillemot	92,239	1,139,220**	0.425	843,023	935,262
Razorbill	33,487	606,914	0.429	455,186	488,672
Puffin	53,384	304,557	0.510	316,739	370,123
Manx shearwater	1,294,334	1,580,895	0.457	1,327,952	2,622,286

Table notes: * Not in Furness (2015); used Stone *et al.* (1995). ** Non-breeding bio-season population used. *** Not in Furness (2015); proportion of juveniles based on population structure given in Table 13.22.

Table 13.21 BDMPS regions, BDMPS population sizes and biogeographic population sizes. From Furness (2015) unless stated otherwise. Breeding population sizes are as calculated in Table 13.20

Species	Return Migration	Breeding	Post-breeding Migration	Migration-free Winter	Non-breeding	Biogeographic population
Gannet (UK Western Waters)	661,888	720,931	454,954	-	-	1,180,000
Kittiwake (UK Western waters plus Channel)	691,526	639,762	911,586	-	-	5,100,000
Great black-backed gull (UK South-west & Channel)	-	23,071	-	-	17,742	235,000
Herring gull (UK Western waters)	-	201,629	-	-	173,299	1,098,000
Lesser black-backed gull (UK Western waters)	163,304	163,177	163,304	41,159	-	864,000
Guillemot (UK Western waters)	-	935,262	-	-	1,139,220	4,125,000
Razorbill (UK Western waters)	606,914	488,672	606,914	341,422	-	1,707,000
Puffin (UK Western waters)	-	370,123	-	-	304,557	11,840,000
Manx shearwater (UK Western water plus Channel)	1,580,895	1,580,895	1,580,895	-	-	2,000,000

Table 13.22 Average annual survival rates of offshore ornithology receptors across age classes, along with productivity and average mortality for entire population calculated using age-specific demographic rates and age class proportions. Data from Horswill and Robinson (2015), except where noted otherwise

Species	Parameter	Survival (Age Class)								Productivity (per pair)	Average Mortality
		0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	Adult		
Gannet	Demographic Rate	0.424	0.829	0.891	0.895	0.895			0.919	0.700	0.188
	Population Age Ratio	0.191	0.081	0.067	0.060	0.054			0.547		
Kittiwake	Demographic Rate	0.790	0.854	0.854	0.854				0.854	0.690	0.157
	Population Age Ratio	0.168	0.133	0.114	0.097				0.488		
Great Black Backed Gull	Demographic Rate[1]	0.798	0.930	0.930	0.930	0.930			0.930	1.139	0.093
	Population Age Ratio	0.178	0.142	0.132	0.123	0.114			0.312		
Herring gull	Demographic Rate	0.798	0.834	0.834	0.834	0.834			0.834	0.920	0.172
	Population Age Ratio	0.177	0.141	0.118	0.098	0.082			0.384		
Common Tern	Demographic Rate	0.441	0.441	0.850					0.883	0.764	0.268
	Population Age Ratio	0.235	0.104	0.046					0.615		
Arctic Tern	Demographic Rate	0.441	0.837	0.837	0.837				0.837	0.380	0.217
	Population Age Ratio	0.135	0.060	0.050	0.042				0.713		
Great skua	Demographic Rate	0.730	0.730	0.730	0.730	0.730	0.882	0.882	0.882	0.651	0.188
	Population Age Ratio	0.156	0.114	0.083	0.061	0.044	0.032	0.029	0.480		

Species	Parameter	Survival (Age Class)								Productivity (per pair)	Average Mortality
		0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	Adult		
Guillemot	Demographic Rate	0.560	0.792	0.917	0.939	0.939	0.939		0.939	0.672	0.138
	Population Age Ratio	0.163	0.091	0.072	0.066	0.062	0.059		0.486		
Razorbill	Demographic Rate	0.630	0.630	0.895	0.895	0.895			0.895	0.570	0.175
	Population Age Ratio	0.161	0.101	0.064	0.057	0.051			0.565		
Manx shearwater	Demographic Rate[2]	0.250	0.250	0.250	0.250	0.250			0.870	0.697	0.327
	Population Age Ratio	0.238	0.060	0.015	0.004	0.001			0.683		

Table Notes :[1] Used herring gull juvenile survival rate for juvenile great black-backed gull; [2] Manx shearwater juvenile survival from Robinson (2005)

13.7 Potential impacts during construction

13.7.1 Impact 1: Disturbance and displacement: Windfarm Site

13.7.1.1 Overview

114. Disturbance and subsequent potential displacement of seabirds during the construction phase is primarily centred around when and where construction vessels and piling activities are planned to occur. The activities may displace individuals that would normally reside within and around the area of sea where the Windfarm Site is proposed to be developed. This potentially reduces the area available to those seabirds to forage, loaf and/ or moult.

115. This displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could theoretically lead to the mortality of individuals (Searle *et al.,* 2018), though this is unlikely during the construction phase of an OWF as construction vessels and piling activities are spatially and temporally restricted. Evidence suggests that some species are more susceptible than others to disturbance from OWF construction activities, which may lead to subsequent displacement. Dierschke *et al*., (2016) noted both avoidance and attraction to varying degrees depending upon the species in question.

116. Due to the above evidence, a screening process was undertaken for the Offshore Project to identify those species which are considered to be sensitive to disturbance and displacement from OWF construction activities (**Table 13.15**).

117. Whilst gannet and Manx shearwater are considered to be of low vulnerability to disturbance and displacement, they have been included in the assessment of potential displacement during the construction phase of the Offshore Project as a precautionary measure at the request of SNCBs (see **Table 13.4**). This is to provide SNCBs with confidence that any potential effects from construction activities have been considered in a quantitative manner.

118. Despite the species being classified as low vulnerability to disturbance and displacement, puffin are included as recommended within the Joint SNCB guidance due to their moderate habitat specialisation (SNCBs, 2022).

119. Guillemot and razorbill have been shown to exhibit behavioural responses to OWF construction activities and may be displaced as a consequence (see **Section 13.8.1**). Therefore, these species are considered further in relation to impacts from disturbance and displacement during construction.

120. Species which are known to be sensitive to disturbance and displacement but have been recorded in very low numbers during baseline data collection, are not considered further in the assessment (see **Table 13.15**). This is because the numbers of birds at risk from displacement are so small that there is no possibility of a significant effect occurring following the method to determine significance laid out in **Section 13.3**.

121. Following the evaluation of Valued Ornithological Receptors (VORs) and key potential impacts (**Table 13.15**) an assessment of displacement has been carried out for the Offshore Project. The methods and results are based on the following set of scenarios that recognise construction activities will be temporally and spatially restricted (see **Section 13.5**):

- Construction activities being undertaken are within only a small portion of the Windfarm Site at any one time
- Construction activities are temporally restricted to approximately 16 months (see **Chapter 5: Project Description**).

122. Given that potential disturbance activities during the construction phase are likely to be both temporally and spatially restricted compared to the operation phase, the potential impact from and consequent displacement is also highly likely to be lower during the construction phase. Therefore, it is unlikely that disturbance activities during the construction phase will have potentially significant effects.

123. Few studies have provided definitive empirical displacement rates for the construction phase of OWF developments. Krijgsveld *et al*., (2011) demonstrated higher flight paths of gannets next to operating vs non-operating WTGs. Displacement rates for auks during construction have been shown to be either significantly lower or comparable to the operation phase (Royal Haskoning (2013); Vallejo *et al*., (2017). These studies suggest that although the level of disturbance from construction activities can be high it is focussed around a spatially restricted area within the development. Therefore, displacement rates will be localised to construction areas including areas where built non-operational WTGs are present and reduced displacement rates will apply to the Windfarm Site where construction is not taking place.

124. As actual rates of displacement during the construction phase are difficult to determine from the available studies, the following methodology has been applied to determine potential impact levels. Given that construction activity is limited both spatially and temporarily within the development area and that any potential effects are unlikely to reach the same level as during the operation, the level to be used is

a 50% reduction in the displacement rate used for operational phase assessments, as has been assessed for other recent projects (RWE, 2022).

125. The evidence for displacement rates and appropriate buffer zones is discussed in detail in the operational phase assessment, as most evidence has been sourced from operational projects (see **Section 13.8.1**). The level of displacement assessed for each species during the construction phase is provided below:

- For guillemot, razorbill and puffin, operational phase displacement assessment considered for the Windfarm Site and surrounding 2km buffer is a displacement rate of 30 to 70%. This displacement rate will be reduced by 50% during the construction phase for the reasons set out in paragraph. This therefore equates to a construction phase displacement rate of 15 to 35%, with the Applicant's position being a displacement rate of 25% (see **Section 13.8.1**)
- For, Manx shearwater, the operational phase displacement assessment considered for the Windfarm Site and surrounding 2 km buffer is a displacement rate of 10%. This therefore equates to a construction phase displacement rate of 5%
- For gannet, the operational phase displacement assessment considered for the Windfarm Site and surrounding 2km buffer is a displacement rate of 60 to 80%. This therefore equates to a construction phase displacement rate of 30 to 40%
- To ensure that assessments represent a robust, yet precautionary approach for all species, the mortality rates considered for the construction phase remain the same as those used for operational phase impacts (please refer to **Section 13.8.1** for justification of mortality rates applied throughout this section). However, it should be noted that due to construction phase displacement impacts being both temporally and spatially restricted, it's highly likely that any associated consequential mortality rate will be less than that from operational impacts.

13.7.1.2 Summary of assessment confidence levels

126. With respect to construction phase disturbance and displacement assessments within the Windfarm Site, confidence in assessment conclusions is considered high. This is due to the displacement and mortality rates provided follow both the Applicant's approach and the SNCB's assumed preferred methods. When consideration is provided to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**) and additional evidence in support of the Applicant's approach (**Section 13.8.1**) it indicates that the SNCB's preferred methods are likely to overestimate the magnitude of the

potential impact and significance of effect. Therefore, the overall outcome of this assessment is still considered precautionary when following the Applicant's approach and, as such, the assessment is considered robust.

13.7.1.3 Guillemot

13.7.1.3.1 Potential magnitude of impact

127. As presented within **Table 13.23**, The annual estimated mortality (when considering a displacement rate of 25% and a mortality rate of 1% as outlined above) for guillemot resulting from disturbance and displacement during construction is approximately 11 (10.9) individuals. This is further broken down into relevant bio-seasons in **Table 13.23**.

128. As detailed in the joint SNCB interim guidance on displacement (SNCBs, 2022), for guillemot SNCBs consider that displacement assessment should consider a displacement rate of 15 to 35% should be considered for assessment. This is based on assessing half the operational phase displacement rate and present a range of mortality rates from 1 to 10%. Presentation of displacement impacts with the SNCB's rates for the construction phase is provided in **Table 13.23**. The main focus of impact assessment is based on the Applicant's approach of a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts.

129. During the breeding bio-season, the mean peak abundance for guillemot is 3,304 individuals within the Windfarm Site plus 2 km buffer. Using a construction phase displacement rate of 25% and a mortality rate of 1% would result in approximately eight (8.3) guillemots being subject to mortality per annum during the breeding bio-season. The regional population in the breeding bio-season is defined as 935,262 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 129,066 individuals per annum. The addition of eight predicted mortalities per annum would increase baseline mortality by 0.006%.

130. This level of impact is considered to be of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

Table 13.23 Guillemot bio-season displacement estimates for the Offshore Project (construction)

Bio-season (Months)	Seasonal Mean Peak Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Guillemots Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	25%Disp; 1% Mort	15-35% Disp; 1-10% Mort	25%Disp; 1% Mort	15-35% Disp; 1-10% Mort
Breeding (Mar-Jul)	3,304	935,262	129,066	8.26	4.96 – 115.64	0.006	0.004 – 0.090
Non-breeding (Aug-Feb)	1,059	1,139,200	157,212	2.65	1.59 – 37.07	0.002	0.001 – 0.024
Annual (BDMPS)	4,363	1,139,200	157,212	10.91	6.54 – 152.71	0.007	0.004 – 0.097
Annual (biogeographic)	4,363	4,125,000	569,250	10.91	6.54 – 152.71	0.002	0.001 – 0.027

Table Note: Values in bold represent the Applicant’s approach to assessment based on the available evidence and expert judgement.

131. During the non-breeding bio-season, the mean peak abundance for guillemot is 1,059 individuals within the Windfarm Site plus 2km buffer. Using displacement rates of 25% and a mortality rate of 1% would result in approximately three (2.7) guillemots being subject to mortality per annum during the non-breeding bio-season. The BDMPS population in the non-breeding bio-season is defined as 1,139,200 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 157,212 individuals per annum. The addition of three predicted mortalities per annum would increase baseline mortality by 0.002%.

132. This level of impact is considered to be of **negligible magnitude during the non-breeding bio-season**, as it represents no discernible change to the baseline conditions due to the very small number of individuals subject to potential mortality per annum as a result of displacement.

133. For all seasons combined, the predicted maximum number of guillemots subject to mortality due to displacement from the Offshore Project is approximately 11 (10.9) per annum individuals. Using the largest BDMPS of 1,139,220 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality rate across all seasons is 157,212 per annum. The addition of 11 predicted mortalities per annum would increase the baseline mortality rate by 0.007%. When considering displacement effects at the wider biogeographic population scale, then based on a population of 4,125,000 (**Table 13.21**), the natural predicted mortality rate is 569,250 individuals per annum. The addition of 11 predicted mortalities would increase the biogeographic baseline mortality rate by 0.002%.

134. The magnitude of impact across all seasons per annum is considered to be of **negligible magnitude overall**, as it represents no discernible increase to baseline mortality levels as a result of displacement.

13.7.1.3.2Sensitivity of the receptor

135. As this receptor is a named feature of Lundy Island SSSI which is a site within foraging range of the Offshore Project, and is Amber listed in BoCC5 (Stanbury *et al.*, 2021), this receptor is afforded a conservation value of **medium** to reflect that. With respect to behavioural sensitivity to disturbance and displacement, it is considered to be medium (**Table 13.15**). Therefore, the overall sensitivity of this receptor to disturbance and displacement of **medium**.

13.7.1.3.3 Significance of effect

136. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10**. Therefore, the potential significance of effect from construction phase disturbance and displacement on guillemots has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by less than 0.01% per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.7.1.4 Razorbill

13.7.1.4.1 Potential magnitude of impact

137. As presented in **Table 13.24**, the annual estimated mortality (when considering displacement rate of 25% and a mortality rate of 1%) as a consequence of the construction phase of the Offshore Project for razorbill is approximately two (2.0) individuals. This figure is further broken down into relevant bio-seasons in **Table 13.24**.

138. As detailed in the joint SNCB interim guidance on displacement (SNCBs, 2022), SNCBs consider that for razorbill the displacement assessment should consider a displacement rate of 15 to 35% for assessment. This is based on assessing half the operational phase displacement rate and present a range of mortality rates from 1 to 10%. Presentation of displacement impacts with SNCB's rates for the construction phase is provided in **Table 13.24**. The main focus of the impact assessment is based on the Applicant's approach of a 1% mortality rate for the construction phase displacement, considering the temporal and spatial restrictions of construction impacts.

139. During the return migration bio-season, the mean peak abundance for razorbill is 345 individuals within the Windfarm Site plus 2 km buffer. Using a construction phase displacement rate of 25% and a mortality rate 1% results in less than one (0.9) razorbill being subject to displacement mortality per annum. The regional population in the return migration bio-season is defined as 606,914 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.24**), the natural predicted mortality in the return migration bio-season is 106,210 individual per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by 0.001%.

140. This level of impact is considered to be of **negligible magnitude during the return migration bio-season**, as it represents no discernible change to baseline mortality.

Table 13.24 Razorbill bio-season displacement estimates for the Offshore Project (construction)

Bio-season (Months)	Seasonal Mean Peak Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Guillemots Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	25% Disp; 1% Mort	15-35% Disp; 1-10% Mort	25%Disp; 1% Mort	15-35% Disp; 1-10% Mort
Return migration (Jan - Mar)	345	606,914	106,210	0.86	0.52 – 12.08	0.001	0.000 - 0.011
Breeding (Apr-Jul)	40	488,672	85,518	0.10	0.06 – 1.40	<0.001	0.000 - 0.002
Post-breeding migration (Aug-Oct)	40	606,914	106,210	0.10	0.06 – 1.40	<0.001	0.000 - 0.001
Migration-free winter (Nov-Dec)	361	341,422	59,749	0.90	0.54 – 12.64	0.002	0.001 - 0.021
Annual (BDMPS)	786	606,914	106,210	1.97	1.18 – 27.51	0.002	0.001 - 0.026
Annual (Biogeographic)	786	1,707,000	298.725	1.97	1.18 – 27.51	0.001	0.000 - 0.009

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

141. During the breeding bio-season, the mean peak abundance for razorbill is 40 individuals within the Windfarm Site plus 2 km buffer. Using a construction phase displacement rate of 25% and a mortality rate 1% results in less than one (0.1) razorbill being subject to displacement mortality per annum. The regional population in the breeding bio-season is defined as 488,672 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.24**), the natural predicted mortality in the breeding bio-season is 85,518 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by <0.001%.

142. This level of impact is considered to be of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

143. During the post-breeding migration bio-season, the mean peak abundance for razorbill is 40 individuals within the Windfarm Site plus 2 km buffer. Using a construction phase displacement rate of 25% and a mortality rate of 1% results in less than one (0.1) razorbill being subject to mortality per annum. The regional population in the post-breeding migration bio-season is defined as 606,914 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.24**), the natural predicted mortality in the post-breeding migration bio-season is 106,210 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by <0.001%.

144. This level of impact is considered to be of **negligible magnitude during the post-breeding migration bio-season**, as it represents no discernible change to baseline mortality.

145. During the migration-free winter bio-season, the mean peak abundance for razorbill is 361 individuals within the Windfarm Site plus 2 km buffer. Using a construction phase displacement rate of 25% and a mortality rate of 1% results in less than one (0.9) razorbill being subject to displacement mortality per annum. The regional population in the migration-free winter bio-season is defined as 341,422 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.24**), the natural predicted mortality in the migration-free winter bio-season is 59,749 individuals per annum. The addition of less than one predicted mortality per annum would increase the baseline mortality by 0.002%.

146. This level of impact is considered to be of **negligible magnitude during the migration-free winter bio-season**, as it represents no discernible change to baseline mortality.

147. For all seasons combined, the predicted maximum number of razorbills subject to mortality due to displacement from the Offshore Project is approximately two (2.0) individuals per annum. Using the largest UK western waters BDMPS of 606,914 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.24**), the natural baseline mortality across all seasons is 106,210 individuals per annum. The addition of two predicted mortalities per annum would increase the baseline mortality by 0.002%. When considering displacement effects at the wider biogeographic population scale, then based on a population of 1,707,000 individuals (**Table 13.21)**, the natural annual mortality will be 298,725 individuals per annum. The addition of two predicted mortalities per annum would increase the biogeographic baseline mortality by 0.001%.

148. This magnitude of impact is considered to be of **negligible magnitude overall**, as it represents no discernible increase to baseline mortality levels as a result of displacement.

13.7.1.4.2 Sensitivity of the receptor

149. As this receptor is a named feature of Lundy Island SSSI which is a site within foraging range of the Offshore Project, and is Amber listed in BoCC5 (Stanbury *et al.*, 2021), this receptor is afforded a conservation value of **medium** to reflect that. With respect to behavioural sensitivity to disturbance and displacement, it is considered to be medium (**Table 13.15**). Therefore, the overall sensitivity of this receptor to disturbance and displacement of **medium**.

13.7.1.4.3 Significance of effect

150. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.9** and the magnitude of impact is negligible. Therefore, the potential significance of effect from construction phase disturbance and displacement on razorbills has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to only two mortalities per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.7.1.5 Puffin

13.7.1.5.1 Potential magnitude of impact

151. As presented within **Table 13.25**, the annual estimated mortality (when considering a displacement rate of 25% and a mortality rate of 1%, as determined in **Section 13.8.1**) as a consequence of displacement during the construction

phase of the Offshore Project for puffin is less than one (0.2) individual. This is further broken down into relevant bio-seasons in **Table 13.25**.

152. As detailed in the joint SNCB interim guidance on displacement (SNCBs, 2022), for puffin SNCBs consider that displacement assessment should consider a displacement rate of 15 to 35% should be considered for assessment. This is based on assessing half the operational phase displacement rate and present a range of mortality rates from 1 to 10%. Presentation of displacement impacts with SNCB's rates for the construction phase is provided in **Table 13.25**. The main focus of impact assessment is based on the Applicant's approach of a 1% mortality rate for the construction phase displacement, considering the temporal and spatial restrictions of construction impacts.

153. During the breeding bio-season, the mean peak abundance for puffin is 49 individuals within the Windfarm Site plus 2km buffer. Using construction phase displacement rates of 25% and a mortality rate of 1% would result in less than one (0.1) puffin being subject to mortality. The regional population in the breeding bio-season is defined as 370,123 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 66,252 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by <0.001%.

154. This level of impact is considered to be of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

155. During the non-breeding bio-season, the mean peak abundance for puffin is 31 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates of 25% and a mortality rate of 1% would result in less than one (0.1) puffin being subject to mortality per annum. The BDMPS population in the non-breeding bio-season is defined as 304,557 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 54,516 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by <0.001%.

156. This level of impact is considered to be of **negligible magnitude during the non-breeding bio-season**, as it represents no discernible change to the baseline conditions due to the very small number of individuals subject to potential mortality per annum as a result of displacement.

Table 13.25 Puffin bio-season displacement estimates for the Offshore Project (construction)

Bio-season (Months)	Seasonal Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Puffins Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	25% Disp; 1% Mort	15-35% Disp; 1-10% Mort	25% Disp; 1% Mort	15-35% Disp; 1-10% Mort
Breeding (Apr-Aug)	49	370,123	66,252	0.12	0.07 – 1.72	<0.001	0.000 – 0.003
Non-breeding (Sep-Mar)	31	304,557	54,516	0.08	0.05 – 1.09	<0.001	0.000 – 0.002
Annual (BDMPS)	80	304,557	54,516	0.20	0.12 – 2.80	<0.001	0.000 – 0.005
Annual (biogeographic)	80	11,840,000	2,119,360	0.20	0.12 – 2.80	<0.001	<0.001

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

157. For all seasons combined, the predicted maximum number of puffins subject to mortality due to displacement from the Offshore Project is less than one (0.2) puffin per annum. Using the largest BDMPS of 304,557 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality rate across all seasons is 54,516 per annum. The addition of less than one predicted mortality per annum would increase the baseline mortality rate by less than <0.001%. When considering displacement effects at the wider biogeographic population scale, then based on a population of 11,840,000 (**Table 13.21**), the natural predicted mortality rate is 2,119,360 individuals per annum. The addition of less than one predicted mortality would increase the biogeographic baseline mortality rate by <0.001%.

158. The magnitude of impact across all seasons per annum is considered to be of **negligible magnitude overall**, as it represents no discernible increase to baseline mortality levels as a result of displacement.

13.7.1.5.2 Sensitivity of the receptor

159. As this receptor is a named feature of Lundy Island SSSI which is a site within foraging range of the Offshore Project, and is Red listed in BoCC5 (Stanbury *et al.*, 2021), this receptor is afforded a conservation value of **medium** to reflect that. With respect to behavioural sensitivity to disturbance and displacement, it is considered to be medium (**Table 13.15**). Therefore, the overall sensitivity of this receptor to disturbance and displacement of **medium**.

13.7.1.5.3 Significance of effect

160. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.9**. and the magnitude of impact is negligible. Therefore, the potential significance of effect from construction phase disturbance and displacement on puffins has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to under a single mortality per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.7.1.6 Manx shearwater

13.7.1.6.1 Potential magnitude of impact

161. As presented within **Table 13.26**, the annual estimated mortality rate (when considering a displacement rate of 5% and a mortality rate of 1%) for Manx shearwater is six (6.1) individuals per annum. This is further broken down into relevant bio-seasons in **Table 13.26**.

162. As detailed in the joint SNCB interim guidance on displacement (SNCBs, 2022), for Manx shearwater SNCBs consider that displacement assessment should consider a displacement rate of 5%. This is based on assessing half the operational phase displacement rate and present a range of mortality rates from 1 to 10%. Presentation of displacement impacts with SNCB's rates for the construction phase is provided in **Table 13.26**. The main focus of impact assessment is based on the Applicant's approach of a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts.

163. During the return migration bio-season, the mean peak abundance for Manx shearwater is 33 individuals within the Windfarm Site plus 2km buffer. Using a displacement rate of 5% and a mortality rate of 1% would result in less than one (<0.1) Manx shearwater being subject to mortality per annum. During the return migration bio-season, the total regional baseline population of Manx shearwaters is predicted to be 1,580,895 individuals (**Table 13.21**). When the average baseline mortality rate of 0.327 (**Table 13.22**) is applied, the natural predicted mortality in the return migration bio-season is 205,516 individuals per annum. The addition of less than a single predicted mortality per annum would increase baseline mortality by <0.001%.

164. This minimal level of potential change is considered to be an impact of **negligible magnitude during the return migration breeding bio-season**, as it represents no discernible increase to baseline mortality.

165. During the breeding bio-season, the mean peak abundance for Manx shearwater is 12,126 individuals within the Windfarm Site plus 2 km. Using a displacement rate of 5 and a mortality rate of 1% would result in six (6.1) Manx shearwaters being subject to mortality. During the breeding bio-season, the total regional baseline population of Manx shearwaters is predicted to be 2,622,286 individuals (**Table 13.21**). When the average baseline mortality rate of 0.327 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 857,488 individuals per annum. The addition of six predicted mortality per annum would increase baseline mortality by 0.001%.

166. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible increase to baseline mortality.

Table 13.26 Manx shearwater bio-season displacement estimates for the Offshore Project (construction)

Bio-season (Months)	Seasonal Mean Peak Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Manx shearwater Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	5% Disp; 1% Mort	5% Disp; 1-10% Mort	5% Disp; 1% Mort	5% Disp; 1-10% Mort
Return migration (Mar)	33	1,580,895	516,953	0.02	0.02 - 0.17	<0.001	<0.001
Breeding (Apr - Aug)	12,126	2,622,286	857,488	6.06	6.06 - 60.63	0.001	0.001 - 0.007
Post-breeding migration (Sep-Oct)	22	1,580,895	516,953	0.01	0.01 - 0.11	<0.001	<0.001
Annual (BDMPS)	12,181	1,580,895	516,953	6.09	6.09 - 60.91	0.001	0.001 - 0.012
Annual (biogeographic)	12,181	2,000,000	654,000	6.09	6.09 - 60.91	0.001	0.001 - 0.009

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

167. During the post-breeding migration bio-season, the mean peak abundance for Manx shearwater is 22 individuals within the Windfarm Site plus 2 km buffer. Using a displacement rate of 5% and mortality rate of 1% would result in less than one (<0.1) Manx shearwater being subject to mortality. During the post-breeding migration bio-season, the total regional baseline population is predicted to be 1,580,895 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 205,516 individuals per annum. The addition of less than a single predicted mortality per annum would increase baseline mortality by <0.001%.

168. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents no discernible increase to baseline mortality.

169. For all seasons combined, the predicted maximum number of Manx shearwater subject to mortality due to displacement from the Offshore Project is six (6.1) Manx shearwater per annum. Using the largest BDMPS population of 1,580,895 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality is 205,516 individuals per annum. The addition of six mortalities would increase baseline mortality by 0.001%. When considering displacement impacts at the wider biogeographic population scale, then based on a population of 2,000,000 (**Table 13.21**), the natural annual mortality rate would be 260,000 individuals per annum. On a biogeographic scale the addition of six predicted mortalities would increase baseline mortality by 0.001%.

170. This level of potential change per annum is considered to be an impact of **negligible magnitude at both the UK Western Waters BDMPS scale and at the biogeographic scale**, as it represents no discernible difference to the baseline conditions due to the number of individuals subject to potential mortality as a result of displacement.

13.7.1.6.2Sensitivity of the receptor

171. Manx shearwater are BoCC5 Amber listed (Stanbury *et al.*, 2021) and are a Birds Directive Migratory Species. Manx shearwaters are a qualifying feature of multiple SPAs within foraging range, given the extensive distance over which Manx shearwater forage. With respect to behavioural sensitivity to disturbance and displacement, it is considered to be low (**Table 13.15**) Considering both the conservation value and sensitivity to the impact, the overall sensitivity of Manx shearwater is assessed as **medium**.

13.7.1.6.3 Significance of effect

172. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from construction phase disturbance and displacement on Manx shearwaters has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by only approximately 0.001% per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.7.1.7 Gannet

13.7.1.7.1 Potential magnitude of impact

173. As presented within **Table 13.27**, the annual estimated mortality (when considering a displacement rate range of 30 to 40% and a mortality rate of 1%) as a consequence of displacement during the construction phase of the Offshore Project for gannet is between one and two individuals. This figure is further broken down into relevant bio-seasons in **Table 13.27**.

174. As detailed in the joint SNCB interim guidance on displacement (SNCBs, 2022), for gannet SNCBs consider that displacement assessment should consider a construction displacement rate of 30 to 40% should be considered for assessment. This is based on assessing half the operational phase displacement rate and present a range of mortality rates from 1 to 10%. Presentation of displacement impacts with the SNCB's rates for the construction phase is provided in **Table 13.27**. The main focus of impact assessment is based on the Applicant's approach of a 1% mortality rate for construction phase displacement, considering the temporal and spatial restriction of construction impacts.

175. During the return migration bio-season, the mean peak abundance for gannet is 76 individuals within the Windfarm Site plus 2 km. Using a displacement rate range of 30 to 40% and a mortality rate 1% results in less than one (0.2 to 0.3) gannet being subject to mortality per annum. The regional population in the return migration bio-season is defined as 661,888 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 124,435 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by less than <0.001%.

Table 13.27 Gannet bio-season displacement estimates for the Offshore Project (construction)

Bio-season (Months)	Seasonal Mean Peak Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Gannets Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	30-40% Disp; 1% Mort	30-40% Disp; 1-10% Mort	30-40% Disp; 1% Mort	30-40% Disp; 1-10% Mort
Return Migration (Dec-Feb)	76	661,888	124,435	0.23 – 0.30	2.28 – 3.04	<0.001	0.002
Breeding (Mar-Sep)	239	720,931	135,535	0.72 – 0.96	7.17 – 9.56	0.001	0.005 – 0.007
Post-breeding migration (Oct-Nov)	141	545,954	102,639	0.42 – 0.56	4.23 – 5.64	0.000 – 0.001	0.004 – 0.005
Annual (BDMPS)	456	661,888	124,435	1.37 – 1.82	13.68– 18.24	0.001	0.011 – 0.015
Annual (biogeographic)	456	1,180,000	221,840	1.37 – 1.82	13.68 – 18.24	0.001	0.006 – 0.008

Table Note: Values in bold represent the Applicant’s approach to assessment based on the available evidence and expert judgement.

176. This minimal level of change is considered to be an impact of **negligible magnitude during the return migration bio-season**, as it represents no discernible change to baseline mortality.

177. During the breeding bio-season, the mean peak abundance for gannet is 239 individuals within the Windfarm Site plus 2 km. Using a displacement rate range of 30 to 40% and a mortality rate 1% results in approximately one (0.7 to 1.0) gannet being subject to mortality per annum. The regional population in the breeding bio-season is defined as 720,931 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 135,535 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by at the most 0.001%.

178. This minimal level of change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

179. During the post-breeding migration bio-season, the mean peak abundance for gannet is 141 individuals within the Windfarm Site plus 2 km buffer. Using a displacement rate range of 30 to 40% and a mortality rate 1% results in less than one (0.4 to 0.6) gannet being subject to mortality per annum. The regional population in the post-breeding migration bio-season is defined as 545,954 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 102,639 individuals per annum. The addition of less than one predicted mortality per annum would increase baseline mortality by at most 0.001%.

180. This minimal level of change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents as it represents between no discernible change to baseline mortality.

181. For all seasons combined, the predicted maximum number of gannets subject to mortality due to displacement from the Offshore Project is less than two (1.4 to 1.8) gannets per annum. Using the largest BDMPS population of 661,888 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality across all seasons is 124,435 per annum. The addition of less than two predicted mortalities would increase baseline mortality by at most 0.001%. When considering displacement effects at the wider biogeographic population scale, and based on a population of 1,180,000 (**Table 13.21**), the natural annual mortality rate would be 221,840 individuals. The addition

of less than two predicted mortalities would increase the biogeographic baseline mortality by at most 0.001%.

182. This magnitude of impact is considered to be of **negligible magnitude overall**, as it represents no discernible increase to baseline mortality levels as a result of displacement.

13.7.1.7.2 Sensitivity of the receptor

183. Gannet are BoCC5 Amber listed (Stanbury *et al.*, 2021) and are a Birds Directive Migratory Species. Gannet is a qualifying feature of multiple SPAs within foraging range, given the extensive distance over which gannets forage, although connectivity with the Offshore Project is likely to be a mix of both breeding and non-breeding individuals. Therefore, gannet has been afforded a conservation value of high. With respect to behavioural sensitivity to disturbance and displacement, it is considered to be low (**Table 13.15**) Considering both the conservation value and sensitivity to the impact, the overall sensitivity of gannet is assessed as **medium**.

13.7.1.7.3 Significance of effect

184. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from construction phase disturbance and displacement on gannets has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to less than two individual mortalities per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.7.1.8 Disturbance and Displacement Further Mitigation

185. As there is deemed to be no significant effect for any species, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.7.2 Impact 2: Disturbance and displacement: Offshore Export Cable Corridor

186. Construction activities associated with offshore export cable installation may lead to disturbance and displacement of species within the Offshore Export Cable Corridor and potentially within surrounding buffers to a lower extent.

187. The laying of the export cable between the Windfarm Site and Landfall would be undertaken across a 12 month period, involving a total of 40 vessel movements (see **Chapter 5: Project Description**). There is therefore potential for construction activities associated with seabed preparation and cable laying, namely the physical

presence of the installation vessels, to lead to disturbance and displacement of birds present within the Offshore Export Cable Corridor should works occur during this period.

188. The baseline characterisation report did not identify any species of high sensitivity or high densities within the Offshore Export Cable Corridor (**Appendix 13.A**). Works within the Offshore Export Cable Corridor are likely to be spatially and temporally restricted as installation of the cable route will be carried out in sections (i.e. disturbance and displacement will not occur along the entire length of the cable route at once). Therefore, the magnitude of impact from disturbance and displacement within the Offshore Export Cable Corridor has been assessed as negligible on all receptors and accordingly, following the matrix approach set out in **Table 13.10** the effect has been assessed as **not significant** regardless of the sensitivity of the receptor.

13.7.2.1 Summary of assessment confidence levels

189. With respect to construction phase disturbance and displacement assessments within the ECC, confidence in assessment conclusions is considered high. This is due to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**), combined with the spatial and temporal limitation of any impact to occur as detailed above. Therefore, the assessment of this potential effect on offshore ornithology receptors is robust.

13.7.2.2 ECC Disturbance and Displacement Further Mitigation

190. As there is deemed to be no significant effect, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.7.3 Impact 3: Barrier Effects

191. In the construction phase, the presence of construction activities and WTGs (once erected) could create a barrier to the movements of birds. This may result in permanent changes in flight routes for the birds concerned and an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for the individuals affected. This could affect both migrating birds and resident birds foraging in the region.

13.7.3.1 Magnitude of impact

192. The location, shape and size of the Offshore Project mean the risk of a barrier effect to migrating birds is low. The Offshore Project is not located in a major flyway for

non-seabirds (Wright *et al.*, 2012; Wernham *et al.*, 2002) and most migratory seabirds tend to follow the coast more closely (Forrester *et al*. 2007; WWT, 2014).

193. The worst-case scenario would be for a bird to reach the edge of the site and follow the perimeter around until resuming its original flight path, which would require a maximum deviation of approximately 10km. Furthermore, migratory birds that do avoid the OWF are able to alter their flight path to a lesser degree, for example adjusting their course earlier on and then correcting to reach the desired endpoint, rather than following the perimeter. For migrating birds, this is a negligible distance as the increase in energy demand is minor and will be insignificant when compared to other factors affecting the energy demand of migratory species, such unsuitable wind conditions (Masden *et al.*, 2010).

194. Most migratory non-seabirds fly at heights well above the maximum turbine blade height (Alerstam, 1990) and therefore are likely to fly at significant height over the OWF, rather than around it.

195. The magnitude of change will therefore be, at most, negligible to all migrating birds.

196. The risk from a barrier effect can be of more concern for resident birds during daily trips during the breeding season, commuting between breeding colonies and feeding locations. The additional exertion required to avoid an offshore wind farm on a daily basis can accumulate into a more significant overall impact than a one-off impact as per migratory birds.

197. However, the location, shape and size of the Offshore Project mean the risk of a barrier effect to commuting birds is low. Tracking studies show that while the Offshore Project Site is occasionally overflown by foraging birds from nearby colonies, there is no clear flyway that the Offshore Project Site would obstruct (Guilford *et al.*, 2008; Dean *et al.*, 2010; Cox *et al.*, 2016).

198. The worst-case scenario would be for a bird to reach the edge of the site and follow the perimeter around until resuming its original flight path, which would require a maximum deviation of approximately 10km. However, commuting birds could alter their flight path to a lesser degree, for example adjusting their course earlier on and then correcting to reach the desired endpoint, rather than following the perimeter exactly. There is also evidence that birds learn and adapt their route to foraging sites, and therefore after first encountering the Offshore Project would subsequently alter their route to minimise any deviation required (Grecian *et al.*, 2018). With respect to any additional energetics used to deviate the Offshore Project is included within the disturbance and displacement assessments within **Section 13.8.1** and **Section 428**.

199. For the purposes of assessment, however, it is usually not possible to distinguish between displacement and barrier effects. Therefore, it should be noted that the effects of displacement from the Windfarm Site during the operational phase of the Offshore Project encapsulate potential barrier effects for the receptors considered, due to the inclusion of flying and sitting birds (all behaviours) within the assessment of displacement, as recommended in joint SNCB's guidance (Parker *et al*., 2022).

200. Therefore, it is concluded that the magnitude of a barrier effect on breeding seabirds would be **negligible** adverse effect at most (see **Section 13.7.1**).

13.7.3.2 Significance of effect

201. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor at most regardless of the sensitivity of the receptor. An effect of minor significance is **not significant in EIA terms**.

13.7.3.3 Summary of assessment confidence levels

202. With respect to construction phase barrier effects, confidence in assessment conclusions is considered high. This is because the disturbance and displacement assessment (**Section 13.7.1**) undertaken currently accounts for consideration of barrier effects, as recommended in Natural England best practice guidance (Parker et al., 2022). A confidence level of high is further compounded due to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**). Therefore, the assessment of this potential effect on offshore ornithology receptors is robust.

13.7.3.4 Barrier Effects Further Mitigation

As there is deemed to be no significant effect, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.7.4 Impact 4: Indirect impacts due to impacts on prey species

203. Indirect effects on offshore ornithology receptors may occur during the construction phase if there are impacts on prey species. Such effects could result from the production of underwater noise (e.g. during piling at the offshore substation platform) or the generation of suspended sediments (e.g. during cable installation). These impact pathways may cause injury or mortality to, or alter the behaviour or availability of, prey species. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour.

204. Construction works may result in increased levels of suspended sediments which can cause fish and mobile invertebrates to avoid the construction area. As it settles out the sediment could also smother key life stages of sandeels and other key fish along with benthic species. These mechanisms may result in less prey being available to offshore ornithology receptors within the impact zone surrounding the construction area. Potential effects on benthic invertebrates and fish have been assessed in **Chapter 10: Benthic and Intertidal Ecology** and **Chapter 11: Fish and Shellfish Ecology**. The conclusions of those assessments inform this assessment of indirect effects on offshore ornithology receptors.

205. With regard to noise impacts on fish, **Chapter 11: Fish and Shellfish Ecology** considers the potential impacts of the Offshore Project on fish, including those relevant to as prey species. This includes herring, sprat and sandeel, which are the main prey items of a range of seabirds including Manx shearwater, kittiwake, gannet and auks. Impacts that have been assessed are considered to be low or negligible in magnitude and are anticipated to result in changes of minor adverse significance at most (see **Chapter 11: Fish and Shellfish Ecology**, summarised in **Section 11.12** and **Table 11.33**). **Chapter 8: Marine and Coastal Processes** and **Chapter 10: Benthic and Intertidal Ecology** discuss the potential impacts on the sea-bed and benthic habitats during the construction phase. The changes predicted to occur as a result of these activities would be temporary, small scale and highly localised. The consequent effect on prey species (such as herring, sprat and sandeel) through habitat loss is considered to be negligible in magnitude and are anticipated to result in changes of negligible adverse significance (see **Chapter 10: Benthic and Intertidal Ecology**, summarised in **Section 10.11** and **Table 10.26**). As the magnitude of this potential impact was assessed as low or negligible as stated above, it can be concluded that for offshore ornithology the magnitude of impact would be considered negligible.

206. All offshore ornithology receptors are considered to possess a medium sensitivity to this potential impact. It is therefore concluded that the significance of effect on all offshore ornithology receptors occurring in or around the Offshore Project during the construction phase would be minor adverse, which is **not significant in EIA terms**.

13.7.4.1 Summary of assessment confidence levels

207. With respect to construction phase indirect effects, confidence in assessment conclusions is considered high. This is primarily because the other chapters of the assessment have used the best available evidence, and best practice methodologies, in assessing potential impacts and drawing conclusions. Therefore, the assessment

of these potential effects on offshore ornithology receptors is robust. In addition, though difficult to measure, no substantial effects have been recorded due to these impact pathways at other OWFs.

13.7.4.2 Indirect Impacts Further Mitigation

208. No additional measures (aside from those outlined in **Chapter 11: Fish and Shellfish Ecology**) are required to mitigate this impact.

13.8 Potential impacts during operation and maintenance

209. The potential effects of the offshore operation and maintenance of the Offshore Project have been assessed on offshore ornithology. The potential environmental effects arising from the operation and maintenance of the Offshore Project are listed in **Table 13.6**, whilst the worst-case scenario describes each impact that has been assessed in **Table 13.3**.

13.8.1 Impact 1: Disturbance and displacement: Windfarm Site

13.8.1.1 Overview

210. The presence of WTGs has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where the Offshore Project is proposed to be developed. This potentially reduces the area available to those seabirds to forage, loaf and/ or moult that currently occur within and around the Offshore Project and may be susceptible to displacement from such a development. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.

211. Seabird species vary in their response to the presence of operational infrastructure associated with OWFs, such as WTGs and shipping activity related to maintenance activities. OWFs are a new feature in the marine environment and as a result there is limited evidence as to the effects of disturbance and displacement by operational infrastructure in the long-term.

212. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which has been widely applied in OWF EIAs. Furness and Wade (2012) developed a similar system with disturbance ratings for particular species that was applied alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity of each species to disturbance and displacement. Bradbury *et al.*, (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters.

213. Natural England and JNCC issued a joint Interim Displacement Guidance Note (Natural England and JNCC 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to OWF developments. This has been superseded more recently by a joint SNCB interim displacement advice note (SNCBs, 2022), which provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs. These guidance notes have shaped the assessment provided below.

214. Some species are more susceptible than others to disturbance from OWF operation, which may lead to subsequent displacement. Dierschke *et al*., (2016) noted both displacement and avoidance to varying degrees by some seabird species while others were attracted to OWFs. A screening process was undertaken for the Offshore Project to identify those species that may be more susceptible than others and therefore which species may be considered for further assessment (**Table 13.15**).

215. Whilst gannet and Manx shearwater are considered to be of relatively low vulnerability to disturbance, they have been included in the assessment of potential displacement during the operational phase of the Offshore Project as a precautionary measure on the recommendation of SNCBs. This is to provide SNCBs with confidence that any potential effects from operational disturbance and displacement have been considered in a quantitative manner.

216. The five species that were scoped in for assessment for disturbance and displacement are guillemot, razorbill, puffin, Manx shearwater and gannet (**Table 13.15**).

217. Following the screening process (**Table 13.15**), an assessment of displacement was carried out for the Offshore Project, with detailed methods and results presented in **Appendix 13.B: Migratory Birds Report**, to provide information for five seabird species of interest identified as potentially at risk and of interest for impact assessment.

218. With respect to the most suitable displacement and mortality rates for assessment, the Applicant has reviewed latest evidence with respect to the five receptors scoped in for assessment as detailed below. The findings of this review have been used to inform the applicant’s approach to disturbance and displacement assessment, ensuring that the approach taken reflects the current research and scientific data.

13.8.1.2 Auk Species

13.8.1.3 Displacement rate evidence base

219. Auk species show a medium level of sensitivity to displacement by ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; Bradbury *et al*., 2014). Displacement impacts from post-consent monitoring studies were collated and reviewed by Dierschke *et al*., (2016). This review summarises evidence of auk displacement obtained from studies of thirteen different European OWF sites that compared changes in seabird abundance between baseline and post-construction. The review concluded that the mean outcome across all OWFs for auks was 'weak displacement' but highly variable. Since the publication of this review, there have been a number of additional OWF sites which have reported displacement effects on auks (APEM 2017; Webb *et al*. 2017; Vanermen *et al*. 2019; Peschko *et al*. 2020; MacArthur Green 2021). Furthermore, previously published datasets from three OWF sites have recently been re-analysed utilising a novel modelling approach, which has resulted in different displacement effects being concluded for some (Zuur 2018; Leopold *et al*. 2011).

220. Since the Dierschke *et al*., (2016) review, a further study has been published using data from OWFs in the German North Sea indicating guillemot displacement rates are reduced during the breeding season compared to the non-breeding season by ~20% (Peschko *et al*, 2020). This is of important consideration as the mean displacement rates derived from the Dierschke *et al*., (2016) review was predominantly from data collected in the non-breeding season. Therefore, by applying a single displacement rate across all bio-seasons of 50% within the Windfarm Site and out to a 2 km buffer would ensure a precautionary rate is used for the assessment of displacement.

221. Hornsea Four OWF (Orsted, 2021) has recently submitted a summary review of all current post consent-monitoring studies undertaken to date within the North Sea and UK Western Waters. This review was completed by APEM (2022), which provides an extensive study and analysis of empirical data from multiple OWFs expanding on from previous studies undertaken, such as that submitted by Norfolk Vanguard (2018). The review undertaken by Hornsea Four OWF found that auk displacement varied considerably within different study sites showing attraction, no significant effect or a displacement effect. The studies included: one OWF with positive displacement effects, eight OWFs with no significant effects or weak displacement effects, three with inferred displacement effects (but not statistically tested) and eight with negative displacement effects. The displacement effects from those studies which provided a defined displacement rate ranged from +112% to -

75%. Examination of the analysis methods and quality of the datasets for these studies, found that some studies have not utilised the most appropriate statistical modelling methods for the data collected. These studies were coincidentally found to have high displacement rates due to low abundance and high numbers of zero counts, making displacement rate prediction highly problematic given natural spatial and temporal variation in auk abundance and distribution. As such, the displacement effects reported in these studies are most likely unreliable. The conclusion from this literature review suggested that a displacement rate of up to 50% for the Windfarm Site and 2 km buffer would be the most applicable, whilst still being suitably precautionary for assessment.

222. Since the Dierschke *et al.*, (2016) review, a further study has been published using data from OWFs in the German North Sea indicating guillemot displacement rates are reduced during the breeding season compared to the non-breeding season by ~20% (Peschko *et al*, 2020). This is of important consideration as the mean displacement rates derived from the Dierschke *et al.*, (2016) review was predominantly from data collected in the non-breeding season. Therefore, by applying a single displacement rate across all bio-seasons of 50% within the Windfarm Site and out to a 2 km buffer would ensure a precautionary rate is used for the assessment of displacement.

223. Furthermore, evidence that an auk displacement rate of 50% is precautionary comes from studies that indicate auk habituation to OWFs. This was recently demonstrated at Thanet OWF, where auk displacement was shown to be statistically significant, but only in the short term, with abundances increasing within the wind farm from year two post-construction suggesting some level of habituation after one year of operation. Indeed, year two and three displacement rates for auks fell from a range of 75% to 85% in the first year of operation to a low of 31% to 41% within year two and three of operations (Royal Haskoning, 2013). There is also further emerging evidence as additional post-construction monitoring of OWFs continues, with reports of auk numbers increasing and observations of foraging behaviour within the wind farm itself (Leopold & Verdaat 2018). This would suggest that displacement rates are expected to diminish over the operational life of OWFs.

224. Therefore, in conclusion, there is strong evidence to support an auk displacement rate of 50% within OWF Windfarm Sites and out to a 2 km buffer, which would still be considered as precautionary.

13.8.1.4 Effects of displacement on auk mortality

225. Current evidence suggests that the response of seabirds to OWFs varies depending on the species and of life stage of the individual birds. The levels both spatially and temporally to which birds avoid OWFs are likely to be based on key factors such as competition levels within the wider area and prey abundance within the OWF. The consequence of such avoidance may result in reduced foraging areas available to individuals. Mortalities are likely to correlate strongly with the quality of the area within the OWF that some individuals are displaced from, but conversely may offer increased foraging efficiency for those still entering the OWF area. If the OWF area is considered to be a key a foraging area and the area outside of the OWF is close to carrying capacity, then higher mortality rates may occur (Busche and Garthe 2016; SNCBs, 2017). Conversely, if birds are being displaced into an area of optimal habitat and closer to breeding colonies, then this could result in a positive impact due to species having a reduction in energy expenditure foraging (Searle *et al*., 2020).

226. For auk species SNCBs current guidance is to present and consider assessing displacement impacts using a mortality rate of up to 10% based on expert opinion (Natural England 2014), due to the lack of empirical evidence and to allow for precaution in assessments (SNCBs, 2017). As presented by Hornsea Four OWF (Orsted, 2021), since the interim guidance on displacement was published there have been two detailed studies with updates to predict consequence of displaced seabirds, including auks, from OWFs (Searle *et al*. 2014 and 2018, and van Kooten *et al*. 2019), and anecdotal evidence of implied low additional mortality rates from auk colony stability on Helgoland, where OWFs have been in operation since 2014 and auk displacement rates have been reported to be between 44 to 63% (Peschko *et al*. 2020).

227. Van Kooten *et al*. (2019) determined the cost of birds avoiding areas based on energy-budget models for two scenarios; using habitat utilization maps and a fixed 10% mortality rate. The results demonstrated that an additional 1% mortality for displaced auks is a more appropriate evidenced-based rate, in comparison to the overly precautionary 10% mortality rate.

228. Searle *et al*. (2014; 2018) assessed the effects displacement and barrier effects on breeding seabirds. The study was based on time and energy budget models being created to estimate the displacement effects on the breeding population of seabirds, including auks during the chick rearing period. The models provided evidence that displacement has the potential to impact on future survival prospects of an auk due to changes in time and energy budgets. The simulations concluded however, that

during the breeding and non-breeding season displacement effects are unlikely to exceed an increase in mortality of 0.5%.

229. Further anecdotal evidence of low mortality rates as a consequence of displacement comes from the post monitoring of the Helgoland auk colony in the German North Sea. OWFs have been in operation in the area since 2014 and the displacement rate of auks is predicted to be between 44 to 63% (Peschko *et al*. 2020). The OWFs have therefore been in operation long enough for any correlations between colony demographics and operation of the OWF to be identified. The latest breeding population status on Helgoland shows a continued increase for both razorbill and guillemot over the latest five-year period, which has remained unchanged compared to long-term data (Gerlach *et al*. 2019), supporting an inferred conclusion that high mortality rates due to displacement are not occurring at the colony.

230. The detailed findings from APEM study (APEM, 2022a) into auk displacement mortality rates provide an extensive study and analysis to further inform the assessment process. Therefore, based on these studies the Applicant considers a mortality rate of 1% to be sufficiently precautionary for assessment of consequential displacement mortality.

13.8.1.5 Summary of assessment confidence levels

231. With respect to operation and maintenance phase disturbance and displacement assessments within the Windfarm Site, confidence in assessment conclusions is considered high. This is due to the displacement and mortality rates provided follow both the Applicant's approach and the SNCB's assumed preferred methods. When consideration is provided to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**) and additional evidence in support of the Applicant's approach (**Section 13.8.1**) it indicates that the SNCB's preferred methods are likely to overestimate the magnitude of the potential impact and significance of effect. Therefore, the overall outcome of this assessment is still considered precautionary when following the Applicant's approach and, as such, the assessment is considered robust.

13.8.1.6 Guillemot

232. For the purpose of this assessment, an evidence-led displacement rate of 50% and mortality rate of 1% was applied to each bio-season based on evaluation of the published literature and in line with values used by other OWF displacement assessments. Additional consideration is provided by reference to the SNCB's preferred method of assessing potential impacts from displacement using a range of between 30% to 70% displacement and range of between 1% and 10% mortality

rates (SNCBs, 2021) as presented in **Table 13.28.** The main focus of impact assessment is based on the Applicant's evidence-led approach.

233. A complete range of displacement matrices are presented in **Appendix 13.B: Migratory Birds Report**, whilst **Table 13.28** has been populated with data for guillemots during the breeding and non-breeding season within the Windfarm Site as well as out to a 2 km buffer. An annual displacement matrix for guillemot within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.29** below.

13.8.1.6.1 Potential magnitude of impact

234. The annual estimated mortality (when considering a displacement rate of 50% and a mortality rate of 1%) as a consequence of displacement during the operation and maintenance phase of the Offshore Project for guillemot is 22 (21.8) individuals. This is further broken down into relevant bio-seasons in **Table 13.28**.

235. During the breeding bio-season, the mean peak abundance for guillemot is 3,304 individuals within the Windfarm Site plus 2 km buffer. When considering a displacement and mortality rate of 50% and 1%, respectively, this would result in approximately 17 (16.5) guillemots being subject to mortality. During the breeding bio-season the total guillemot regional baseline population, including breeding adults and immature birds, is predicted to be 935,262 individuals (**Table 13.21**). Using the average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality of guillemots in the breeding bio-season is 129,066 individuals per annum. The addition of 17 predicted mortalities would increase baseline mortality by 0.013%.

236. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

Table 13.28 Guillemot bio-season displacement estimates for the Offshore Project (operation)

Bio-season (Months)	**Seasonal Abundance (Windfarm Site plus 2 km buffer)**	**Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)**		**Estimated Number of Guillemots Subject to Mortality**		**Increase in Baseline Mortality (%)**	
		Population	**Baseline Mortality**	**50% Disp; 1% Mort**	**30-70% Disp; 1-10% Mort**	**50% Disp; 1% Mort**	**30-70% Disp; 1-10% Mort**
Breeding (Mar-Jul)	3,304	935,262	129,066	16.52	9.91 – 231.28	0.013	0.008 – 0.179
Non-breeding (Aug-Feb)	1,059	1,139,220	157,212	5.30	3.18 – 74.13	0.003	0.002 – 0.047
Annual (BDMPS)	4,363	1,139,220	157,212	21.82	13.09 – 305.41	0.014	0.008 – 0.194
Annual (biogeographic)	4,363	4,125,000	569,250	21.82	13.09 – 305.41	0.004	0.002 – 0.054

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

237. During the non-breeding bio-season, the mean peak abundance for guillemot is 1,059 individuals within the Windfarm Site and 2 km buffer. When considering a displacement and mortality rate of 50% and 1%, respectively, this would result in approximately five (5.3) guillemots being subject to mortality. The UK Western Waters BDMPS for the non-breeding bio-season is defined as 1,139,220 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 157,212 individuals per annum. The addition of five predicted mortalities would increase baseline mortality by 0.003%.

238. This level of potential change is considered to be an impact of **negligible magnitude during the non-breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

239. For all seasons combined, the estimated number of guillemots subject to mortality due to displacement from the Windfarm Site plus 2 km buffer is 22 (21.8) individuals per annum. Using the largest UK Western Waters BDMPS population of 1,139,220 individuals (**Table 13.21**) as a proxy for the total BDMPS population across the year, with an average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality across all seasons is 157,212 individuals per annum. The addition of 22 predicted mortalities would increase baseline mortality rate 0.014% at the BDMPS scale. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality of the biogeographic population of 4,125,000 (**Table 13.21**) across all seasons is 569,250 individuals per annum. On a biogeographic scale, the addition of 22 predicted mortalities would increase the baseline mortality by 0.004%.

240. This level of potential change per annum is considered to be an impact of **negligible magnitude at both the UK Western Waters BDMPS scale and negligible at the biogeographic scale**, as it represents only a slight difference to the baseline conditions due to the number of individuals subject to potential mortality as a result of displacement.

13.8.1.6.2Sensitivity of the receptor

241. As detailed in **Section 13.3.8**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

Table 13.29 Guillemot annual displacement matrix for the Windfarm Site plus 2 km buffer

Guillemot Annual Displacement Matrix (Based on Abundance of 4,363 for the Windfarm Site plus 2 km buffer)																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	2	2	4	9	13	17	22	26	31	35	39	44
10	0	4	9	13	17	22	44	87	131	175	218	262	305	349	393	436
20	0	9	17	26	35	44	87	175	262	349	436	524	611	698	785	873
30	0	13	26	39	52	65	131	262	393	524	654	785	916	1,047	1,178	1,309
40	0	17	35	52	70	87	175	349	524	698	873	1,047	1,222	1,396	1,571	1,745
50	0	22	44	65	87	109	218	436	654	873	1,091	1,309	1,527	1,745	1,963	2,182
60	0	26	52	79	105	131	262	524	785	1,047	1,309	1,571	1,832	2,094	2,356	2,618
70	0	31	61	92	122	153	305	611	916	1,222	1,527	1,832	2,138	2,443	2,749	3,054
80	0	35	70	105	140	175	349	698	1,047	1,396	1,745	2,094	2,443	2,792	3,141	3,490
90	0	39	79	118	157	196	393	785	1,178	1,571	1,963	2,356	2,749	3,141	3,534	3,927
100	0	44	87	131	175	218	436	873	1,309	1,745	2,182	2,618	3,054	3,490	3,927	4,363

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

13.8.1.6.1 Significance of effect

242. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on guillemots has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by less than 0.02% per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.1.7 Razorbill

243. For the purpose of this assessment, an evidence-led displacement and mortality rate of 50% and 1%, respectively, was applied to each bio-season based on evaluation of the published literature and in line with values used by other OWF displacement assessments. Additional consideration is given to SNCBs preferred method of assessing potential impacts from displacement using a range of between 30% to 70% displacement and between 1% and 10% mortality rates (SNCBs, 2022) as presented in **Table 13.30**. The main focus of impact assessment is based on the Applicant's evidence-led approach.

244. A complete range of displacement matrices are presented in **Appendix 13.B: Migratory Birds Report**, whilst **Table 13.30** has been populated with data for razorbills during the return migration, breeding, post-breeding migration and migration-free wintering bio-seasons within the Windfarm Site as well as out to a 2 km buffer. An annual displacement matrix for razorbill within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.31** below.

13.8.1.7.1 Potential magnitude of impact

245. The annual estimated mortality (when considering a displacement rate of 50% and a mortality rate of 1%) as a consequence of displacement during the operation and maintenance phase of the Offshore Project for razorbill is four (3.9) individuals. This is further broken down into relevant bio-seasons in **Table 13.30**.

Table 13.30 Razorbill bio-season displacement estimates for the Offshore Project (operation)

Bio-season (Months)	Seasonal Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Guillemots Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	50% Disp; 1% Mort	30-70% Disp; 1-10% Mort	50% Disp; 1% Mort	30-70% Disp; 1-10% Mort
Return migration (Jan - Mar)	345	606,914	106,210	1.73	1.04 – 24.15	0.002	0.001 – 0.023
Breeding (Apr-Jul)	40	488,672	85,518	0.20	0.12 – 2.80	<0.001	0.000 – 0.003
Post-breeding migration (Aug-Oct)	40	606,914	106,210	0.20	0.12 – 2.80	<0.001	0.000 – 0.003
Migration-free winter (Nov- Dec)	361	341,422	59,749	1.81	1.08 – 25.27	0.003	0.002 – 0.042
Annual (BDMPS)	786	606,914	106,210	3.93	2.36 – 55.02	0.004	0.002 – 0.052
Annual (Biogeographic)	786	1,707,000	298,725	3.93	2.36 – 55.02	0.001	0.001 – 0.018

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

246. During the return migration bio-season, the mean peak abundance for razorbill is 345 individuals within the Windfarm Site and 2 km buffer. When considering evidence-based displacement and mortality rates of 50% and 1%, respectively, this would result in approximately two (1.7) razorbills being subject to mortality. The UK Western Waters BDMPS for the return migration bio-season is defined as 606,914 (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 106,210 individuals per annum. The addition of two predicted mortalities would increase baseline mortality by 0.002%.

247. This level of potential change is considered to be an impact of **negligible magnitude during the return migration bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

248. During the breeding bio-season, the mean peak abundance for razorbill is 40 individuals within the Windfarm Site and 2 km buffer. When considering evidence-based displacement and mortality rates of 50% and 1%, respectively, this would result in approximately less than one (0.2) razorbill being subject to mortality. The regional population in the breeding bio-season is defined as 488,672 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 85,518 individuals per annum. The addition of less than one predicted mortality would increase baseline mortality by <0.001%.

249. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

250. During the post-breeding migration bio-season, the mean peak abundance for razorbill is 40 individuals within the Windfarm Site and 2 km buffer. When considering the evidence-based displacement and mortality rate of 50% and 1% respectively, this would result in less than one (0.2) razorbill being subject to mortality. The UK Western Waters BDMPS for the post-breeding migration bio-season is defined as 606,914 (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 106,210 individuals per annum. The addition of less than one predicted mortality would increase baseline mortality by <0.001%.

251. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents no discernible change to baseline mortality.

252. During the migration-free winter bio-season, the mean peak abundance for razorbills is 361 individuals within the Windfarm Site and 2 km. Using the evidence-based displacement and mortality rate of 50% and 1% would result in two (1.8) razorbill being subject to mortality. The BDMPS population in the migration-free winter bio-season is defined as 341,422 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the migration-free winter bio-season is 59,749 individuals per annum. The addition of two predicted mortalities would increase baseline mortality by 0.003%.

253. This level of potential change is considered to be an impact of **negligible magnitude during the migration-free winter bio-season**, as it represents no discernible change to baseline mortality.

254. For all seasons combined, the maximum number of razorbills subject to mortality due to displacement from the Offshore Project Windfarm Site plus 2 km buffer is four (3.9) individuals per annum. Using the largest UK Western Waters BDMPS population of 606,914 (**Table 13.21**), as a proxy for the total BDMPS population across the year, with an average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality across all seasons is 106,210 individuals per annum. The addition of four predicted mortalities would increase baseline mortality by 0.004% at the BDMPS scale. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality of the biogeographic population of 1,707,000 (**Table 13.21**) across all seasons is 298,725 per annum. On a biogeographic scale, the addition of four predicted mortalities would increase baseline mortality by 0.001%.

255. This level of potential change per annum is considered to be an impact of **negligible magnitude at the UK Western Waters BDMPS scale and negligible magnitude at the biogeographic scale**, as it represents no discernible difference to the baseline conditions due to the very small number of individuals subject to potential mortality as a result of displacement.

13.8.1.7.2Sensitivity of the receptor

256. As detailed in **Section 13.7.1**, this receptor is classified as having an overall sensitivity to disturbance and displacement of **medium**.

13.8.1.7.3 Significance of effect

257. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on razorbills has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to four mortalities per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

Table 13.31 Razorbill annual displacement matrix for the Windfarm Site plus 2 km buffer

Razorbill Annual Displacement Matrix (Based on Abundance of 786 for the Windfarm Site plus 2 km buffer)																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	2	2	3	4	5	6	6	7	8
10	0	1	2	2	3	4	8	16	24	31	39	47	55	63	71	79
20	0	2	3	5	6	8	16	31	47	63	79	94	110	126	141	157
30	0	2	5	7	9	12	24	47	71	94	118	141	165	189	212	236
40	0	3	6	9	13	16	31	63	94	126	157	189	220	252	283	314
50	0	4	8	12	16	20	39	79	118	157	197	236	275	314	354	393
60	0	5	9	14	19	24	47	94	141	189	236	283	330	377	424	472
70	0	6	11	17	22	28	55	110	165	220	275	330	385	440	495	550
80	0	6	13	19	25	31	63	126	189	252	314	377	440	503	566	629
90	0	7	14	21	28	35	71	141	212	283	354	424	495	566	637	707
100	0	8	16	24	31	39	79	157	236	314	393	472	550	629	707	786

Table Note: Values in bold represent the Applicant’s approach to assessment based on the available evidence and expert judgement

13.8.1.8 Puffin

258. For the purpose of this assessment, an evidence-led displacement and mortality rate of 50% and 1%, respectively, was applied to each bio-season based on evaluation of the published literature and in line with values used by other OWF displacement assessments. Additional consideration is given to SNCBs preferred method of assessing potential impacts from displacement using a range of between 30% to 70% displacement and between 1% and 10% mortality rates (SNCBs, 2022) as presented in **Table 13.32.** The main focus of impact assessment is based on the Applicant's evidence-led approach.

259. A complete range of displacement matrices are presented in **Appendix 13.B: Migratory Birds Report**, whilst **Table 13.32** has been populated with data for puffins during each of the return migration, non-migratory breeding, post-breeding migration and non-migration wintering bio-seasons within the Windfarm Site as well as out to a 2 km buffer. An annual displacement matrix for puffin within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.33** below.

13.8.1.8.1 Potential magnitude of impact

260. The annual estimated mortality (when considering a displacement rate of 50% and a mortality rate of 1%) as a consequence of displacement during the operation and maintenance phase of the Offshore Project for puffin is less than a single individual (0.4). This is further broken down into relevant bio-seasons in **Table 13.32**.

Table 13.32 Puffin bio-season displacement estimates for the Offshore Project (operation).

Bio-season (Months)	Seasonal Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Guillemots Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	50% Disp; 1% Mort	30-70% Disp; 1-10% Mort	50% Disp; 1% Mort	30-70% Disp; 1-10% Mort
Breeding (Mar-Jul)	49	370,123	66,252	0.25	0.15 – 3.43	<0.001	0.000 – 0.005
Non-breeding (Aug-Feb)	31	304,557	54,516	0.16	0.09 – 2.17	<0.001	0.000 – 0.004
Annual (BDMPS)	80	304,557	54,516	0.40	0.24 – 5.60	0.001	0.000 – 0.010
Annual (biogeographic)	80	11,840,000	2,119,360	0.40	0.24 – 5.60	<0.001	<0.001

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

261. During the breeding bio-season, the mean peak abundance for puffin is 49 individuals within the Windfarm Site plus 2 km buffer. When considering evidence-based displacement and mortality rates of 50% and 1%, respectively, this would result in approximately less than one (0.3) puffin being subject to mortality. During the breeding bio-season the total puffin regional baseline population, including breeding adults and immature birds, is predicted to be 370,123 individuals (**Table 13.21**). Using the average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality of puffins in the breeding bio-season is 66,252 individuals per annum. The addition of less than a single predicted mortalities would increase baseline mortality by <0.001%.

262. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

263. During the non-breeding bio-season, the mean peak abundance for puffin is 31 individuals within the Windfarm Site and 2 km buffer. When considering evidence-based displacement and mortality rates of 50% and 1%, respectively, this would result in approximately less than one (0.2) puffins being subject to mortality. The UK Western Waters BDMPS for the non-breeding bio-season is defined as 304,557 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 54,516 individuals per annum. The addition of less than a single predicted mortalities would increase baseline mortality by <0.001%.

264. This level of potential change is considered to be an impact of **negligible magnitude during the non-breeding bio-season**, as it represents no discernible change to baseline mortality.

265. For all seasons combined, the estimated number of puffins subject to mortality due to displacement from the Windfarm Site plus 2 km buffer is less than one (0.4) individuals per annum. Using the largest UK Western Waters BDMPS population of 304,557 individuals (**Table 13.21**) as a proxy for the total BDMPS population across the year, with an average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality across all seasons is 54,516 individuals per annum. The addition of less than a single predicted mortalities would increase baseline mortality rate by 0.001% at the BDMPS scale. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality of the biogeographic population of 11,840,000 (**Table 13.21**) across all seasons is 2,119,360 individuals per annum. On a biogeographic scale, the addition of less

than a single predicted mortalities would increase the baseline mortality by <0.001%.

266. This level of potential change per annum is considered to be an impact of **negligible magnitude at both the UK Western Waters BDMPS scale and negligible at the biogeographic scale**, as it represents no discernible change to baseline mortality.

13.8.1.8.2 Sensitivity of the receptor

267. As detailed in **Section 13.3.9**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

13.8.1.8.3 Significance of effect

268. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on puffins has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to under a single individual mortality per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

Table 13.33 Puffin annual displacement matrix for the Windfarm Site plus 2 km buffer.

Puffin Annual Displacement Matrix (Based on Abundance of 80 for the Windfarm Site plus 2 km buffer)																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
10	0	0	0	0	0	0	1	2	2	3	4	5	6	6	7	8
20	0	0	0	0	1	1	2	3	5	6	8	10	11	13	14	16
30	0	0	0	1	1	1	2	5	7	10	12	14	17	19	22	24
40	0	0	1	1	1	2	3	6	10	13	16	19	22	26	29	32
50	0	0	1	1	2	2	4	8	12	16	20	24	28	32	36	40
60	0	0	1	1	2	2	5	10	14	19	24	29	34	38	43	48
70	0	1	1	2	2	3	6	11	17	22	28	34	39	45	50	56
80	0	1	1	2	3	3	6	13	19	26	32	38	45	51	58	64
90	0	1	1	2	3	4	7	14	22	29	36	43	50	58	65	72
100	0	1	2	2	3	4	8	16	24	32	40	48	56	64	72	80

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

13.8.1.9 Manx shearwater

13.8.1.10 Displacement rate evidence base

269. Most previous studies have not identified Manx shearwater as being sensitive to disturbance. Dierschke *et al*., (2016) classified Manx shearwater as "weakly avoiding wind farms", although it is noted that evidence is lacking for the species. Bradbury *et al*., (2014) classify Manx shearwater as having "very low" population vulnerability to displacement.

270. Dierschke *et al*., (2016) do suggest that Manx shearwater are avoiding North Hoyle wind farm, stating that an obvious distribution gap was observed at the OWF. It is not clear exactly how the authors reached this conclusion beyond applying subjective expert opinion to the results of the North Hoyle post-consent monitoring and concluding that fewer Manx shearwater were recorded than would be expected. Dierschke *et al*., (2016) also note that Manx shearwater have been recorded within Robin Rigg OWF.

271. Due to the limited evidence available for Manx shearwater as to suitable displacement and mortality rates, the Applicant has assessed in accordance with the Joint SNCB interim guidance note (SNCBs, 2022). Due to Manx Shearwater being classified as having low sensitivity to displacement and are known to have a large foraging range, Joint SNCB guidance recommends a 10% displacement rate within the Windfarm Site plus 2 km buffer and 1 to 10% mortality rate, although the Applicant considers a 1% mortality rate to be the more likely impact based on expert judgement. An annual displacement matrix for Manx shearwater within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.34** below.

13.8.1.10.1 Potential magnitude of impact

272. The annual estimated mortality rate (when considering a displacement rate of 10% and a mortality rate of 1%) for Manx shearwater is 12 (12.2) individuals. This is further broken down into relevant bio-seasons in **Table 13.34**. An annual displacement matrix for manx shearwater within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.35** below.

Table 13.34 Manx shearwater bio-season displacement estimates for the Offshore Project (operation).

Bio-season (Months)	**Seasonal Abundance (Windfarm Site plus 2 km buffer)**	**Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)**		**Estimated Number of Manx shearwater Subject to Mortality**		**Increase in Baseline Mortality (%)**	
		Population	Baseline Mortality	10% Disp; 1% Mort	10% Disp; 10% Mort	10% Disp; 1% Mort	10% Disp; 10% Mort
Return migration (Mar)	33	1,580,895	516,953	0.03	0.33	<0.001	<0.001
Breeding (Apr – Aug)	12,126	2,622,286	857,488	12.13	121.26	0.001	0.014
Post-breeding migration (Sep-Oct)	22	1,580,895	516,953	0.02	0.22	<0.001	<0.001
Annual (BDMPS)	12,181	1,580,895	516,953	12.18	121.81	0.002	0.024
Annual (biogeographic)	12,181	2,000,000	654,000	12.18	121.81	0.002	0.019

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

273. During the return migration bio-season, the mean peak abundance for Manx shearwater is 33 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 10% and mortality rates of between 1% would result in less than one (<0.1) Manx shearwater being subject to mortality. During the return migration bio-season, the total regional baseline population of Manx shearwaters is predicted to be 1,580,895 individuals (**Table 13.21**). When the average baseline mortality rate of 0.327 (**Table 13.22**) is applied, the natural predicted mortality in the return migration bio-season is 516,953 individuals per annum. The addition of less than a single predicted mortalities would increase baseline mortality by <0.001%.

274. This level of potential change is considered to be an impact of **negligible magnitude during the return migration bio-season**, as it represents no discernible increase to baseline mortality levels due to less than a single individual being subject to potential mortality as a result of displacement.

275. During the breeding bio-season, the mean peak abundance for Manx shearwater is 12,126 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 10% and mortality rates of 1% would result in approximately 12 (12.1) Manx shearwaters being subject to mortality. During the breeding bio-season, the total regional baseline population is predicted to be 2,622,286 individuals (**Table 13.21**). When the average baseline mortality rate of 0.327 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 857,488 individuals per annum. The addition of 12 predicted mortalities would increase baseline mortality by 0.001%.

276. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible increase to baseline mortality levels due to the very small number of individuals subject to potential mortality as a result of displacement.

277. During the post-breeding migration bio-season, the mean peak abundance for Manx shearwater is 22 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 10% and mortality rates of 1% would result in approximately less than one (<0.1) Manx shearwater being subject to mortality. During the post-breeding migration bio-season, the total regional baseline population is predicted to be 1,580,895 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 516,953 individuals per annum. The addition of less than a single predicted mortality would increase baseline mortality by <0.001%.

278. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents no discernible increase to baseline mortality levels due to less than a single individual being subject to potential mortality as a result of displacement.

279. For all seasons combined, the maximum number of Manx shearwater subject to mortality due to displacement from the Windfarm Site plus a 2 km buffer is 12 (12.2) Manx shearwaters per annum. Using the largest UK Western Waters BDMPS of 1,580,895 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality across all seasons is 516,953 individuals per annum. The addition of 12 predicted mortalities would increase baseline mortality by 0.002%. When considering displacement impacts at the wider biogeographic population scale, then based on a population of 2,000,000 (**Table 13.21**), the natural annual mortality rate would be 654,000 individuals. On a biogeographic scale the addition of 12 predicted mortalities per annum would increase baseline mortality by 0.002%.

280. This level of potential change per annum is considered to be an impact of **negligible magnitude at the UK Western Waters BDMPS scale and negligible at the biogeographic scale**, as it represents no discernible difference to the baseline conditions due to the number of individuals subject to potential mortality as a result of displacement.

281. In each bio-season and on an annual basis, the potential impact is considered to be of **negligible** magnitude, as it represents no discernible increase to baseline mortality levels as a result of displacement.

13.8.1.10.2 Sensitivity of the receptor

282. As detailed in **Section 13.3.9**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

13.8.1.10.3 Significance of the effect

283. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on Manx shearwaters has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by less than 0.01% per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

Table 13.35 Manx shearwater annual displacement matrix for the Windfarm Site plus 2 km buffer.

Manx shearwater Annual Displacement Matrix (Based on Abundance of 12,181 for the Windfarm Site plus 2 km buffer)																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	4	5	6	12	24	37	49	61	73	85	97	110	122
10	0	12	24	37	49	61	122	244	365	487	609	731	853	974	1,096	1,218
20	0	24	49	73	97	122	244	487	731	974	1,218	1,462	1,705	1,949	2,193	2,436
30	0	37	73	110	146	183	365	731	1,096	1,462	1,827	2,193	2,558	2,923	3,289	3,654
40	0	49	97	146	195	244	487	974	1,462	1,949	2,436	2,923	3,411	3,898	4,385	4,872
50	0	61	122	183	244	305	609	1,218	1,827	2,436	3,045	3,654	4,263	4,872	5,481	6,091
60	0	73	146	219	292	365	731	1,462	2,193	2,923	3,654	4,385	5,116	5,847	6,578	7,309
70	0	85	171	256	341	426	853	1,705	2,558	3,411	4,263	5,116	5,969	6,821	7,674	8,527
80	0	97	195	292	390	487	974	1,949	2,923	3,898	4,872	5,847	6,821	7,796	8,770	9,745
90	0	110	219	329	439	548	1,096	2,193	3,289	4,385	5,481	6,578	7,674	8,770	9,867	10,963
100	0	122	244	365	487	609	1,218	2,436	3,654	4,872	6,091	7,309	8,527	9,745	10,963	12,181

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

13.8.1.11 Gannet

284. Gannets show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). A study by Krijgsveld *et al*., (2011) using radar and visual observations to monitor the post-construction effects of the Offshore Wind farm Egmond aan Zee (OWEZ) established that 64% of gannets avoided entering the wind farm (macro-avoidance). The results of the post-consent monitoring surveys for Thanet OWF found that gannet densities reduced within the site in the third year, but the report did not quantify this (Royal Haskoning DHV, 2013). Evidence from a recent review undertaken by APEM (2022), which has collated and critically appraised studies from 25 OWFs, suggests that gannet behavioural response to OWFs varies seasonally with data suggesting displacement rates of 40 to 60% during the breeding season and 60 to 80% during the non-breeding season. For the purpose of this assessment, a precautionary approach has been taken and the level of displacement considered across all bio-seasons is between 60 to 80%.

285. **Table 13.36** has been populated with data for gannets during each of the return migration, breeding and post-breeding migration bio-seasons for the Windfarm Site plus a 2 km buffer. An annual displacement matrix for gannet within the Windfarm Site plus a 2 km buffer is also presented in **Table 13.37** below.

286. A mortality rate of 1% was selected for this assessment, based on expert judgement supported by additional evidence that suggests that gannet have a large mean max (315 km) and maximum (709 km) foraging range (Woodward *et al*., 2019) and feed on a variety of different prey items that provide sufficient alternative foraging opportunities despite the potential reduced foraging activities within the Offshore Project.

13.8.1.11.1 Potential magnitude of impact

287. The annual estimated mortality (when considering a displacement rate of 60 to 80% and a mortality rate of 1%) for gannet is at most four (2.7 to 3.7) individuals. This is further broken down into relevant bio-seasons in **Table 13.36**.

Table 13.36 Gannet bio-season displacement estimates for the Offshore Project (operation).

Bio-season (Months)	Seasonal Abundance (Windfarm Site plus 2 km buffer)	Regional Baseline Populations and Baseline Mortality Rates (Individuals per annum)		Estimated Number of Gannets Subject to Mortality		Increase in Baseline Mortality (%)	
		Population	Baseline Mortality	60-80% Disp; 1% Mort	60-80% Disp; 10% Mort	60-80% Disp; 1% Mort	60-80% Disp; 10% Mort
Return Migration (Dec-Feb)	76	661,888	124,435	0.46 – 0.61	4.56 – 6.08	<0.001	0.004 – 0.005
Breeding (Mar-Sep)	239	720,931	135,535	1.43 – 1.91	14.34 – 19.12	0.001	0.011 – 0.014
Post-breeding migration (Oct-Nov)	141	545,954	102,639	0.85 – 1.13	8.46 – 11.28	0.001	0.008 – 0.011
Annual (BDMPS)	456	661,888	124,435	2.74 – 3.65	27.36 – 36.48	0.002 – 0.003	0.022 – 0.029
Annual (biogeographic)	456	1,180,000	221,840	2.74 – 3.65	27.36 – 36.48	0.001 – 0.002	0.012 – 0.016

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

288. During the return migration bio-season, the mean peak abundance for gannet is 76 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 60 to 80% and mortality rates of 1% would result in less than one (0.5 to 0.6) gannet being subject to mortality. During the return migration bio-season, the total regional baseline population of gannets is predicted to be 661,888 individuals (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the return migration bio-season is 124,435 individuals per annum. The addition of less than a single predicted mortality would increase baseline mortality by <0.001%.

289. This level of potential change is considered to be an impact of **negligible magnitude during the return migration bio-season**, as it represents no discernible increase to baseline mortality levels due to less than a single individual being subject to potential mortality as a result of displacement.

290. During the breeding bio-season, the mean peak abundance for gannet is 239 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 60 to 80% and a mortality rate of 1% would result in approximately one to two (1.4 to 1.9) gannets being subject to mortality. During the breeding bio-season, the total regional baseline population of breeding adults and immature gannets is predicted to be 720,931 individuals (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 135,535 individuals per annum. The addition of one to two predicted mortalities would increase baseline mortality by 0.001%.

291. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible increase to baseline mortality levels due to the very small number of individuals subject to potential mortality as a result of displacement.

292. During the post-breeding migration bio-season, the mean peak abundance for gannet is 141 individuals within the Windfarm Site plus 2 km buffer. Using displacement rates between 60 to 80% and a mortality rate 1% would result in approximately one (0.9 to 1.1) gannets being subject to mortality. The UK Western Waters BDMPS for the post-breeding migration bio-season is defined as 545,954 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 102,639 individuals per annum. The addition of one predicted mortality would increase baseline mortality by 0.001%.

293. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents no discernible increase to baseline mortality levels due to only a single individual being subject to potential mortality as a result of displacement.

294. For all seasons combined, the maximum number of gannets subject to mortality due to displacement from the Windfarm Site plus 2 km buffer is three to four (2.7 to 3.7) individuals per annum. Using the largest UK Western Waters BDMPS of 661,888 individuals (**Table 13.21**) and, using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality across all seasons is 124,435 individuals per annum. The addition of three to four predicted additional mortalities would increase baseline mortality by at most 0.003%. When considering displacement impacts at the wider biogeographic population scale, then based on a population of 1,180,000 (**Table 13.21**), the natural annual mortality rate would be 221,840 individuals. On a biogeographic scale the addition of three to four predicted mortalities would increase baseline mortality by at most 0.002%.

295. This level of potential change per annum is considered to be an impact of **negligible magnitude at the UK Western Waters BDMPS scale and negligible at the biogeographic scale**, as it represents no discernible difference to the baseline conditions due to the small number of individuals subject to potential mortality as a result of displacement.

13.8.1.11.2 Sensitivity of the receptor

296. As detailed in **Section 13.3.9**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

13.8.1.11.3 Significance of effect

297. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on gannets has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to only four mortalities per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

Table 13.37 Gannet annual displacement matrix for the Windfarm Site plus 2 km buffer.

Gannet Annual Displacement Matrix (Based on Abundance of 456 for the Windfarm Site plus 2 km buffer)																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5
10	0	0	1	1	2	2	5	9	14	18	23	27	32	36	41	46
20	0	1	2	3	4	5	9	18	27	36	46	55	64	73	82	91
30	0	1	3	4	5	7	14	27	41	55	68	82	96	109	123	137
40	0	2	4	5	7	9	18	36	55	73	91	109	128	146	164	182
50	0	2	5	7	9	11	23	46	68	91	114	137	160	182	205	228
60	0	3	5	8	11	14	27	55	82	109	137	164	192	219	246	274
70	0	3	6	10	13	16	32	64	96	128	160	192	223	255	287	319
80	0	4	7	11	15	18	36	73	109	146	182	219	255	292	328	365
90	0	4	8	12	16	21	41	82	123	164	205	246	287	328	369	410
100	0	5	9	14	18	23	46	91	137	182	228	274	319	365	410	456

Table Note: Values in bold represent the Applicant's approach to assessment based on the available evidence and expert judgement.

13.8.1.12 Disturbance and Displacement Further Mitigation

298. As there is deemed to be no significant effect, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.8.2 Impact 2: Collision Risk: Windfarm Site

299. There is potential risk to birds from OWFs through collision with WTGs and associated infrastructure described in the worst-case scenario (see **Section 13.3.4**) resulting in injury or fatality. This may occur when birds fly through the Windfarm Site whilst foraging for food, commuting between breeding sites and foraging areas, or during migration.

300. Collision Risk Modelling (CRM) has been carried out for White Cross, with detailed methods and results presented in **Appendix 13.C: Revised Collision Risk Modelling** to provide information for five seabird species of interest identified as potentially at risk and of interest for impact assessment. A selection process was undertaken based on the density of flying birds recorded within the Windfarm Site and consideration of their perceived risk from collision (identified from the published literature). The results of this selection exercise are presented in **Table 13.15**. This screening process screened out the species for which the risk of collision is considered as very low, such as for Manx shearwater that fly very close to the sea surface so are unlikely to interact with WTGs. Species were also screened out if their densities in flight within the Windfarm Site were very low, as this also provides evidence of very low risk of collision. Following this selection process, five species were identified as following the screening criteria for CRM assessment; gannet, kittiwake, great black-backed gull, lesser black-backed gull and herring gull.

301. CRM was undertaken using the sCRM, developed on behalf of Marine Scotland (McGregor, 2018), using the advocated parameters within the Natural England best practice guidance document (Parker *et al.*, 2022).

302. CRM accounts for several different species-specific behavioural aspects of the seabird being assessed, including the height at which birds fly, their ability to avoid moving or statis structures and how active they are diurnally and nocturnally. Details of these considerations are provided in **Appendix 13.C: Revised Collision Risk Modelling.**

303. In order to provide a range of values to capture variability for each species, the applicant has run a variety of scenarios, the results of which can be found in the **Appendix 13.C: Revised Collision Risk Modelling**. A precautionary approach

for this EIA means the worst-case scenario has been presented only, based on a 18MW turbine scenario with a range of nocturnal activity factors.

304. All estimates are presented using Band Option 2 (BO2) following Natural England best practice guidance (Parker *et al.*, 2022). Sample sizes of flight height estimates from the site-specific aerial digital surveys were too small to produce robust estimates of flight height and therefore Band Option 1 was not used.

305. BO2 applies a uniform distribution of bird flights between the lowest and the highest levels of rotors. The proportion of birds at Potential Collision Height (PCH) was determined from the results of the Strategic Ornithological Support Services SOSS-02 project (Cook *et al.*, 2012) that analysed the flight height measurements taken from boat surveys conducted around the UK. The Offshore Project was updated following Johnston *et al.* (2014), and the revised published spreadsheet is used to determine the 'generic' percentage of flights at PCH for each species based on the proposed project's WTG parameters. This Band Option has been considered for all species.

306. In addition, further consideration has been given to the risk of collision to migratory species. Migratory birds may not be reliably detected using aerial digital surveys or any other existing generally applied survey method. Migratory birds may move through in short pulses, in poor weather or at night (when no surveys take place), or at high altitudes, which makes recording their numbers extremely complex.

13.8.2.1.1Precautionary nature to CRM

307. It must be noted that a number of components of additional precaution were included in the input parameters applied in the sCRM for this assessment, including considering a range of nocturnal activity factors and lower avoidance rates than that currently predicted from the latest scientific evidence. The nature of such precaution is evidenced through the findings of the Bird Collision Avoidance Study funded by ORJIP (Offshore Renewables Joint Industry Programme), which undertook a study to understand seabird behaviour at sea around offshore wind farms (Skov *et al.*, 2018). The ORJIP project studied birds around thanet offshore wind farm for a two-year period (between 2014 and 2016) recording over 12,000 bird movements throughout the day and night (Skov *et al.*, 2018). The findings of this study presented updated values for both nocturnal activity and avoidance behaviour from an empirical data source, which it recommended for future incorporation in CRM. It also reported that only six birds (all gull species) collided with WTGs from over 12,000 birds recorded during the two-year period, providing evidence of the precautionary nature of collision risk modelling for all species of seabirds.

308. A further review of the data from the ORJIP project was undertaken by Bowgen and Cook (2018), which analysed all the data collected across the two-year period to understand more about seabird behaviour and provide evidence to support updates to the previous avoidance rates from Cook *et al*. (2014). The findings from this study were that for gannet and kittiwake higher avoidance rates of 99.5% and 99.0%, respectively, were more appropriate. It concluded that even when applying these higher rates of avoidance, they considered that precaution remained within the estimated number of collision mortality rates.

309. The most recent empirical led study of collision risk to seabirds (AOWFL, 2023) was undertaken over two years off the coast of Aberdeen at an OWF site with 11 WTGs collecting data during the breeding and post-breeding season (covering the months of April to October 2020 and 2021). The results from this study and its overall conclusions were that it is now evident that seabirds are exposed to very low risks of collision with WTGs during daylight hours. This was also substantiated by the fact that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the two years of monitoring. Despite this study not covering the period outside of the breeding / post-breeding season, when weather conditions may be more testing for birds and may influence flight behaviour more, it is evident that current annual collision risk modelling outputs are likely to overestimate the risk to seabirds. Therefore, it is considered that the collision mortality rates estimated for seabirds within this impact assessment are likely to be overestimates during the breeding and post-breeding months and therefore base impacts on a total annual risk level that is precautionary in nature.

310. Another study on gannets by APEM Ltd during the migratory period (APEM, 2014) found that overall avoidance of WTGs was certainly higher than the SNCBs recommended rate of 98.9%. This study found that all gannets avoided the WTGs within the study area, which provided evidence that gannets may actually have an avoidance rate as high as 100% during migratory periods at least. However, the concluding recommendation from APEM's research suggested that if it was not appropriate to use a 100% avoidance rate, then a rate of 99.5% for the autumn migration will still offer suitable precaution in collision estimates. This indicates that when estimating gannet collision mortality rates, the use of an avoidance rate of 98.9% is understood to overestimate the risk to this species, as noted by Cook *et al*., (2014), who acknowledged that precaution remained within the avoidance rates put forward for gannets and gull species.

311. Therefore, it is considered that the CRM input parameters used in the assessment of collision risk to seabirds for White Cross and those from other developments at the cumulative level incorporate a high degree of precaution.

13.8.2.2 Summary of assessment confidence levels

312. With respect to operation and maintenance phase collision risk assessments, confidence in assessment conclusions is considered high. This is due to collision risk being modelled following Natural England's best practice guidance (Parker et al., 2022), the details of which are presented within **Appendix 13.C: Revised Collision Risk Modelling**. When consideration is provided to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**) and the additional evidence above indicating the precautionary nature of Natural England's current recommended approach, it indicates that the SNCB's preferred methods are likely to overestimate the magnitude of the potential impact and significance of effect. Therefore, the overall outcome of this assessment is still considered highly precautionary, as such, the assessment is considered robust.

13.8.2.3 Results

313. The monthly collision rates and total annual collisions for all species assessed is shown in **Table 13.38** below.

Table 13.38 Summary of CRM results.

Month	Gannet	Kittiwake	Herring gull	Lesser black-backed gull	Great black-backed gull
January	0.00 - 0.00	8.67 - 11.09	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
February	0.00 - 0.00	1.90 - 2.39	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
March	0.81 - 0.91	4.17 - 4.96	0.00 - 0.00	0.00 - 0.00	0.29 - 0.34
April	0.48 - 0.53	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
May	0.51 - 0.53	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
June	0.53 - 0.55	0.26 - 0.28	0.00 - 0.00	0.00 - 0.00	0.32 - 0.36
July	0.49 - 0.51	0.00 - 0.00	0.00 - 0.00	0.25 - 0.30	0.00 - 0.00
August	1.17 - 1.23	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
September	0.44 - 0.46	0.41 - 0.48	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
October	1.69 - 1.83	0.22 - 0.27	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
November	0.00 - 0.00	0.73 - 0.94	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
December	0.00 - 0.00	0.78 – 1.06	0.21 - 0.28	0.00 - 0.00	0.00 - 0.00
Annual total	6.1 - 6.5	17.1 - 21.5	0.2 - 0.3	0.3 - 0.3	0.6 - 0.7

13.8.2.4 Kittiwake

13.8.2.4.1 Potential magnitude of impact

314. The monthly estimated mortality rates are presented in **Table 13.39,** which vary from a minimum of less than one individual for eight months to a maximum of approximately 11 individuals in January. On an annual basis, the estimated mortality rate for collision risk from White Cross is approximately 22 (21.5) individuals, which is further broken down into relevant bio-seasons in **Table 13.39**.

Table 13.39 Kittiwake bio-season collision estimates and increase in baseline mortality

Bio-season (months)	Mean collisions	Regional baseline populations and baseline mortality rates (individuals per annum)		Increase in baseline mortality (%)
		Population	Baseline mortality	
Return migration (Jan–Feb)	10.58 – 13.48	691,526	108,570	0.010 – 0.012
Breeding (Mar–Aug)	4.43 – 5.24	639,762	100,443	0.004 – 0.005
Post-breeding migration (Sep–Dec)	2.14 – 2.75	911,586	143,119	0.001 – 0.002
Annual (BDMPS)	17.14 – 21.46	911,586	143,119	0.012 – 0.015
Annual (Biogeographic)	17.14 – 21.46	5,100,000	800,700	0.002 – 0.003

315.

316. During the return migration bio-season, 13 (13.5) kittiwakes may be subject to mortality. During the return migration bio-season, the BDMPS population is 691,526 kittiwakes (**Table 13.21**). When the average baseline mortality rate of 0.157 (**Table 13.22**) is applied, the natural predicted mortality in the return migration bio-season is 108,570 individuals per annum. The addition of 13 predicted mortalities would increase the mortality relative to the baseline mortality by 0.012%.

317. This level of potential change is considered to be an impact of **negligible magnitude during the return-migration bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

318. During the breeding bio-season, five (5.2) kittiwakes may be subject to mortality. During the breeding bio-season, the BDMPS population is 639,762 kittiwakes (**Table 13.21**). When the average baseline mortality rate of 0.157 (**Table 13.22**) is

applied, the natural predicted mortality in the breeding bio-season is 100,443 individuals per annum. The addition of five predicted mortalities would increase the mortality relative to the baseline mortality by 0.005%.

319. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season** as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

320. During the post-breeding migration bio-season, three (2.8) kittiwakes may be subject to mortality. During the post-breeding migration bio-season, the BDMPS population is 911,586 kittiwakes (**Table 13.21**). When the average baseline mortality rate of 0.157 (**Table 13.22**) is applied, the natural predicted mortality in the post-breeding migration bio-season is 143,119 individuals per annum. The addition of three predicted mortalities would increase the mortality relative to the baseline mortality by 0.002%.

321. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season** represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

322. The annual total of kittiwakes subject to mortality due to collision is estimated to be 21 (21.5) individuals. Using the largest BDMPS population of 911,586 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.157 (**Table 13.22**), the natural predicted mortality is 143,119 individuals per annum. The addition of 21 predicted mortalities would increase the baseline mortality by 0.015%. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 5,100,000 (**Table 13.21**) across all seasons is 800,700 individuals per annum. On a biogeographic scale, the addition of 21 predicted mortalities would increase baseline mortality by 0.003%.

323. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.4.2Sensitivity of the receptor

324. As this receptor is a notified feature of a variety of designated sites (SPAs, Ramsar sites, SSSIs) to have potential connectivity to White Cross, and is red listed in BoCC5 (Stantbury *et al.*, 2021), this receptor is afforded a conservation value of medium to reflect that. With respect to behavioural sensitivity to collision, it is considered to be high (**Table 13.15**). As it is of high behavioural sensitivity, and it is of

conservation value this leads to an overall sensitivity of this receptor to collision risk of **medium**.

13.8.2.4.3 Significance of effect

325. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on kittiwakes has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by only approximately 0.01% per annum at the BDMPS level then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.5 Great black-backed gull

13.8.2.5.1 Potential magnitude of impact

326. The monthly estimated mortality rates are presented in **Table 13.40** which are all less than one individual. On an annual basis, the estimated mortality rate for collision risk from White Cross is less than one (0.7) individual, which is further broken down into relevant bio-seasons in **Table 13.40** below.

Table 13.40 Great black-backed gull bio-season collision estimates and increase in baseline mortality

Bio-season (months)	Mean collisions	Regional baseline populations and baseline mortality rates (individuals per annum)		Increase in baseline mortality (%)
		Population	Baseline mortality	
Breeding (March-Aug)	0.61 – 0.70	23,071	2,146	0.028 – 0.033
Non-breeding (Sep-Feb)	0.00	17,742	1,650	0.000
Annual (BDMPS)	0.61 – 0.70	17,742	1,650	0.037 – 0.042
Annual (Biogeographic)	0.61 – 0.70	235,000	21,855	0.003

327. During the breeding bio-season, less than one (0.7) great black-backed gull may be subject to mortality. During the breeding bio-season, the BDMPS population is 23,071 great black-backed gulls (**Table 13.21**). When the average baseline mortality rate of 0.093 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 2,146 individuals per annum. The addition of less than a

single predicted mortality would increase the mortality relative to the baseline mortality by 0.033%.

328. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents no discernible change to baseline mortality.

329. During the non-breeding bio-season, no great black-gulls were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the non-breeding bio-season**.

330. The annual total of great black-backed gulls subject to mortality due to collision is estimated to be less than one (0.7) individual. Using the largest BDMPS population of 17,742 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.093 (**Table 13.22**), the natural predicted mortality is 1,650 individuals per annum. The addition of less than a single predicted mortality would increase the baseline mortality by 0.042% when considering the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 235,000 (**Table 13.21**) across all seasons is 21,855 individuals per annum. On a biogeographic scale, the addition of less than a single predicted mortality would increase baseline mortality by 0.003%.

331. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.5.2Sensitivity of the receptor

332. As this receptor is not connected with a significant number of designated sites within the UK Western Waters BDMPS or wider bio-geographic population scales, but is Red listed in BoCC5 (Stantbury *et al.*, 2021), this receptor is afforded a conservation value of low. With respect to behavioural sensitivity to collision, it is considered high (**Table 13.15**). Whilst it may be of high behavioural sensitivity, it is only of low conservation value leading to an overall sensitivity of this receptor to collision risk of **medium**.

13.8.2.5.3Significance of effect

333. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on great black-backed gulls has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited

to under a single individual mortality per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.6 Herring gull

13.8.2.6.1 Potential magnitude of impact

334. The monthly estimated mortality rates are presented in **Table 13.41** which are all less than one individual. On an annual basis, the estimated mortality rate for collision risk from the Offshore Project is less than one (0.3) individual, which is further broken down into relevant bio-seasons in **Table 13.41** below.

Table 13.41 Herring gull bio-season collision estimates and increase in baseline mortality

Bio-season (months)	Mean collisions	Regional baseline populations and baseline mortality rates (individuals per annum)		Increase in baseline mortality (%)
		Population	Baseline mortality	
Breeding (March-Aug)	0.00	201,629	34,680	0.000
Non-breeding (Sep-Feb)	0.21 – 0.28	173,299	29,807	0.001
Annual (BDMPS)	0.21 – 0.28	173,299	29,807	0.001
Annual (Biogeographic)	0.21 – 0.28	1,098,000	188,856	<0.001

335. During the breeding bio-season, no herring gulls were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the breeding bio-season**.

336. During the non-breeding bio-season, less than one (0.3) herring gull may be subject to mortality. During the non-breeding bio-season, the BDMPS population is 173,299 herring gulls (**Table 13.21**). When the average baseline mortality rate of 0.172 (**Table 13.22**) is applied, the natural predicted mortality in the non-breeding bio-season is 29,807 individuals per annum. The addition of less than a single predicted mortality would increase mortality relative to the baseline mortality by 0.001%.

337. This level of potential change is considered to be an impact of **negligible magnitude during the non-breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

338. The annual total of herring gulls subject to mortality due to collision is estimated to be less than one (0.3) individual. Using the largest BDMPS population of 173,299 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average

baseline mortality rate of 0.172 (**Table 13.22**), the natural predicted mortality is 29,807 individuals per annum. The addition of less than a single predicted mortality would increase the baseline mortality by 0.001% when considering the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,098,000 (**Table 13.21**) across all seasons is 188,856 individuals per annum. On a biogeographic scale, the addition of less than a single predicted mortality would increase baseline mortality by <0.001%.

339. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.6.2 Sensitivity of the receptor

340. As this receptor is not connected with a significant number of designated sites within the UK Western Waters BDMPS or wider bio-geographic population scales, but is Red listed in BoCC5 (Stantbury *et al.*, 2021), this receptor is afforded a conservation value of low. With respect to behavioural sensitivity to collision, it is considered high (**Table 13.15**). Whilst it may be of high behavioural sensitivity, it is only of low conservation value leading to an overall sensitivity of this receptor to collision risk of **medium**.

13.8.2.6.3 Significance of effect

341. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on herring gulls has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to well under a single mortality per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.7 Lesser black-backed gull

13.8.2.7.1 Potential magnitude of impact

342. The monthly estimated mortality rates are presented in **Table 13.42** which are all less than one individual. On an annual basis, the estimated mortality rate for collision risk from the Offshore Project is less than one (0.3) individual, which is further broken down into relevant bio-seasons in **Table 13.42** below.

Table 13.42 Lesser black-backed gull bio-season collision estimates and increase in baseline mortality

Bio-season (months)	Mean collisions	Regional baseline populations and baseline mortality rates (individuals per annum)		Increase in baseline mortality (%)
		Population	Baseline mortality	
Return migration (Mar)	0.00	163,304	20,250	0.000
Breeding (Apr-Aug)	0.25 – 0.30	163,177	20,234	0.001
Post-breeding migration (Sep-Oct)	0.00	163,304	20,250	0.000
Winter (Nov-Feb)	0.00	41,159	5,104	0.000
Annual (BDMPS)	0.25 – 0.30	163,304	20,250	0.001
Annual (Biogeographic)	0.25 – 0.30	864,000	107,136	<0.001

343. During the return migration bio-season, no lesser black-backed gulls were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the return migration bio-season**.

344. During the breeding bio-season, less than one (0.30) lesser black-backed gull may be subject to mortality. During the breeding bio-season, the BDMPS population is 163,177 lesser black-backed gulls (**Table 13.21**). When the average baseline mortality rate of 0.124 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 20,234 individuals per annum. The addition of less than a single predicted mortality would increase the mortality relative to the baseline mortality by 0.001%.

345. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

346. During the post-breeding migration bio-season, no lesser black-backed gulls were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the post-breeding migration bio-season**.

347. During the migration-free winter bio-season, no lesser black-backed gulls were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the migration-free winter bio-season**.

348. The annual total of lesser black-backed gulls subject to mortality due to collision is estimated to be less than one (0.3) individual. Using the largest BDMPS population of 163,304 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.124 (**Table 13.22**), the natural predicted mortality is 20,250 individuals per annum. The addition of less than a single predicted mortality would increase the baseline mortality by 0.001% when considering the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 864,000 (**Table 13.21**) across all seasons is 107,136 individuals per annum. On a biogeographic scale, the addition of less than a single predicted mortality would increase baseline mortality by <0.001%.

349. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.7.2Sensitivity of the receptor

350. As this receptor is not connected with a significant number of designated sites within the UK Western Waters BDMPS or wider bio-geographic population scales, but is Red listed in BoCC5 (Stantbury *et al*., 2021), this receptor is afforded a conservation value of low. With respect to behavioural sensitivity to collision, it is considered high (**Table 13.15**). Whilst it may be of high behavioural sensitivity, it is only of low conservation value leading to an overall sensitivity of this receptor to collision risk of **medium**.

13.8.2.7.3Significance of effect

351. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on less black-backed gulls has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to well under a single mortality per annum then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.8 Gannet

13.8.2.8.1 Potential magnitude of impact

352. The monthly estimated mortality rates are presented in **Table 13.43** which vary from a minimum of less than one individual in all months apart from August and October where a maximum of approximately two (1.8) individuals in October is reached. On an annual basis, the estimated mortality rate for collision risk from White Cross is approximately seven (6.5) individuals, which is further broken down into relevant bio-seasons in **Table 13.43** below.

Table 13.43 Gannet bio-season collision estimates and increase in baseline mortality

Bio-season (months)	Mean collisions	Regional baseline populations and baseline mortality rates (individuals per annum)		Increase in baseline mortality (%)
		Population	Baseline mortality	
Return migration (December - February)	0.00	661,888	124,435	0.000
Breeding (March - September)	4.43 – 4.72	720,931	135,535	0.003
Post-breeding migration (October - November)	1.69 – 1.83	545,954	102,639	0.002
Annual (BDMPS)	6.12 – 6.55	661,888	124,435	0.005
Annual (Biogeographic)	6.12 – 6.55	1,180,000	221,840	0.003

353. During the return migration bio-season, no gannets were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the return migration bio-season**.

354. During the breeding bio-season, five (4.7) gannets may be subject to mortality. During the breeding bio-season, the BDMPS population is 720,931 gannets (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 135,535 individuals per annum. The addition of five predicted mortalities would increase the mortality relative to the baseline mortality by 0.003%.

355. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

356. During the post-breeding migration bio-season, two (1.8) gannets may be subject to mortality. During the post-breeding migration bio-season, the BDMPS population is 545,954 gannets (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the post-breeding migration bio-season is 102,639 individuals per annum. The addition of two predicted mortalities would increase the mortality relative to the baseline mortality by 0.002%.

357. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding migration bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

358. The annual total of gannets subject to mortality due to collision is estimated to be seven (6.55) individuals. Using the largest BDMPS population of 661,888 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality is 124,435 individuals per annum. The addition of seven predicted mortalities would increase the baseline mortality by 0.005% when considering the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,180,000 (**Table 13.21**) across all seasons is 221,840 individuals per annum. On a biogeographic scale, the addition of seven predicted mortalities would increase baseline mortality by 0.003%.

359. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.8.2Sensitivity of the receptor

360. As detailed in **Section 13.7.1**, this receptor is classified as high conservation value. With respect to behavioural sensitivity to collision, it is considered to be medium (**Table 13.15**), in line with the most recent evidence that gannets have a strong aversion to OWFs. As gannets are now considered less likely to enter OWFs areas in general (see below section on inclusion of macro-avoidance below and the introduction to **Section 13.9.2**) due to this behavioural trait then their overall sensitivity is determined to be **medium** to reflect that.

13.8.2.8.3 Significance of effect

361. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on gannets has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by well under 0.01% per annum at the BDMPS level then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.9 Gannet – macro avoidance

13.8.2.9.1 Potential magnitude of impact

362. An additional assessment for gannet has been undertaken which includes consideration of macro avoidance. In addition to the above collision risk estimates for gannet, the applicant has also assessed collision risk using the 70% displacement of birds (the average of the 60 and 80% used in assessments), with values presented in **Table 13.44**.

Table 13.44 Gannet bio-season collision estimates (with macro-avoidance) and increase in baseline mortality

Bio-season (months)	**Mean collisions**	**Regional baseline populations and baseline mortality rates (individuals per annum)**		**Increase in baseline mortality (%)**
		Population	Baseline mortality	
Return migration (December - February)	0.00	661,888	124,435	0.000
Breeding (March - September)	1.33 – 1.42	720,931	135,535	0.001
Post-breeding migration (October - November)	0.51 – 0.55	545,954	102,639	0.000 – 0.001
Annual (BDMPS)	1.84 – 1.96	661,888	124,435	0.001 – 0.002
Annual (Biogeographic)	1.84 – 1.96	1,180,000	221,840	0.001

363. During the return migration bio-season, no gannets were predicted to suffer mortality with respect to collision risk. This level of potential change is therefore considered to be of **no impact during the return migration bio-season**.

364. During the breeding bio-season, one (1.42) gannet may be subject to mortality. During the breeding bio-season, the BDMPS population is 720,931 gannets (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the breeding bio-season is 135,535 individuals per annum. The addition of five predicted mortalities would increase the mortality relative to the baseline mortality by 0.001%.

365. This level of potential change is considered to be an impact of **negligible magnitude during the breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

366. During the post-breeding migration bio-season, less than one (0.55) gannet may be subject to mortality. During the post-breeding migration bio-season, the BDMPS population is 545,954 gannets (**Table 13.21**). When the average baseline mortality rate of 0.188 (**Table 13.22**) is applied, the natural predicted mortality in the post-breeding migration bio-season is 102,639 individuals per annum. The addition of two predicted mortalities would increase the mortality relative to the baseline mortality by 0.001%.

367. This level of potential change is considered to be an impact of **negligible magnitude during the post-breeding bio-season**, as it represents only a slight difference to the baseline conditions due to the small number of estimated collisions.

368. The annual total of gannets subject to mortality due to collision is estimated to be two (1.96) individuals. Using the largest BDMPS population of 661,888 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality is 124,435 individuals per annum. The addition of two predicted mortalities would increase the baseline mortality by 0.002% when considering the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,180,000 (**Table 13.21**) across all seasons is 221,840 individuals per annum. On a biogeographic scale, the addition of two predicted mortalities would increase baseline mortality by 0.001%.

369. This level of potential impact is considered to be an impact of negligible magnitude on an annual basis at both the BDMPS and bio-geographic scale.

13.8.2.9.2Sensitivity of the receptor

370. As detailed in **Paragraph 360** the overall sensitivity of this receptor to collision risk of **medium**.

13.8.2.9.3Significance of effect

371. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from collision risk on gannets has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by only approximately 0.01% per annum at the BDMPS level then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.2.10 Collision Risk Further Mitigation

372. As there is deemed to be no significant effect for the five species considered, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.8.2.11 Migratory Collision Risk

373. There is potential that seabirds, waders, passerines, raptors and wildfowl may intersect the Windfarm Site whilst undertaking annual migratory movements from breeding and wintering grounds. A strategic assessment for 27 different seabird and 38 non-seabird migratory species was undertaken in relation to migratory collision risk by WWT and MacArthur Green Ltd (2014).

374. For seabird species it was considered that based on expert opinion and known migratory behaviour, seabirds tend to migrate within coastal bands out to a maximum of 60km from the coast. The tendency for migratory seabirds to travel up to a maximum of 60km from the coast correlates with the Offshore Project site-specific survey results, as a very limited number of migratory seabirds were recorded within the Windfarm Site during migratory months. The Windfarm Site's shortest distance to shore is 52km offshore, this therefore suggests limited intersection of potential migratory corridors.

375. For wildfowl and wader species, WWT and MacArthur Green (2014) indicate that collision estimates are very small. Waterfowl and wader species migratory flights are at a high altitude and so collisions with turbines are highly unlikely. Only during unfavourable weather occurs will these species lower their flight altitude and follow coastal pointers to navigate (van de Kam *et al*, 2004).

376. The most recent project to consider and quantify the impacts of migratory collision risk in the western waters BDMPS was Awel Y Môr (AyM) OWF (APEM, 2022b). AyM is located 10.5km off the North Wales coast and is a proposed development of up

to 50 turbines. The results of AyM migratory collision risk modelling predicted an annual collision mortality value for the majority of species assessed of well under a single individual and a maximum predicted mortality of less than two individuals per annum. When considering the above predicted impacts for AyM, it can be inferred that the level of predicted impacts apportioned to migratory species from the Offshore Project would almost certainly be immaterial. This is because the Offshore Project consists of significantly fewer turbines and is located at the limit of species potential migratory corridors.

13.8.2.11.1 Magnitude of impact

377. In relation to the above evidence, it can therefore be confidently concluded that the magnitude of impact to any migratory bird species is **negligible**.

13.8.2.11.2 Significance of effect

378. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor at most regardless of the sensitivity of the receptor. An effect of minor significance is **not significant in EIA terms**.

13.8.2.12 Migratory Collision Risk Further Mitigation

379. As there is deemed to be **no significant effect**, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.8.2.13 Updates since Application

380. Since application, modelling of migratory bird movements and migratory CRM has been undertaken by the Applicant in accordance with the request from Natural England. Results of migratory modelling are presented in **Offshore Ornithology Appendix 13.B: Migratory Birds Report**.

381. Within this report, migratory seabird species were assessed using the 'broad front' approach, whilst non-seabird species were modelled using APEM Ltd's bespoke 'MIGROPATH' modelling tool in accordance with Natural England's best practice guidance (Parker *et al.* 2022). Further detail on modelling methods and species selection is provided within **Appendix 13.B: Migratory Birds Report**.

382. In relation to migratory seabird species, the modelling results predicted for any seabird species modelled, an annual predicted mortality rate of significantly less than a single individual at an EIA level. This level of predicted impact further validates the original conclusions made within the ES, that there is no significant effect from the Project on migratory seabirds with respect to collision risk.

383. In relation to migratory non – seabirds, it was concluded that significantly less than 1% of the UK population was expected to pass through the Windfarm Site. It can

therefore be confidently concluded that there is no potential for a significant effect from collision risk to non-seabirds whilst on migration, due to the limited levels of connectivity predicted. This level of predicted impact further validates the original conclusions made within the ES.

13.8.3 Impact 3: Combined operational displacement and collision risk

13.8.3.1 Gannet

384. Due to gannet being scoped in for both displacement and collision risk assessment during the O&M phase, there is a potential for these two potential impacts to adversely affect gannet populations cumulatively. Previous sections have concluded negligible predicted magnitudes of impact with respect to collision risk or displacement acting alone. However, the combined impact of both collision risk and displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required. However, it is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to consequent displacement mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment.

13.8.3.1.1Potential magnitude of impact

385. As detailed in **Table 13.36** and **Table 13.43**, following the Applicant's evidence-led assessment the combined predicted mortality in the O&M phase (displacement and collision risk) equates to between five (4.7) and six (5.6) predicted additional mortalities per annum. Using the largest BDMPS population of 661,888 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality is 124,435 individuals per annum. The addition of five to six predicted mortalities would increase baseline mortality by 0.005% of the annual BDMPS population. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,180,000 (**Table 13.21**) across all seasons is 221,840 individuals per annum. On a biogeographic scale, the addition of five to six predicted mortalities would increase baseline mortality by 0.003%. It should be noted that the impacts associated with both displacement and collision risk combined assessed in this simplistic manner are

almost certainly an overestimate, as a bird which has been displaced from the Windfarm Site can no longer collide with a turbine and vice versa.

386. This level of potential impact is considered to be an impact of **negligible magnitude on an annual basis at both BDMPS and biogeographic scales**, as it represents no discernible increase to baseline mortality levels due to the small number of estimated mortalities from both displacement and collision combined.

13.8.3.1.2Sensitivity of the receptor

387. As detailed in previous assessments for both displacement and collision risk combined for gannet, the overall sensitivity of this receptor is **medium**.

13.8.3.1.3Significance of effect

388. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from disturbance and displacement combined with collision risk on gannets has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level increases the baseline mortality by under 0.01% per annum at the BDMPS level then the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.8.3.2 Summary of assessment confidence levels

389. As summarised in **Section 13.8.1** and **13.8.2,** with respect to operation and maintenance phase collision risk and disturbance and displacement assessments, confidence in assessment conclusions is considered high. It can therefore be concluded that confidence levels of assessment conclusions for both impacts combined is high. This is especially true when considering the highly precautionary nature of combining both impacts in an additive manner as explained above, is likely to overestimate the magnitude of the potential impact and significance of effect. Therefore, the overall outcome of this assessment is considered highly precautionary, as such, the assessment is considered robust.

13.8.4 Impact 4: Entanglement

390. There is a risk to diving seabirds of becoming entangled in submerged ropes, chains and cables whilst foraging underwater. This risk can be split into "primary entanglement" in which the bird becomes entangled in ropes, chains and cables deployed as part of the Offshore Project, and also "secondary entanglement", in which the bird becomes entangled in drifting debris (primarily fishing gear) that has

become snagged on infrastructure associated with the Offshore Project. If seabirds become entangled, it is likely to lead to injury and death.

391. The ornithological features considered to be at risk from entanglement are those diving seabirds established to be present in the Offshore Project Site (see **Section 13.3.9**); namely gannet, guillemot, razorbill, puffin and Manx shearwater.

13.8.4.1 Magnitude of impact

392. There is significant evidence that offshore infrastructure can act as "fish aggregating devices" (Castro, 2002). Fish may be attracted to offshore infrastructure. Offshore infrastructure also provides a substrate that is colonised by seaweed and other marine organisms (biofouling) which provides further suitable habitat. If fish are attracted to the Offshore Project, this could draw in foraging seabirds and increase the risk of entanglement.

393. However, the strong evidence is that contrary to being attracted to OWFs, all ornithological features at risk tend to avoid the Windfarm Sites of OWFs i.e. displacement (see **Section 13.8.1**).

394. The risk from primary entanglement is deemed to be very low, because the diameter, weight and tension of mooring lines and cables associated with floating windfarms means they are physically unlikely to entangle seabirds (SEER, 2022).

395. Secondary entanglement is the more likely pathway, as drifting fishing gear has characteristics that make entanglement more likely. Currently, however, there is very little evidence that secondary entanglement of seabirds occurs with any frequency (SEER, 2022). If secondary entanglement was a high risk to seabirds, it is expected that it would have been detected and reported in relation to other offshore deployments including oil and gas platforms (Benjamins *et al.*, 2014).

396. Furthermore, it is expected that the operation and maintenance schedule for the Offshore Project will include measures to detect and remove accumulations of debris, as is standard practice for floating offshore windfarms (Kincardine Offshore Windfarm, 2016; Pentland floating offshore wind farm, 2022). This will further reduce the risk of entanglement.

397. Therefore, the overall magnitude of impact is deemed to be **negligible**.

13.8.4.2 Sensitivity of the receptor

398. For all ornithological features considered, it is assumed that entanglement would be potentially fatal for the individual concerned. The sensitivity to entanglement is likely to depend on both behavioural characteristics, sensory characteristics, and physical

characteristics, all of which may influence the probability of encountering debris and subsequently becoming entangled in it (Benjamins *et al.*, 2014). Using the framework Benjamins *et al.* (2014) developed for marine megafauna would appear to suggest the ornithological features are less sensitive to entanglement due to their small size, relatively flexible bodies, good underwater vision, and pursuit hunting mode of foraging.

399. Therefore, on a precautionary basis, the sensitivity of all receptors has been categorised as **medium**.

13.8.4.3 Significance of effect

400. Given a negligible magnitude of impact and medium sensitivity for all receptors, the significance of the effect is concluded to be minor adverse for all receptors, which is **not significant in EIA terms**.

13.8.4.4 Summary of assessment confidence levels

401. With respect to operation and maintenance phase entanglement assessment, confidence in assessment conclusions is considered high. This is primarily due to the evidence stated above suggesting limited potential for such an impact to occur, combined with the Offshore Project embedded mitigation to remove any accumulation of debris on mooring lines. Therefore, the assessment of this potential effect on offshore ornithology receptors is robust. In addition, though difficult to measure, no substantial mortalities have been cited due to this impact pathway at other OWFs.

13.8.4.5 Entanglement Further Mitigation

402. As there is deemed to be **no significant effect**, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.8.5 Impact 5: Barrier Effects

403. In the operational phase, the presence of WTGs could create a barrier to the movements of birds. This may result in permanent changes in flight routes for the birds concerned and an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for the individuals affected.

404. This could affect both migrating birds and resident birds foraging in the region.

13.8.5.1 Magnitude of impact

405. The location, shape and size of the Offshore Project mean the risk of a barrier effect to migrating birds is low. The Offshore Project is not located in a major flyway for non-seabirds (Wright *et al*., 2012; Wernham *et al*., 2002) and most migratory seabirds tend to follow the coast more closely (Forrester *et al*. 2007; WWT, 2014).

406. The worst-case scenario would be for a bird to reach the edge of the site and follow the perimeter around until resuming its original flight path, which would require a maximum deviation of approximately 10km. Furthermore, migratory birds that do avoid the OWF are able to alter their flight path to a lesser degree, for example adjusting their course earlier on and then correcting to reach the desired endpoint, rather than following the perimeter exactly. For migrating birds, this is a negligible distance as the increase in energy demand is minor and will be insignificant compared to unsuitable wind conditions (Masden *et al*., 2010).

407. Most migratory non-seabirds fly at heights well above the maximum turbine blade height (Alerstam, 1990) and therefore are likely to fly over the OWF, rather than around it.

408. The magnitude of change will therefore be, at most, negligible to all migrating birds.

409. Risk from a barrier effect can be more significant for resident seabirds on daily trips during the breeding season, commuting between breeding colonies and feeding locations. The additional exertion required to avoid the Offshore Project on a daily basis can accumulate into a more significant overall impact than a one-off impact as per migratory birds.

410. However, the location, shape and small size of the Offshore Project mean the risk of a barrier effect to commuting birds is low. Tracking studies show that while the Offshore Project Site is occasionally overflown by foraging birds from nearby colonies, there is no clear flyway that the Offshore Project Site would obstruct (Guilford *et al*., 2008; Dean *et al*., 2010; Cox *et al*., 2016).

411. The worst-case scenario would be for a bird to reach the edge of the site and follow the perimeter around until resuming its original flight path, which would require a maximum deviation of approximately 10km. However, commuting birds could alter their flight path to a lesser degree, for example adjusting their course earlier on and then correcting to reach the desired endpoint, rather than following the perimeter exactly. There is also evidence that birds learn and adapt their route to foraging sites, and therefore after first encountering the Offshore Project would subsequently alter their route to minimise any deviation required (Grecian *et al*., 2018).

412. For the purposes of assessment, however, it is usually not possible to distinguish between displacement and barrier effects. Therefore, it should be noted that the effects of displacement from the Windfarm Site during the operational phase of the Offshore Project encapsulate potential barrier effects for the receptors considered, due to the inclusion of flying and sitting birds (all behaviours) within the assessment of displacement, as recommended in joint SNCB's guidance (Parker *et al.*, 2022).

413. Therefore, it is concluded that the magnitude of impact from a barrier effect on breeding seabirds would be **negligible** at most (see **Section 13.8.1**).

13.8.5.2 Significance of effect

414. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor adverse at most regardless of the sensitivity of the receptor, which is **not significant in EIA terms**.

13.8.5.3 Summary of assessment confidence levels

415. With respect to operation and maintenance phase barrier effects, confidence in assessment conclusions is considered high. This is because the disturbance and displacement assessment (**Section 13.8.1**) undertaken currently accounts for consideration of barrier effects, as recommended in Natural England best practice guidance (Parker et al., 2022). A confidence level of high is further compounded due to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**). Therefore, the assessment of this potential effect on offshore ornithology receptors is robust.

13.8.5.4 Barrier Effects Further Mitigation

416. As there is deemed to be no significant effect, no further mitigation is required other than that already incorporated into the Offshore Project design.

13.8.6 Impact 6: Indirect impacts due to impacts on prey species: Windfarm Site

417. Indirect effects on offshore ornithology receptors may occur during the operational phase of the Offshore Project (along with any required maintenance works) if there are impacts on prey species. Such effects could result from the generation of suspended sediments (e.g. by the scouring effects of the catenary action of the mooring lines and around the foundations of the mooring anchors) and the production of underwater noise (e.g. as a result of vessel activity and operational turbines).

418. These impact pathways may cause injury or mortality to, or alter the behaviour or availability of, prey species. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the operation and maintenance area and may smother key life stages of sandeels / other key fish and hide immobile benthic prey. These mechanisms could potentially result in reduced prey availability in areas adjacent operational floating wind sites to seabird foraging areas. This may result in disturbance and displacement effects, effectively reducing habitat availability for foraging and other activities. Any form of indirect effect (including reductions in prey and habitat availability) may cause reduced survival or reproductive fitness of the species deemed at risk. The maximum impact on ornithological receptors will result from the maximum impact on fish and benthic organisms.

419. These potential indirect impacts may occur during the operational phase of the Offshore Project. Potential impacts are likely to occur within or immediately next to the Windfarm Site footprint, the offshore export cable corridor and areas of intertidal landfall through effects on benthic habitat and prey species. Such potential effects on benthic invertebrates and fish have been assessed in **Chapter 10: Benthic and Intertidal Ecology** and **Chapter 11: Fish and Shellfish Ecology** and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

420. With regard to changes to the seabed and to suspended sediment levels, **Chapter 8: Marine and Physical Processes, Chapter 9: Marine Water and Sediment Quality and Chapter 10: Benthic and Intertidal Ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to be low or negligible in magnitude and are anticipated to result in changes of minor adverse significance at most (see **Chapter 10: Benthic and Intertidal Ecology**, summarised in Section 10.11 and Table 10.26). The consequent indirect impact on fish through habitat loss is considered to be low in magnitude (see **Chapter 11: Fish and Shellfish Ecology**, summarised in Section 11.12 and Table 11.33) for species such as herring, sprat and sandeel, which are the main prey items of seabirds such as Manx shearwater, kittiwake, gannet and auks. With a minor or negligible impact on fish that are bird prey species, it is concluded that the magnitude of indirect impacts would also be on seabirds negligible adverse at most. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor adverse effect at most regardless of the sensitivity of the receptor, which is not significant in EIA terms.

13.8.6.1 Summary of assessment confidence levels

421. With respect to operation and maintenance phase indirect effects within the Windfarm Site, confidence in assessment conclusions is considered high. This is primarily because the other chapters of the assessment have used the best available evidence, and best practice methodologies, in assessing potential impacts and drawing conclusions. Therefore, the assessment of these potential effects on offshore ornithology receptors is robust. In addition, though difficult to measure, no substantial effects have been recorded due to these impact pathways at other OWFs.

13.8.7 Impact 7: Indirect impacts due to impacts on prey species: Offshore Export Cable Corridor

422. During the operational phase of the Offshore Export Cable Corridor, there is the potential for indirect effects on offshore ornithology arising from impacts on prey species affecting their availability. Original loss of seabed habitats may reduce prey availability. Furthermore, temporary seabed disturbance resulting from offshore export cable repairs may release sediment into the water column, causing fish and mobile invertebrates to avoid the Windfarm Site. Suspended sediment may also smother and hide immobile benthic prey. Increased suspended sediment would also make it harder for seabirds to see their prey in the water column. These mechanisms may result in less prey being available within the Offshore Export Cable Corridor to foraging seabirds.

423. However, the total area of Temporary habitat loss / physical disturbance within the Offshore Export Cable Corridor is predicted to be a maximum of 4,680,000m^2. The total area of seabed affected by remediation events over the 25-year operational lifespan of the Offshore Project is 1,500,000m^2. Therefore, both original habitat loss for prey species and temporary increases in suspended sediment will be small in extent. As no significant effects were identified to potential prey species (fish, shellfish or benthos) or on the habitats that support them in **Chapter 10: Benthic and Intertidal Ecology** and **Chapter 11: Fish and Shellfish Ecology**, then there is **no potential for any indirect effects of an adverse significance to occur on offshore ornithology receptors.**

13.8.7.1 Summary of assessment confidence levels

424. With respect to operation and maintenance phase indirect effects within the ECC, confidence in assessment conclusions is considered high. This is primarily because the other chapters of the assessment have used the best available evidence, and best practice methodologies, in assessing potential impacts and drawing

conclusions. Therefore, the assessment of these potential effects on offshore ornithology receptors is robust. In addition, though difficult to measure, no substantial effects have been recorded due to these impact pathways at other OWFs.

13.9 Potential impacts during decommissioning

425. No decision has been made regarding the final decommissioning policy for the Offshore Project as it is recognised that industry best practice, rules and legislation change over time. The decommissioning methodology would be finalised nearer to the end of the lifetime of the Offshore Project to be in line with current guidance, policy and legalisation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works are likely to be subject to a separate licencing and consenting approach.

426. The anticipated decommissioning activities are outlined in **Section 5.10** of **Chapter 5: Project Description**. The potential impacts of the decommissioning of the Offshore Project have been assessed for offshore ornithology on the assumption that decommissioning methods will be similar or of a lesser scale than those deployed for construction.

427. The impacts of the offshore decommissioning of White Cross have been assessed for offshore ornithology features. The potential environmental impacts arising from the decommissioning of White Cross are listed in **Table 13.6**. The worst-case scenario against which each decommissioning phase impact has been assessed is presented in **Table 13.3**.

13.9.1 Summary of assessment confidence levels

428. With respect to potential impact assessments during the decommissioning phase, the confidence in this prediction is high. This is primarily because consideration of impact levels during the decommissioning phase are based on those concluded within the construction phase, which is considered to be equal to or less than the worst-case scenario for the decommissioning phase. Therefore, decommissioning phase assessments can be considered precautionary and robust.

13.9.2 Impact 1: Disturbance and displacement: Windfarm Site

429. Decommissioning activities within the Windfarm Site associated with foundations and WTGs may lead to disturbance and displacement of species within the Windfarm Site and different degrees of buffers surrounding it.

430. The worst case scenario for decommissioning activities within the Windfarm Site is equal to or less than the worst case scenario for the construction phase within the Windfarm Site (**Table 13.3**). Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations), or left buried (e.g. in the case of subsea cables). This may reduce the amount of vessel activity required.

431. As potential effects from disturbance and displacement within the construction phase were deemed to be not significant (see **Section 13.7.1**), **no significant effects** are expected within the decommissioning phase.

13.9.3 Impact 2: Disturbance and displacement: Offshore Export Cable Corridor

432. Decommissioning activities within the Offshore Export Cable Corridor associated with decommissioning the export cable may lead to disturbance and displacement of species within the offshore export cable corridor and different degrees of buffers surrounding it.

433. Therefore, the impacts are likely to be similar. The worst case scenario for decommissioning activities within the Windfarm Site is equal to or less than the worst case scenario for the construction phase within the Windfarm Site (**Table 13.3**). Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations), or left buried (e.g. in the case of subsea cables). This may reduce the amount of vessel activity required.

434. As described in **Section 13.7.1** and **Section 13.7.2**, potential effects of disturbance and displacement within the construction phase were deemed to be not significant, therefore **no significant effects** are expected within the decommissioning phase either.

13.9.4 Impact 3: Barrier Effects

435. In the decommissioning phase, the presence of decommissioning activities and WTGs (prior to being removed) could create a barrier to the movements of birds. This may result in permanent changes in flight routes for the birds concerned and

an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for the individuals affected. This could affect both migrating birds and resident birds foraging in the region.

436. The worst-case scenario for decommissioning activities within the Windfarm Site is equal to or less than the worst case scenario for the construction phase within the Windfarm Site (**Section 13.7.3**). Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations), or left buried (e.g. in the case of subsea cables). This may reduce the amount of vessel activity required.

437. As potential effects from a barrier effect within the construction phase were deemed to be not significant (see **Section 13.7.3**), **no significant effects** are expected within the decommissioning phase either.

13.9.5 Impact 3: Indirect impacts due to impacts on prey

438. Indirect impacts during the decommissioning phase are likely to be predominantly from benthic disturbance when removing anchors and chain that has embedded in the sediment. There will likely be increases in boat traffic and noise compared to the operational stage which will contribute to any cumulative effects.

439. Impacts, namely from the production of suspended sediments, may alter the distribution, physiology and behaviour of prey species and habitats. These mechanisms could potentially result in reduced prey availability in areas adjacent to active construction sites to seabird foraging areas. This may result in disturbance and displacement effects, effectively reducing habitat availability for foraging and other activities. Any form of indirect effect (including reductions in prey and habitat availability) may cause reduced survival or reproductive fitness of the species deemed at risk. The maximum impact on ornithological receptors will result from the maximum impact on benthic habitat and prey species when infrastructure is removed.

440. Such potential effects on benthic invertebrates and fish have been assessed in **Chapter 10: Benthic and Intertidal Ecology** and **Chapter 11: Fish and Shellfish Ecology** and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

441. With regard to noise impacts on fish, **Chapter 11: Fish and Shellfish Ecology** discusses the potential impacts upon fish relevant to ornithology as prey species of the Offshore Project. For species such as herring sprat and sandeel, which are the main prey items of seabirds such as Manx shearwater, kittiwake, gannet and auks, underwater noise impacts (physical injury or behavioural changes) during decommissioning phase are considered to be less than that during the construction phase and predicted to be of minor adverse significance at most. With a minor or negligible impact on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the Offshore Project during the construction phase is similarly a phase is similarly a minor or negligible adverse impact.

442. With regard to changes to the seabed and to suspended sediment levels, **Chapter 8: Marine and Physical Processes**, **Chapter 9: Marine Water and Sediment Quality** and **Chapter 10: Benthic and Intertidal Ecology** discuss the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to be negligible in magnitude and are anticipated to result in changes of negligible adverse significance (see **Chapter 10: Benthic and Intertidal Ecology**, summarised in **Section 10.11** and **Table 10.26**). The consequent indirect impact on fish through habitat loss is considered to be low in magnitude (see **Chapter 11: Fish and Shellfish Ecology**, summarised in **Section 11.12** and **Table 11.33**) for species such as herring, sprat and sandeel, which are the main prey items of seabirds such as Manx shearwater, kittiwake, gannet and auks. With a minor or negligible impact on fish that are bird prey species, it is concluded that the magnitude of indirect impacts would also be significance on seabirds occurring in or around the Offshore Project during the decommissioning phase is negligible adverse at most impact. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor adverse effect at most regardless of the sensitivity of the receptor, which is **not significant in EIA terms**.

13.10 Consideration of impacts apportioned to Lundy Island SSSI

443. As detailed with **Table 13.4**, the RSPB and MMO requested specific consideration of potential impacts from the Offshore Project on features of the Lundy Island SSSI, which exceed international importance threshold and consideration of biosecurity.

444. Lundy Island SSSI boundary is located approximately 44km from the Offshore Project area, while the seabird colony is located approximately 46km distant. The

proposed Offshore Export Cable Corridor is located approximately 3km from Lundy SSSI at its nearest point.

445. As detailed within the site description, Lundy Island is cited as supporting the following offshore ornithology features during the breeding season:

- Kittiwake with a latest colony count in 2021 of 284 Apparently Occupied Nests (AON) or 568 breeding individuals (SMP, 2023). As presented in Appendix A of Kober *et al.*, (2018) the 1% international importance threshold is cited as 66,000 individuals
- Guillemot with a latest colony count in 2021 of 13,239 breeding individuals (SMP, 2023; when considering a count of 9,880 individuals and a conversion factor of 1.34 accounted for as recommended in Birkhead, 1978; Harris 1989 for guillemot census counts). As presented in Appendix A of Kober *et al.*, (2018) the 1% international importance threshold is cited as48,000 individuals
- Razorbill with a latest colony count in 2021 of 4,734 breeding individuals (SMP, 2023; when considering a count of 3,533 individuals and a conversion factor of 1.34 accounted for as recommended in Birkhead, 1978; Harris 1989 for razorbill census counts). As presented in Appendix A of Kober *et al.*, (2018) the 1% international importance threshold is cited as 13,800 individuals
- Puffin with a latest colony count in 2021 of 848 individuals (SMP, 2023). As presented in Appendix A of Kober *et al.*, 2018 the 1% international importance threshold is cited as 20,000 individuals
- Manx shearwater with a latest colony count in 2017/2018 of 5,504 Apparently Occupied Burrows (AOB) or 11,008 breeding individuals (SMP, 2023). As presented in Appendix A of Kober *et al.*, 2018 the 1% international importance threshold is cited as 11,300 individuals.

446. With respect to the above offshore ornithological features, only Manx Shearwater is close to reaching the international species threshold, as suggested above. Therefore, only Manx shearwater feature of Lundy SSSI has been individually assessed.

447. With respect to the other offshore ornithological features, as presented within **Sections 13.7**, **13.8** and **13.9**, the magnitude of impact during the breeding season was concluded as negligible for all offshore ornithology features assessed in comparison to the regional BDMPS population in the breeding season. As described in Section 13.6, the regional BDMPS population in the breeding season consists of birds from breeding colonies within foraging range plus an estimated number of immature or non-breeding birds. Therefore, while no detailed apportionment has

been carried out, impacts will be split between the various colonies and non-breeding birds approximately in proportion to their contribution to the regional population. Therefore, it is expected that the conclusion of a magnitude of impact of negligible will apply to each individual colony, which can be concluded as not significant in EIA terms.

13.10.1 Assessment of Manx shearwater feature of Lundy SSSI

13.10.1.1 Functional linkage and seasonal apportionment of potential effects

448. As detailed within **Appendix 13.A Offshore Ornithology Technical Report**, predicted impacts from the Offshore Project have been apportioned to individual colonies based on the SNH (2018) apportionment methodology. The level of potential connectivity between the Offshore Project and the offshore ornithology features of seabird colonies may vary seasonally, therefore apportionment has been undertaken on a seasonal basis.

449. The Offshore Project is within the mean max plus one SD foraging distance of 1,346.8+1,018.7km (Woodward *et al*. 2019). As detailed in **Appendix 13.A Offshore Ornithology Technical Report** for Lundy Island SSSI, an apportionment process has been undertaken for the full breeding (April to August), post-breeding migration (September to October) and return migration (March) seasons based on Furness (2015), with the level of abundance apportioned for the Windfarm Site plus 2km buffer to Lundy Island SSSI presented in **Table 13.45**.

450. As detailed in **Section 13.8.1**, for Manx shearwater a displacement distance of the Windfarm Site plus 2km buffer has been selected and a displacement rate of 10% and a mortality rate of 1 to 10% for operational and maintenance phase impacts as recommended in the Joint SNCB interim guidance on displacement (SNCBs, 2022), with the focus of assessment being on the Applicant's position of 10% displacement rate and a 1% mortality rate, which is considered to represent a realistic worst case scenario.

451. As detailed within **Appendix 13.A Offshore Ornithology Technical Report**, an additional apportionment process has also been undertaken for the migration-free breeding (June to July), post-breeding migration (August to October) and return migration (March to May) seasons based on Furness (2015), with the level of abundance apportioned for the Windfarm Site plus 2 km buffer to Lundy SSSI presented in **Table 13.46**.

452. Further detail of how the level of impact apportioned to each colony is derived, is presented within **Appendix 13.A Offshore Ornithology Technical Report**.

Table 13.45 Manx shearwater level of abundance apportioned to Lundy Island SSSI when considering the full breeding season.

Season	Level of apportionment (%)	Apportioned Abundance (breeding individuals)
Full Breeding (Apr - Aug)	1.64	198.4
Post-breeding migration (Sep - Oct)	0.70	0.2
Return migration (Mar)	0.70	0.2

Table 13.46 Manx shearwater level of abundance apportioned to Lundy Island SSSI when considering the migration-free breeding season.

Season	Level of apportionment (%)	Apportioned Abundance (breeding individuals)
Migration-free Breeding (June-July)	1.71	52.2
Post-breeding migration (Aug-Oct)	0.70	3.5
Return migration (Mar-May)	0.70	70.1

13.10.1.2 Construction and decommissioning phase potential disturbance and displacement effects on Manx Shearwater

13.10.1.2.1 Potential magnitude of impact

453. During the construction and decommissioning phase, the potential level of impact apportioned to the SSSI seasonally is summarised in **Table 13.47** for both the Applicant's and SNCB's assumed preferred approach.

Table 13.47 Summary of Manx shearwater construction and decommissioning phase disturbance and displacement impacts apportioned to Lundy Island SSSI when considering the full breeding season.

Population Size (Breeding individuals)	**Season**	**Applicant's approach disturbance and displacement impact**		**SNCBs assumed approach disturbance and displacement impact**	
		5% Disp; 1% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)	5% Disp; 1-10% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)
Latest Count (11,008)	Full breeding	0.1	0.007	0.1 - 1.0	0.007 - 0.069
	Post-breeding migration	<0.1	<0.001	<0.1	<0.001
	Return migration	<0.1	<0.001	<0.1	<0.001
	Annual	0.1	0.007	0.1 - 1.0	0.007 - 0.069

Table 13.48 Summary of Manx shearwater construction and decommissioning phase disturbance and displacement impacts apportioned to Lundy Island SSSI when considering the migration-free breeding season.

Population Size (Breeding individuals)	**Season**	**Applicant's approach disturbance and displacement impact**		**SNCBs assumed approach disturbance and displacement impact**	
		5% Disp; 1% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)	5% Disp; 1-10% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)
Latest Count (11,008)	Full breeding	<0.1	0.002	0.0 - 0.3	0.002 - 0.018
	Post-breeding migration	<0.1	<0.001	<0.1	0.000 - 0.001
	Return migration	<0.1	0.002	0.0 - 0.4	0.002 - 0.024
	Annual	0.1	0.004	0.1 - 0.6	0.004 - 0.044

454. A potential impact of less than a single (<0.1 or 0.1) additional breeding individual is predicted as summarised **Table 13.47** or **Table 13.48** on an annual basis to the Lundy Island SSSI. Based on the most recent population of 11,008 breeding adults at Lundy SSSI, and an annual breeding adult baseline mortality rate of 0.13 (1 - 0.870, Horswill and Robinson (2015)), 1,431 breeding individuals from the SSSI population would be subject to natural mortality per annum. The predicted loss of less than a single additional breeding individual suffering displacement consequent mortality would represent a 0.007% or 0.004% increase in baseline mortality rate annually, respectively.

455. This level of potential change per annum is considered to be an impact of **negligible magnitude**, as it represents no discernible difference to the baseline conditions.

13.10.1.2.2 Sensitivity of the receptor

456. When considering the assessment methodology detailed in **Section 13.3.8**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

13.10.1.2.3 Significance of effect

457. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from construction and decommissioning disturbance and displacement on Manx shearwaters has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to well under a single individual mortality per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

13.10.1.3 Summary of assessment confidence levels

458. With respect to assessment of impacts apportioned to Lundy SSSI Manx shearwater's, confidence in assessment conclusions is considered high. This is due to the displacement and mortality rates provided follow both the Applicant's approach and the SNCB's assumed preferred methods. When consideration is provided to the high level of confidence in the baseline data (**Appendix 13.A: Offshore Ornithology Technical Report**) and additional evidence in support of the Applicant's approach (**Section 13.8.1**) it indicates that the SNCB's preferred methods are likely to overestimate the magnitude of the potential impact and significance of effect. Therefore, the overall outcome of this assessment is still

considered precautionary when following the Applicant's approach and, as such, the assessment is considered robust.

13.10.1.4 Operational and maintenance phase potential disturbance and displacement effects on the qualifying feature in isolation

13.10.1.4.1 Potential magnitude of impact

459. During the operation and maintenance phase the potential level of impact apportioned to the SSSI seasonally is summarised in **Table 13.49** and **Table 13.50** for both the Applicant's and SNCB's presumed preferred approach.

460. Displacement matrices are also presented for the annual apportioned abundance for the Windfarm Site plus 2km buffer to Lundy Island SSSI when considering the full breeding season and the migration-free breeding season (**Table 13.51** and **Table 13.52**).

Table 13.49 Summary of Manx shearwater operation and maintenance phase disturbance and displacement impacts apportioned to Lundy Island SSSI when considering the full breeding season.

Population Size (Breeding individuals)	**Season**	**Applicant's approach disturbance and displacement impact**		**SNCBs assumed approach disturbance and displacement impact**	
		10% Disp; 1% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)	10% Disp; 1-10% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)
Latest Count (10,008)	Full breeding	0.2	0.014	0.2 - 2.0	0.014 - 0.139
	Post-breeding migration	<0.1	<0.001	<0.1	<0.001
	Return migration	<0.1	<0.001	<0.1	<0.001
	Annual	0.2	0.014	0.2 - 2.0	0.014 - 0.139

Table 13.50 Summary of Manx shearwater operation and maintenance phase disturbance and displacement impacts apportioned to Lundy Island SSSI when considering the migration-free breeding season.

Population Size (Breeding individuals)	**Season**	**Applicant's approach disturbance and displacement impact**		**SNCBs assumed approach disturbance and displacement impact**	
		10% Disp; 1% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)	10% Disp; 1-10% Mort (Breeding individuals per annum)	Increase in baseline mortality rate (%)
Latest Count (10,008)	Full breeding	0.1	0.004	0.1 - 0.5	0.004 - 0.036
	Post-breeding migration	<0.1	<0.001	<0.1	0.002
	Return migration	0.1	0.005	0.1 - 0.7	0.005 - 0.049
	Annual	0.1	0.009	0.1 - 1.3	0.009 - 0.088

461. A potential impact of less than a single (0.1 or 0.2) additional breeding individual is predicted as summarised in **Table 13.49** or **Table 13.50** on an annual basis to the Lundy Island SSSI. Based on the most recent population of 11,008 breeding adults at Lundy SSSI, and an annual breeding adult baseline mortality rate of 0.13 (1 - 0.870, Horswill and Robinson (2015)), 1,431 breeding individuals from the SSSI population would be subject to natural mortality per annum. The predicted loss of less than a single additional breeding individual suffering displacement consequent mortality would represent a 0.014% or 0.009% increase in baseline mortality rate annually, respectively.

462. This level of potential change per annum is considered to be an impact of **negligible magnitude**, as it represents no discernible difference to the baseline conditions.

13.10.1.4.2 Sensitivity of the receptor

463. When considering the assessment methodology detailed in **Section 13.3.8**, this receptor is classified has having an overall sensitivity to disturbance and displacement of **medium**.

13.10.1.4.3 Significance of effect

464. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from operational and maintenance disturbance and displacement on Manx shearwaters has initially been determined to be minor adverse following the matrix approach (**Table 13.13**). However, when considering expert opinion, given the potential impact level is limited to well under a single individual mortality per annum the final significance of effect is determined to be negligible adverse, which is **not significant in EIA terms**.

Table 13.51 Manx shearwater operation and maintenance phase disturbance annual displacement matrix for impacts apportioned to Lundy Island SSSI considering the full breeding season.

Displacement	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	0	1	1	1	2	4	6	8	10	12	14	16	18	20
15	0	0	1	1	1	1	3	6	9	12	15	18	21	24	27	30
20	0	0	1	1	2	2	4	8	12	16	20	24	28	32	36	40
25	0	0	1	1	2	2	5	10	15	20	25	30	35	40	45	50
30	0	1	1	2	2	3	6	12	18	24	30	36	42	48	54	60
35	0	1	1	2	3	3	7	14	21	28	35	42	49	56	63	70
40	0	1	2	2	3	4	8	16	24	32	40	48	56	64	72	80
50	0	1	2	3	4	5	10	20	30	40	50	60	70	80	89	99
60	0	1	2	4	5	6	12	24	36	48	60	72	83	95	107	119
70	0	1	3	4	6	7	14	28	42	56	70	83	97	111	125	139
80	0	2	3	5	6	8	16	32	48	64	80	95	111	127	143	159
90	0	2	4	5	7	9	18	36	54	72	89	107	125	143	161	179
100	0	2	4	6	8	10	20	40	60	80	99	119	139	159	179	199

<1% increase in baseline mortality		>1% increase in baseline mortality	>1% threshold for citation population

Table 13.52 Manx shearwater operation and maintenance phase disturbance annual displacement matrix for impacts apportioned to Lundy Island SSSI considering the migration-free breeding season.

Displacement	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
10	0	0	0	0	1	1	1	3	4	5	6	8	9	10	11	13
15	0	0	0	1	1	1	2	4	6	8	9	11	13	15	17	19
20	0	0	1	1	1	1	3	5	8	10	13	15	18	20	23	25
25	0	0	1	1	1	2	3	6	9	13	16	19	22	25	28	31
30	0	0	1	1	2	2	4	8	11	15	19	23	26	30	34	38
35	0	0	1	1	2	2	4	9	13	18	22	26	31	35	40	44
40	0	1	1	2	2	3	5	10	15	20	25	30	35	40	45	50
50	0	1	1	2	3	3	6	13	19	25	31	38	44	50	57	63
60	0	1	2	2	3	4	8	15	23	30	38	45	53	60	68	75
70	0	1	2	3	4	4	9	18	26	35	44	53	62	70	79	88
80	0	1	2	3	4	5	10	20	30	40	50	60	70	80	91	101
90	0	1	2	3	5	6	11	23	34	45	57	68	79	91	102	113
100	0	1	3	4	5	6	13	25	38	50	63	75	88	101	113	126

	<1% increase in baseline mortality		>1% increase in baseline mortality		>1% threshold for citation population

13.10.1.5 Consideration of entanglement with mooring lines

465. Consideration of the potential impact of entanglement with mooring lines on is provided in **Section 13.8.4**. As presented within **Section 13.8.4**, the potential magnitude of impact was concluded as negligible for all offshore ornithology features assessed in comparison to the regional BDMPS population. While no detailed apportionment has been carried out, impacts will be split between the various colonies and non-breeding birds approximately in proportion to their contribution to the regional population. Therefore, it is expected that the conclusion of a magnitude of impact of negligible will apply to each individual colony, which can be concluded as **not significant in EIA terms**.

13.10.1.6 Consideration of indirect impacts due to impacts on prey species

466. Consideration of the potential indirect impacts on prey species is provided in **Section 13.7.4, 13.8.6** and **13.9.5** for each project phase. The potential magnitude of impact when considering indirect impacts on prey species was concluded as negligible for all offshore ornithology features assessed in comparison to the regional BDMPS population. While no detailed apportionment has been carried out, impacts will be split between the various colonies and non-breeding birds approximately in proportion to their contribution to the regional population. Given the magnitude of the impact has been determined to be negligible, the significance of the effect would be minor adverse effect at most regardless of the sensitivity of the receptor, which can be concluded as **not significant in EIA terms**.

13.10.1.7 Consideration of potential effects cumulatively with other projects

467. When considering the level of impact for any project phase assessed above, the level of impact for the Offshore Project alone was concluded as indistinguishable from natural fluctuations in the population. As this level of effect would be well within the error margins of the assessment there is, Therefore, no potential for any contribution for a cumulative effect to occur. This is further compounded due to the fact that there is a only a small number of projects within the south of the Western Waters BDMPS region currently, thus limiting the potential for any cumulative effects to occur.

13.11 Inter-relationships

468. The inter-related effects assessment considers potentially significant effects from multiple impacts and activities from the construction, operation and

decommissioning of the Offshore Project on the same receptor, or group of receptors. These can include:

- Project lifetime effects: assessment of the scope for effects that occur throughout more than one phase of the Offshore 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 stages (e.g. subsea noise effects from piling, operational WTGs, vessels and decommissioning)
- Receptor led effects: assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on offshore ornithology, such as collision risk, disturbance and displacement, barrier effect and indirect effects may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer-term effects.

469. Consideration of the inter-relationships between EIA topics that may lead to environmental effects, is required under Schedule 4 of The Infrastructure Planning (EIA) Regulations 2017. Guidance on inter-related effects is provided within Section 4.13 of PINS Advice Note Nine: Rochdale Envelope (PINS, 2018), which states that "*inter-relationships consider impacts of the proposals on the same receptor. These occur where a number of separate impacts, (e.g. noise and air quality), affect a single receptor such as fauna*". The approach to inter-related effects has taken into account this Advice Note, along with all other guidance that exists at present.

470. The approach to the assessment of inter-related effects considers receptor-led effects; that is effects that interact spatially and/ or temporally resulting in interrelated effects upon a single receptor.

471. The assessment of inter-related effects has also been undertaken with specific reference to the potential for such effects to arise in relation to receptor groups. The term 'receptor group' is used to highlight the fact that the proposed approach to inter-relationships assessment has not, in the main, assessed every individual receptor assessed at the EIA stage, but rather, potentially sensitive groups of receptors.

472. The broad approach to inter-related effects assessment has followed the following key steps:

- review of effects for individual EIA topic areas

- review of the assessment carried out for each EIA topic area, to identify "receptor groups" requiring assessment
- potential inter-related effects on these receptor groups identified via review of the assessment carried out across a range of topics
- development of lists for all potential receptor-led effects
- qualitative assessment on how individual effects may combine to create interrelated effects.

473. It is important to note that the inter-relationships assessment has only considered effects produced by the Offshore Project, and not those from other developments (these will be considered within the Cumulative Effects Assessment (CEA) in **Section 13.13**). Note that for receptors/ impacts scoped out of the EIA process based on the findings of the Scoping Report, no inter-related assessment has been undertaken.

474. The construction, operation and decommissioning phases of the Offshore Project may cause a range of effects on offshore ornithological receptors. The magnitude of these effects has been assessed individually using expert judgement, drawing from a wide science base that includes project-specific surveys and previously acquired knowledge of the bird ecology of western waters.

475. These effects have the potential to form an inter-relationship, directly impacting the seabird receptors. They also have the potential to manifest as sources for impacts upon receptors other than those considered within the context of offshore ornithology.

476. In terms of how impacts to offshore ornithological interests may form inter-relationships with other receptor groups, assessments of significance are provided in the chapters listed in the second column of **Table 13.53** below. In addition, the table shows where other chapters have been used to inform the offshore ornithology inter-relationships assessment.

Table 13.53 Chapter topic inter-relationships.

Topic and description	Related Chapter	Where addressed in this chapter
Indirect impacts through impacts on prey during construction.	**Chapter 10: Benthic and Intertidal Ecology** and **Chapter 11: Fish and Shellfish Ecology**	**Section 13.7.4**
Indirect impacts through impacts on prey during operation.		**Section 13.8.6** and **Section 13.8.7**

Topic and description	Related Chapter	Where addressed in this chapter
Indirect impacts through impacts on prey during decommissioning		**Section 13.9.5**

477. However, as none of the offshore impacts on birds were assessed individually to have any greater than a minor adverse effect, it is considered highly unlikely that they will inter-relate to form an overall significant effect on offshore ornithology receptors.

13.12 Transboundary effects

478. Transboundary effects arise when impacts from a development within one European Economic Area (EEA) states affects the environment of another EEA state(s).

479. Transboundary impacts upon offshore ornithological receptors are possible due to the wide foraging and migratory ranges of typical bird species in the Celtic Sea.

480. In particular, there is potential for transboundary collisions and displacement with those offshore renewable energy projects present, or in planning, in Irish waters, including the operational Arklow Bank offshore windfarm. It is likely that there will be temporal overlap within the operational phases of at least some of these Irish offshore renewable energy projects. However, as outlined in **Section 13.11**, consideration of potential transboundary effects is limited by the data available upon which to base the assessment. The age of Arklow Bank means that it lacks a comparable dataset upon which to base assessment. Furthermore, those developments which are not fully realised have not released their data into the public domain, and there is a high degree of uncertainty regarding which proposed developments will ultimately be consented.

481. During the breeding bio-season, it is highly unlikely that even those key receptors with relatively large mean-maximum foraging ranges such as gannet will travel further than the Celtic and Irish Seas (Wakefield *et al.*, 2014; Woodward *et al.*, 2019). Therefore, developments outside of UK and Irish waters will not contribute significantly to any transboundary effects.

482. During the non-breeding bio-season, key receptors are able to travel more widely and as such, may come into contact with developments elsewhere in European waters such as those operational, under construction or in planning in the Channel and western waters. Given this larger spatial scale, any potential transboundary effects would be in relation to much larger populations than those considered at the

UK-scale. Therefore, it is apparent that the scale of development within such a wide context would be relatively smaller with respect to any potential impacts considered at the UK BDMPS scale.

483. Therefore, the inclusion of non-UK OWFs is considered very unlikely to alter the conclusions of the existing assessment, and highly likely to reduce estimated impacts at population levels if calculated at larger spatial scales.

13.13 Potential cumulative effects

484. The approach to cumulative effects assessment (CEA) is set out in **Chapter 6: EIA Methodology**. Only projects which are reasonably well described and sufficiently advanced to provide information on which to base a meaningful and robust assessment have been included in the CEA. Projects which are sufficiently implemented during the site characterisation for the Offshore Project have been considered as part of the baseline for the EIA. Where possible OWL has sought to agree with stakeholders the use of as-built project parameter information (if available) as opposed to consented parameters to reduce over-precaution in the cumulative assessment. The scope of the CEA was, therefore, established on a topic-by-topic basis with the relevant consultees.

485. The CEA for offshore ornithology was undertaken in two stages. The first stage was to consider the potential for the impacts assessed as part of the project to lead to cumulative effects in conjunction with other projects. Following the Planning Inspectorate's Advice Note Seventeen (PINS, 2019) and components of the RenewableUK cumulative effect assessment guidelines (RenewableUK, 2013), a number of reasonably foreseeable plans and projects were identified which may act cumulatively. The full list of developments that has been identified which may act cumulatively with the Offshore Project is provided in **Table 13.55**. The projects identified as potentially impacting on the same ornithological receptors as the Offshore Project are identified in **Table 13.56**. These developments are currently at varying stages of the planning process, with the final proposed project designs for some at the assessment and reporting stage, while others may not actually be taken forward or completed to their full maximum capacities. To incorporate this uncertainty, developments were categorised into different tiers dependent on project status (**Table 13.54**, **Table 13.56**).

486. As stated in **Section 13.3.9**, some species (i.e. gannet and Manx shearwater) are considered to have low vulnerability to disturbance and displacement, but have been included in the development alone analysis. This is to ensure confidence that all

potential receptors have been included as a precautionary approach and this is continued through into the cumulative effect assessments.

487. The second stage of the CEA is to evaluate the projects considered for the CEA to determine whether a cumulative effect is likely to arise. The list of considered projects (identified in **Chapter 6: EIA Methodology Section 6.6.11**) and their anticipated potential for cumulative effects are summarised in **Table 13.55**.

488. Certain impacts assessed for the Offshore Project alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e they occur entirely within the Offshore Project only)
- Management measures proposed by the Offshore Project will also be in place for other projects reducing the risk of occurring
- Where potential significance of the impact from the Offshore Project alone has been assessed as negligible and considered not to contribute in any meaningful way to an existing potential cumulative effect.

489. Other aspects, namely indirect impacts associated with prey distribution and availability and lighting are very difficult to quantify, and although it is acknowledged that cumulative effects are possible, the magnitude of these impacts is not considered to be significant at a population level for any offshore ornithology receptor and is therefore not considered further within the CEA. The impacts excluded for the above reasons are:

- Export cable laying (construction) impacts on offshore ornithology receptors within or in close proximity to the Offshore Export Cable Corridor due to no plans or projects being identified that may have a source-impact-pathway that coincide spatially or temporally with the Offshore Project
- Displacement of seabirds during the construction phase of the Offshore Project due to the potential impacts and effects predicted for the Offshore Project being negligible, spatially restricted and no local plans or projects being identified that may have a source-impact-pathway that coincide spatially or temporally with the Offshore Project
- Indirect impacts during any phase of the Offshore Project, as they will be spatially limited and all were predicted as negligible at most at a project level
- Barrier effects for all project phases due to the magnitude of impact being concluded as negligible for all phases combined with very low likelihood of any single individual encountering multiple OWFs on regular commuting flights. Furthermore, as detailed within the Natural England's best practice guidance

note (Parker *et al.*, 2022) any impact from barrier effect is currently considered to be assessed within disturbance and displacement assessments

- All impacts during the decommissioning phase, as potential impacts during this phase were all predicted to be negligible and there is no data or low confidence in data in relation to other plans and projects with respect to this potential source of impact.

490. For all projects included in the CEA, it is assumed that the projects are developed to their fullest extent, with the exclusion of the Morlais tidal development which has currently only been granted consent for 30% of the proposed scale of the development. This reduction is accounted for the in the numbers presented.

Table 13.54 Description of tiers of other developments considered for CEA (adapted from PINS Advice Note 17).

Tier Level	Description
Tier 1	Built and operational projects.
Tier 2	Projects under construction.
Tier 3	Projects that have been consented (but construction has not yet commenced).
Tier 4	Projects that have an application submitted to the appropriate regulatory body that have not yet been determined.
Tier 5	Projects that the regulatory body are expecting to be submitted for determination (e.g., projects listed under the Planning Inspectorate programme of projects).
Tier 6	Projects that have been identified in relevant strategic plans or programmes.

Table 13.55 Projects considered in the cumulative effects assessment on offshore ornithology.

Tier	Project	Status	Distance from windfarm site (km)	Included in the CEA?	Rationale
1	Arklow Bank Phase 1 OWF	Consented 2002	184	No	Operational for a sufficiently long time that its effects will have been incorporated in surveys. Although population responses remain uncertain, lack of supporting data means a meaningful assessment cannot be undertaken.
1	Barrow	Consented 2003	326	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys, but not yet in population responses. Qualitative assessment only.
1	Burbo Bank	Consented 2007	268	Yes	Included as an operational project that does not yet form part of the baseline. Qualitative assessment only.
1	Burbo Bank Extension	Consented 2014	268	Yes	Included as an operational project that does not yet form part of the baseline. Quantitative assessment will be included as far as possible.

Tier	Project	Status	Distance from windfarm site (km)	Included in the CEA?	Rationale
1	Gwynt y Môr	Consented 2008	266	Yes	Included as an operational project that does not yet form part of the baseline. Qualitative assessment only.
1	Morlais (tidal)	Consented Dec 2021	236	Yes	Outputs from the ES have been included.
1	North Hoyle	Consented 2002	264	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
1	Ormonde	Consented 2007	372	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
1	Rampion I	Consented 2014	510	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
1	Rhyl Flats	Consented 2002	264	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
1	Robin Rigg	Consented 2003	413	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
1	Walney Extension	Consented 2014	372	Yes	Outputs from the ES have been included
1	Walney I & II	Consented 2007	372	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys

Tier	Project	Status	Distance from windfarm site (km)	Included in the CEA?	Rationale
					but not yet in population responses. Qualitative assessment only.
1	West of Duddon Sands	Consented 2004	326	Yes	Operational for a sufficiently long time that its effects will have been incorporated in surveys but not yet in population responses. Qualitative assessment only.
3	Erebus	Consented 2023	38	Yes	Included as an operational project that does not yet form part of the baseline. Outputs from the environmental statement have been included
3	TwinHub	Consented 2020	76	Yes	Outputs from the ES have been included
4	Awel y Môr	Planning	262	Yes	Outputs from the ES have been included
5	Emerald	Planning	207	Yes	Outputs from the environmental statement have been included
5	Morecambe OWF	Concept/ early planning	327	Yes	Currently limited data available for assessment.
5	Morgan OWF	Concept/ early planning	325	Yes	Currently limited data available for assessment.
5	Mona OWF	Concept/ early planning	210	Yes	Currently limited data available for assessment.
5	Rampion II (PIER)		510	Yes	Outputs from the PEIR have been included
6	Arklow Bank Phase 2 OWF	Concept/ early planning	184	No	Currently no data available for assessment. This will be included at submission, assuming data are available.
6	Isle of Man	Concept/ early planning	347	No	Currently limited information is available for this project (scoping submitted in 2014 but then on hold); however, cumulative effects are possible given the proximity to the Offshore

Tier	Project	Status	Distance from windfarm site (km)	Included in the CEA?	Rationale
					Project. This will be addressed for the submission subject to information.
6	Llyr Projects	Scoping April 2022	22	No	Currently no data available for assessment. This will be included at submission, assuming data are available.

Table 13.56 Potential cumulative effects considered for offshore ornithology

Impact	Potential for cumulative effect	Rationale
Operational Cumulative disturbance and displacement	For White Cross OWF plus the cumulative full development of the following projects within the UK Western Waters and English Channel (where appropriate): Tier 1: Operational OWFs in the UK Western Waters and English Channel (where appropriate). Tier 2: OWFs under construction in the UK Western Waters and English Channel (where appropriate). Tier 3: Permitted OWF projects not yet implemented. Tier 4: OWF projects with submitted applications not yet determined. Tier 5: OWF projects that the regulatory body are expecting to be submitted for	Multiple OWF developments within a species foraging range may cause increased levels of disturbance. The maximum interactive effects from operational and maintenance activities from the Offshore Project and other developments (**Table 13.55**). These developments were selected as deemed to be within the ZOI and therefore the birds present within the Offshore Project area are expected to interact with the protected sites and features scoped with this environmental assessment.

Impact	Potential for cumulative effect	Rationale
	determination. Included where data is available from PEIRs on developer's website (not yet available via PINS). Tier 6: No Tier 6 projects identified, as quantitative data not available on displacement of seabirds at this stage.	
Operational collision risk	For White Cross OWF plus the cumulative full development of the following projects within the UK Western Waters and English Channel (where appropriate): Tier 1: Operational OWFs in the UK Western Waters and English Channel (where appropriate). Tier 2: OWFs under construction in the UK Western Waters and English Channel (where appropriate). Tier 3: Permitted OWF projects not yet implemented. Tier 4: OWF projects with submitted applications not yet determined. Tier 5: OWF projects that the regulatory body are expecting to be submitted for determination. Included where data is available from PEIRs on developer's website (not yet available via PINS).	Multiple OWF developments within a species foraging range may cause increased levels of collision. The maximum interactive effects from operational and maintenance activities from the Offshore Project and other developments (**Table 13.55**). These developments were selected as deemed to be within the ZOI and therefore the birds present within the Offshore Project area are expected to interact with the protected sites and features scoped with this environmental assessment.

Impact	Potential for cumulative effect	Rationale
	Tier 6: No Tier 6 projects identified, as quantitative data not available on displacement of seabirds at this stage.	

491. It is noted that one of the projects listed above is the Town and Country Planning Application for the onshore components of the White Cross OWF, which is a separate element to the offshore Section 36 consent application for which this ES is prepared.

13.13.1.1 Summary of assessment confidence levels

492. With respect to both disturbance/displacement and collision risk assessments, confidence in assessment conclusions is considered high. Although for some projects, impact totals are not available, due to the age of these projects, it is likely that any potential impact would be included within the regional baseline. Further to this, a precautionary assessment has been undertaken for cumulative effects as detailed within **Section 13.13.2** and **Section 13.13.3**. Which when assessed for all projects combined, is highly likely to lead to overinflation of impacts. Therefore, the overall outcome of these assessment is considered sufficiently robust.

13.13.2 Cumulative Effect 1: Operational Disturbance and Displacement

493. The estimated mortality resulting from disturbance and displacement arising from the developments included in this section are presented for each species assessed. The values are based on the latest available data on seasonal mean peak abundance estimates from each project's relevant documentation or subsequent amendments as agreed with ETG stakeholders. The inclusion of seasonal mean peak abundance estimates for each species from each project, where available, ensures that a consistent approach to estimating potential displacement consequent mortality rates can be provided. It also reduces any uncertainties from projects that may not have undertaken or presented quantitative assessments for displacement.

494. A separate potential impact on auk species attributed to potential underwater collision mortality from tidal projects was identified through the CEA process. This is in relation to a single consented project, the Morlais tidal energy project off the coast of Anglesey. As cumulative underwater collision risk from tidal devices is not considered on its own with this CEA in order to account for any potential impacts from that project it has been included in this assessment of disturbance and displacement as a precautionary measure and to simplify the process.

13.13.2.1 Guillemot

13.13.2.1.1 Potential magnitude of impact

495. For this cumulative displacement and disturbance assessment, the Applicant applied a displacement rate of 50% and a mortality rate of 1% based on best available evidence, as detailed in **Section 13.8.1**. This approach to assessment is considered

suitably precautionary as the estimates are based on peak mean abundance data for each bio-season. Subsequently, the estimated mean peak abundances within each project area (and associated buffers) are likely to be artificially higher than possible when combining all data sets together. This is due to no correction factor being considered or applied to account for the double counting of individual birds being present within multiple project areas across a single bio-season.

496. During the breeding season, the cumulative abundance for guillemot is 12,877 individuals (**Table 13.57**), which results in a conservative estimate of 64 (64.4) mortalities as a consequence of displacement. Consideration is also provided for the 38 mortalities estimated for the Morlais tidal energy project, meaning the total additional cumulative mortality for guillemots is 102 (102.4) individuals. The regional population of guillemots within the breeding bio-season is estimated to be 935,262 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 129,066 individuals per annum. Therefore, the addition of 102 (102.4) individual mortalities, due to cumulative displacement and the predicted collisions from Morlais, would increase the mortality relative to the baseline mortality by 0.078%.

497. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

498. During the non-breeding bio-season, the cumulative abundance for guillemot is 33,881 individuals (**Table 13.57**), which results in a conservative estimate of 169 (169.4) mortalities as a consequence of displacement. Consideration is also provided for the 8 mortalities estimated for the Morlais tidal energy project, meaning the total additional cumulative mortality for guillemots is 178 individuals. The regional population for guillemots within the non-breeding bio-season is estimated to be 1,139,220 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.138 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 157,212 individuals per annum. Therefore, the addition of 178 (177.5) individual mortalities, due to cumulative displacement and the predicted collisions from Morlais would increase the mortality relative to the baseline mortality by 0.113%.

499. This level of potential cumulative effect represents only a limited change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **non-breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

500. Annually, the estimated cumulative number of guillemots subject to mortality is estimated to be 280 (279.9) individuals. Using the UK Western Waters BDMPS population of 1,139,220 (**Table 13.21**) as a proxy for total BDMPS population across the year, the natural baseline mortality is 157,212 individuals. The addition of 280 mortalities, from cumulative displacement and from Morlais collisions, would increase total mortality by 0.178%. Similarly, the additional of 280 mortalities on the biogeographic population size, of 4,125,000 individual guillemots (**Table 13.21**), would result in an increase in mortality relative to baseline mortality of 0.049%.

501. This level of potential cumulative effect annually represents only a limited change to the baseline mortality. Therefore, **the magnitude of cumulative effects per annum are considered negligible** as the change is minimal from the expected natural baseline conditions.

13.13.2.1.2 Significance of effect

502. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of the guillemots, which can be concluded as **not significant in EIA terms**.

13.13.2.1.3 Further mitigation

503. No measures to mitigate for cumulative disturbance and displacement are deemed required as the potential cumulative effect is **not significant**.

Table 13.57 Guillemot cumulative bio-season and total abundance estimates (operational).

Developments	Predicted abundance			Tier
Consented	Breeding	Non-breeding	Annual	
Arklow	-	Unknown	-	1
Burbo Bank Ext	1,003	1,565	2,568	1
Barrow	-	0	0	1
Burbo Bank	-	0	0	1
Gwynt y Môr	-	0	0	1
North Hoyle	-	0	0	1
Ormonde	-	0	0	1
Rhyl Flats	-	0	0	1
Robin Rigg	-	0	0	1
Walney Phase 1	-	0	0	1
Walney Phase 2	-	0	0	1
Walney Extension	-	0	0	1
West of Duddon Sands	-	0	0	1
Erebus	7,001	28,338	35,339	3

Developments	Predicted abundance			Tier
Twin Hub	-	-	0	3
Total (Consented)	8,004	29,903	37,907	
White Cross	3,304	1,059	4,363	4
Total (Consented + White Cross)	11,308	30,962	42,270	
Awel y Mor	1,569	2,919	4,488	4
Morecambe OWF	-	-	-	5
Morgan OWF	-	-	-	5
Mona OWF	-	-	-	5
Total (All developments)	12,877	33,881	46,758	
Tidal	**Predicted collision mortality**			
	Breeding	**Non-breeding**	**Annual**	**Tier**
Morlais	38.0 (1.5-74.4)	8.1 (0.3-15.9)	46.1 (1.8-90.3)	1

13.13.2.2 Razorbill

13.13.2.2.1 Potential magnitude of impact

504. For this cumulative displacement and disturbance assessment, the Applicant applied a displacement rate of 50% and mortality rate of 1% based on best available evidence as detailed in **Section 13.8.1**. This approach to assessment is considered suitably precautionary as the estimations are based on peak mean abundance data for each bio-season. Subsequently, the estimated mean peak abundances within each project area (and associated buffers) are likely to be artificially higher than possible when combining all data sets together. This is due to no correction factor being considered or applied to account for the double counting of individual birds being present within multiple project areas across a single bio-season.

505. During the breeding season, the cumulative abundance for razorbill is 438 individuals (**Table 13.58**), which results in an estimate of two (2.2) mortalities as a consequence of displacement. Consideration is also provided for the 12 (11.7) mortalities estimated for the Morlais tidal energy project, meaning the total cumulative mortality for razorbills is 14 (13.9) individuals. The regional population of razorbills within the breeding bio-season is estimated to be 488,672 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 85,518 individuals per annum. Therefore, the addition of 438 individual mortalities, due to cumulative displacement and the predicted collisions from Morlais would increase the mortality relative to the baseline mortality by 0.016%.

506. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the

breeding bio-season are considered negligible as the change is only very slight from the expected natural baseline conditions.

507. During the return migration bio-season, the cumulative abundance for razorbill is 1,578 individuals (**Table 13.58**), which results in an estimate of eight (7.9) mortalities as a consequence of displacement. The regional population for razorbills within the return migration bio-season is estimated to be 606,914 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 106,210 individuals per annum. Therefore, the addition of eight individual mortalities, due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.007%.

508. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **return migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

509. During the post-breeding migration bio-season, the cumulative abundance for razorbill is 1,814 individuals (**Table 13.58**), which results in an estimate of nine (9.1) mortalities as a consequence of displacement. The regional population for razorbills within the post-breeding migration bio-season is 606,914 individuals (**Table 13.21**). Assuming and average baseline mortality rate of 0.175 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 106,210 individuals per annum. Therefore, the addition of nine individual mortalities due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.009%.

510. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **post-breeding migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

511. During the migration-free winter bio-season, the cumulative abundance for razorbill is 1,609 individuals (**Table 13.58**), which results in an estimate of eight (8.0) mortalities as a consequence of displacement. Consideration is also provided for the 12 (11.9) mortalities estimated for the Morlais tidal energy project, meaning the total cumulative mortality for razorbills is 20 (19.7) individuals. The regional population for razorbills within the migration-free winter bio-season is 341,422 individuals (**Table 13.21**). Assuming an average baseline mortality of 0.175 (**Table 13.22**), the natural predicted mortality in the migration-free winter bio-season is

59,749 individuals per annum. Therefore, the addition of 20 individual mortalities, due to cumulative displacement and the predicted collisions from Morlais, would increase the mortality relative to the baseline mortality by 0.033%.

512. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **migration- free winter bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

513. Annually, the estimated cumulative number of razorbills subject to mortality is estimated to be 27 (27.2) individuals as a consequence of displacement. Consideration is also provided for the 23 (23.4) mortalities estimated for the Morlais tidal energy project, meaning the total cumulative mortality for razorbills is 51 (50.6) individuals. Using the UK Western Waters BDMPS population of 606,914 (**Table 13.21**) as a proxy for total BDMPS population across the year, the natural baseline mortality is 106,210 individuals. The addition of 51 mortalities, from cumulative displacement and from Morlais collisions, would increase the mortalities relative to baseline by 0.048%. Similarly, the addition of 51 mortalities on the biogeographic population size, of 1,707,000 individual razorbills (**Table 13.21**), would result in an increase in mortality relative to baseline mortality of 0.017%.

514. This level of potential cumulative effect annually represents no discernible change to baseline mortality. Therefore, **the magnitude of cumulative effects per annum are considered negligible** as the change is minimal from the expected natural baseline conditions.

13.13.2.2.2 Significance of effect

515. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of razorbills, which can be concluded as **not significant in EIA terms**.

13.13.2.2.3 Further mitigation

516. No measures to mitigate for cumulative disturbance and displacement are deemed required as the potential cumulative effect is **not significant**.

Table 13.58 Razorbill cumulative bio-season and total abundance estimates (operational).

Developments	Predicted abundance					Tier
Consented	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	
Arklow	0	0	0	-	0	1
Burbo Bank Ext	0	64	0	29	93	1
Barrow	0	0	0	-	0	1
Burbo Bank	-	0	-	-	0	1
Gwynt y Môr	0	0	0	-	0	1
North Hoyle	0	0	0	-	0	1
Ormonde	0	0	0	-	0	1
Rhyl Flats	0	0	0	-	0	1
Robin Rigg	0	0	0	-	0	1
Walney Phase 1	0	0	0	-	0	1
Walney Phase 2	0	0	0	-	0	1
Walney Extension	0	0	0	-	0	1
West of Duddon Sands	0	0	0	-	0	1
Erebus	896	194	1,708	1,069	3,867	3
Twin Hub	1	-	0	0	0	3
Total (Consented)	897	258	1,708	1,098	3,960	
White Cross	345	40	40	361	786	4
Total (Consente	1,242	298	1,748	1,459	4,746	

Developments	Predicted abundance					Tier
d + White Cross)						
Awel y Mor	336	140	66	150	692	4
Morecambe OWF	-	-	-	-	-	5
Morgan OWF	-	-	-	-	-	5
Mona OWF	-	-	-	-	-	5
Total (All developments)	1,578	438	1,814	1,609	5,438	
Tidal	**Predicted Collision Mortality**					**Tier**
	Return Migration	**Breeding**	**Post-breeding migration**	**Migration-free winter**	**Annual**	
Morlais	-	11.7 (0.6-22.8)	-	11.7 (0.6-22.8)	23.4 (1.2-45.6)	1

13.13.2.3 Puffin

13.13.2.3.1 Potential magnitude of impact

517. For this cumulative displacement and disturbance assessment, the Applicant applied a displacement rate of 50% and mortality rate of 1% based on best available evidence, as detailed in **Section 13.8.1**. This approach to assessment is considered suitably precautionary as the estimates are based on peak mean abundance data for each bio-season. Subsequently, the estimated mean peak abundances within each project areas (and associated buffers) are likely to be artificially higher than possible when combining all data sets together. This is due to no correction factor being considered or applied to account for the double counting of individual birds being present within multiple project areas across a single bio-season.

518. During the breeding season, the cumulative abundance for puffin is 2,149 individuals (**Table 13.59**), which results in an estimate of 11 (10.7) mortalities as a consequence of displacement. The regional population of puffins within the

breeding bio-season is estimated to be 370,123 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 66,252 individuals per annum. Therefore, the addition of 11 individual mortalities, due to cumulative displacement would increase the mortality relative to the baseline mortality by <0.001%.

519. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

520. During the non-breeding bio-season, the cumulative abundance for puffin is 378 individuals (**Table 13.59**), which results in an estimate of two (1.9) mortalities as a consequence of displacement. The regional population for puffins within the non-breeding bio-season is estimated to be 304,557 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.179 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 54,516 individuals per annum. Therefore, the addition of two mortalities due to the scoped in projects would increase the mortality relative to the baseline mortality by <0.001%.

521. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **non-breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

522. Annually, the estimated cumulative number of puffin subject to mortality is estimated to be 13 (12.6) individuals cumulatively across all projects. Using the UK Western Waters BDMPS population of 304,557 (**Table 13.21**) as a proxy for total BDMPS population across the year, the natural baseline mortality is 54,516 individuals. The addition of 13 mortalities, from cumulative displacement would increase total mortality by <0.001%. Similarly, the addition of 13 mortalities on the biogeographic population size, of 11,840,000 individual puffins (**Table 13.21**), would result in an increase in mortality relative to baseline mortality of <0.001%.

523. This level of potential cumulative effect annually represents no discernible change to the baseline mortality rate. Therefore, **the cumulative effect per annum is considered negligible** as the change is very slight from the expected natural baseline conditions.

13.13.2.3.2 Significance of effect

524. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most

regardless of the sensitivity of puffins, which can be concluded as **not significant in EIA terms**.

13.13.2.3.3 Further mitigation

525. No measures to mitigate for cumulative disturbance and displacement are deemed required as the potential cumulative effect is **not significant**.

Table 13.59 Puffin cumulative bio-season and total abundance estimates (operational).

Developments	**Predicted abundance**			**Tier**
Consented	Breeding	Non-breeding	Annual	
Arklow	-	Unknown	-	1
Burbo Bank Ext	-	-	-	1
Barrow	-	-	-	1
Burbo Bank	493	-	493	1
Gwynt y Môr	-	-	-	1
North Hoyle	-	-	-	1
Ormonde	-	-	-	1
Rhyl Flats	-	-	-	1
Robin Rigg	-	-	-	1
Walney Phase 1	-	-	-	1
Walney Phase 2	-	-	-	1
Walney Extension	191	187	378	1
West of Duddon Sands	-	-	-	1
Arklow Bank Phase 2 OWF	-	-	-	3
Erebus	1,416	160	1,576	3
Twin Hub	-	-	-	3
Total (Consented)	2,100	347	2,447	
White Cross	49	31	80	4
Total (Consented + White Cross)	2,149	378	2,527	
Awel y Mor	-	-	-	4
Morecambe OWF	-	-	-	5
Morgan OWF	-	-	-	5
Mona OWF	-	-	-	5
Total (All developments)	2,149	378	2,527	
Tidal	**Predicted collision mortality**			**Tier**
	Breeding	**Non-breeding**	**Annual**	
Morlais	-	-	-	1

13.13.2.4 Manx shearwater

13.13.2.4.1 Potential magnitude of impact

526. For this cumulative assessment of disturbance and displacement the Applicant has considered potential levels of impacts using a displacement rate of 30% and mortality rate of 1%. This approach is based on the best available evidence and accounts for SNCB's guidance on shearwater species (SNCBs, 2022), as detailed in **Section 13.8.1**. The assessment is considered suitably precautionary as it is based on peak mean abundance data for each bio-season. Subsequently, the estimated mean peak abundances with each project area (and associated buffers) are likely to be artificially higher than possible when combining all data sets together. This is due to no correction factor being considered or applied to account for the double counting of individual birds being present within multiple project areas across a single bio-season.

527. During the return migration bio-season, the cumulative abundance for Manx shearwater is 411 individuals (**Table 13.60**), which results in an estimate of one (1.2) mortality as a consequence of displacement. The regional population of Manx shearwaters within the return migration bio-season is estimated to be 1,580,895 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 516,953 individuals per annum. Therefore, the addition of one individual mortality, due to cumulative displacement would increase the mortality relative to the baseline mortality by <0.001%.

528. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **return migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

529. During the breeding bio-season, the cumulative abundance for Manx shearwater is 18,079 individuals (**Table 13.60**), which results in an estimate of 54 (54.2) mortalities as a consequence of displacement. Consideration is also provided for the 0.3 mortalities estimated for the Morlais tidal energy project, meaning the total cumulative mortality rate for Manx shearwaters is 55 (54.5) individuals. The regional population of Manx shearwaters within the breeding bio-season is estimated to be 2,622,286 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 857,488 individuals per annum. Therefore, the addition of 55 individual mortalities, due to cumulative displacement and the predicted collisions from Morlais would increase the mortality relative to the baseline mortality by 0.006%.

530. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

531. During the post-breeding migration bio-season, the cumulative abundance for Manx shearwater is 1,810 individuals (**Table 13.60**), which results in an estimate of five (5.4) mortalities as a consequence of displacement. The regional population of Manx shearwaters within the post-breeding bio-season is estimated to be 1,580,895 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.327 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 516,953 individuals per annum. Therefore, the addition of five individual mortalities, due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.001%.

532. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **post-breeding migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

533. Annually, the estimated cumulative number of Manx shearwaters subject to mortality is estimated to be 61 (61.2) individuals. Using the UK Western Waters BDMPS population of 1,580,895 (**Table 13.21**) as a proxy for total BDMPS population across the year, the natural baseline mortality is 516,953 individuals. The addition of 61 mortalities from cumulative displacement and from Morlais collisions would increase total mortality rates by 0.012%. Similarly, the addition of 61 mortalities on the biogeographic population size, of 2,000,000 individual Manx shearwaters (**Table 13.21**), would result in an increase in mortality relative to baseline mortality of 0.009%.

534. This level of potential cumulative effect annually represents no discernible change to baseline mortality. Therefore, **the magnitude of cumulative effects per annum are considered negligible** as the change is minimal from the expected natural baseline conditions.

13.13.2.4.2 Significance of effect

535. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of Manx shearwaters, which can be concluded as **not significant in EIA terms**.

13.13.2.4.3 Further mitigation

536. No measures to mitigate for cumulative disturbance and displacement are deemed required as the potential cumulative effect is **not significant**.

Table 13.60 Manx shearwater cumulative bio-season and total abundance estimates (operational).

Developments			**Predicted abundance**		**Tier**
Consented	Return migration	Breeding	Post-breeding migration	Annual	
Arklow	0	-	0		1
Burbo Bank Ext	0	2,937	0	2,937	1
Barrow	0	-	0	0	1
Burbo Bank	0	-	0	0	1
Gwynt y Môr	0	-	0	0	1
North Hoyle	0	-	0	0	1
Ormonde	0	-	0	0	1
Rampion 1	0	33	0	33	1
Rhyl Flats	0	-	0	-	1
Robin Rigg	0	-	0	-	1
Walney Phase 1	0	-	0	-	1
Walney Phase 2	0	-	0	-	1
Walney Extension	183	1,417	1,017	2,617	1
West of Duddon Sands	-	-	0	-	1
Erebus	18	1,540	557	2,115	3
Twin Hub	-	-	-	0	3
Total (Consented)	201	5,927	1,574	7,702	
White cross	33	12,126	22	12,181	4
Total (Consented + White cross)	234	18,053	1,596	19,883	
Awel y Mor	177	26	214	417	4
Morecambe OWF	-	-	-	-	5
Morgan OWF	-	-	-	-	5
Mona OWF	-	-	-	-	5
Rampion 2 (PEIR)	-	-	-	-	5

Developments			Predicted abundance	Tier	
Total (All developments)	411	18,079	1,810	20,300	
Tidal		**Predicted collision mortality**			
	Return migration	**Breeding**	**Post-breeding migration**	**Annual**	**Tier**
Morlais	-	0.3	0	0.3	1

13.13.2.5 Gannet

13.13.2.5.1 Potential magnitude of impact

537. For this cumulative displacement and disturbance assessment, the Applicant applied a displacement rate of 60 to 80% and a mortality rate of 1% based on best available evidence, as detailed in **Section 13.8.1**. This approach to assessment is considered suitably precautionary as the estimatimates are based on peak mean abundance data for each bio-season. Subsequently, the estimated mean peak abundances within each project area (and associated buffers) are likely to be artificially higher than possible when combining all data sets together. This is due to no correction factor being considered or applied to account for the double counting of individual birds being present within multiple project areas across a single bio-season.

538. During the return migration bio-season, the cumulative abundance for gannet is 685 individuals (**Table 13.61**), which results in an estimate of four (4.1) to six (5.5) mortalities as a consequence of displacement. The regional population of gannets within the return migration bio-season is estimated to be 661,888 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 124,435 individuals per annum. Therefore, the addition of four to six individual mortalities, due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.003% to 0.004%.

539. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **return migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

540. During the breeding bio-season, the cumulative abundance for gannet is 1,392 individuals (**Table 13.61**), which results in an estimate of eight (8.4) to eleven (11.1) mortalities as a consequence of displacement. The regional population of

gannets within the breeding bio-season is estimated to be 720,931 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 135,535 individuals per annum. Therefore, the addition of eight to eleven individual mortalities due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.006% to 0.008%.

541. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **breeding bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

542. During the post-breeding migration bio-season, the cumulative abundance for gannets is 968 individuals (**Table 13.61**), which results in an estimate of six (5.8) to eight (7.7) mortalities as a consequence of displacement. The regional population of gannets within the post-breeding migration bio-season is estimated to be 545,954 individuals (**Table 13.21**). Assuming an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 102,639 individuals per annum. Therefore, the addition of six to eight individual mortalities due to cumulative displacement would increase the mortality relative to the baseline mortality by 0.006 to 0.008%.

543. This level of potential cumulative effect represents no discernible change to the baseline mortality rate. Therefore, the magnitude of cumulative effects in the **post-breeding migration bio-season are considered negligible** as the change is only very slight from the expected natural baseline conditions.

544. Annually, the estimated cumulative number of gannets subject to mortality is estimated to be 18 (18.3) to 24 (24.4) individuals. Using the UK Western Waters BDMPS population of 661,888 (**Table 13.21**) as a proxy for total BDMPS population across the year, the natural baseline mortality is 124,435 individuals. The addition of 18 to 24 mortalities from cumulative displacement would increase total mortality rates by 0.015% to 0.020%. Similarly, the addition of 18 to 24 mortalities on the biogeographic population size, of 1,180,000 gannets (**Table 13.21**), would result in an increase in mortality relative to the baseline mortality of 0.008% to 0.011%.

545. This level of potential cumulative effect annually represents no discernible change to baseline mortality. Therefore, **the magnitude of cumulative effects per annum are considered negligible** as the change is minimal from the expected natural baseline conditions.

13.13.2.5.2 Significance of effect

546. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of gannets, which can be concluded as **not significant in EIA terms**.

13.13.2.5.3 Further mitigation

547. No measures to mitigate for cumulative disturbance and displacement are deemed required as the potential cumulative effect is **not significant**.

Table 13.61 Gannet cumulative bio-season abundance estimates (operational).

Developments	Predicted abundance				Tier
Consented	Return migration	Breeding	Post-breeding migration	Annual	
Arklow	-	-	-	-	1
Burbo Bank Ext	-	429	0	429	1
Barrow	-	-	-	-	1
Burbo Bank	-	-	-	-	1
Gwynt y Môr	-	-	-	-	1
North Hoyle	-	-	-	-	1
Ormonde	-	-	-	-	1
Rhyl Flats	-	-	-	-	1
Robin Rigg	-	-	-	-	1
Walney Phase 1	-	-	-	-	1
Walney Phase 2	-	-	-	-	1
Walney Extension	509	172	292	973	1
West of Duddon Sands	-	-	-	-	1
Erebus	100	224	334	658	3
Twin Hub	-	-	-	-	3
Total (Consented)	609	825	626	2,060	
White Cross	76	239	141	456	4
Total (Consented + White Cross)	685	1,064	767	2,516	
Awel y Mor	0	328	201	528	4
Total (All developments)	685	1,392	968	3,044	
Tidal	Predicted collision mortality				Tier
	Return migration	Breeding	Post-breeding migration	Annual	
Morlais	-	-	-	-	1

13.13.3 Cumulative Effect 2: Collision Risk

548. The estimated cumulative collision risk mortality from the developments included in this section are presented for each species assessed. The values are based on the latest available data on collision risk from each project's relevant documentation or

subsequent amendments as agreed with stakeholders. The cumulative collision risk estimates are presented for each species as annual totals only to provide a consistent approach and is due to limitations in the provision of data from specific projects. To ensure cumulative estimates remained precautionary, where ranges of potential collision mortality values were available the maximum values were used within this CEA.

13.13.3.1 Gannet

13.13.3.1.1 Potential magnitude of impact

549. During the return migration bio-season, a total of less than a single (0.9) gannet may be subject to mortality (). The BDMPS for the return migration season (**Table 13.21**) is 661,888 and using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 124,435. Therefore, the addition of less than a single individual mortality would represent an increase in mortality relative to the baseline mortality of 0.001%.

550. This level of potential cumulative effect represents no discernible change to baseline mortality. Therefore, the magnitude of cumulative effect is considered negligible during the return migration bio-season, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions. During the breeding bio-season, a total of 22 (22.1) gannets may be subject to mortality (**Table 13.62**). The BDMPS for the breeding bio-season (**Table 13.21**) is 720,931 and using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 135,535. Therefore, the addition of 22 individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.016%.

551. This level of potential cumulative effect is considered to be of low magnitude during the breeding bio-season, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions. During the post-breeding migration bio-season, a total of 11 (11.1) gannets may be subject to mortality (**Table 13.63**). The BDMPS for the post-breeding migration season (**Table 13.21**) is 545,954 and using the average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 102,639. Therefore, the addition of 11 individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.011%.

552. This level of potential cumulative effect is considered to be of **low magnitude during the post-breeding migration bio-season**, as it represents only a slight

increase to baseline mortality rate levels due to the small number of estimated collisions.

553. The annual cumulative collision mortality total for gannets is estimated to be 82 (81.9) individuals, with 6.6 from the Offshore Project. Using the largest BDMPS population of 661,888 individuals (**Table 13.21**), as a proxy for the annual BDMPS population the natural predicted mortality is 124,435 individuals per annum based on an average baseline mortality rate of 0.188. The addition of 82 predicted mortalities would increase mortality relative to baseline mortality by 0.066%. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,180,000 individuals (**Table 13.21**) across all seasons is 221,840 individuals per annum. On a biogeographic scale, the addition of 82 mortalities would be an increase in mortality relative to baseline mortality of 0.037%.

554. This level of cumulative effect annually is considered to be of **low magnitude on an annual basis at the BDMPS and bio-geographic scales** respectively. This is due to the limited increases to baseline mortality levels of under 0.1% and well under the threshold of 1% considered by SNCBs to require further detailed population level assessments.

13.13.3.1.2 Significance of effect

555. Given the magnitude of the annual impact has been determined to be low cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of gannets, which can be concluded as **not significant in EIA terms**.

13.13.3.1.3 Further Mitigation

556. No measures to mitigate for cumulative collision risk are deemed required as the potential cumulative effect is **not significant**.

Table 13.62 Annual cumulative collision mortality estimates for gannet .

Developments	Return migration	Breeding	Post-breeding migration	Annual	Tier
Consented					1
Arklow	-	-	-	0	1
Burbo Bank Ext	-	-	-	10.4	1
Barrow	-	-	-	0	1
Burbo Bank	-	-	-	0	1
Gwynt y Môr	-	-	-	0	1
North Hoyle	-	-	-	0	1

Developments	Return migration	Breeding	Post-breeding migration	Annual	Tier
Ormonde	-	-	-	0	1
Rhyl Flats	-	-	-	0	1
Robin Rigg	-	-	-	0	1
Walney Phase 1	-	-	-	0	1
Walney Phase 2	-	-	-	0	1
Walney Extension	0.0	0.0	0.0	37.4	1
West of Duddon Sands	-	-	-	0	1
Erebus	0.93	5.15	0.93	7.01	3
TwinHub	-	-	-	-	3
Total (Consented)	0.9	5.2	0.9	54.81	
White cross	0.0	4.7	1.8	6.6	4
Total (Consented + White cross)	0.9	9.9	2.8	61.36	
Awel y Mor	0.0	12.2	8.3	20.5	4
Morecambe OWF	-	-	-	-	5
Morgan OWF	-	-	-	-	5
Mona OWF	-	-	-	-	5
Total (All developments)	2.7	104.7	23.8	179.0	

13.13.3.2 Kittiwake

13.13.3.2.1 Potential magnitude of impact

557. During the return migration bio-season, a total of 108 (108.0) kittiwakes may be subject to mortality (**Table 13.65**). The BDMPS for the return migration season (**Table 13.21**) is 691,526 and using the average baseline mortality rate of 0.157 (**Table 13.22**), the natural predicted mortality in the return migration bio-season is 108,570. Therefore, the addition of 108 individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.099%.

558. This level of potential cumulative effect is considered to be of **low magnitude during the return migration bio-season**, as it represents only a slight increase to baseline mortality rate levels despite being over 100 estimated collisions.

559. During the breeding bio-season, a total of 87 (87.1) kittiwakes may be subject to mortality (**Table 13.66**). The BDMPS for the breeding bio-season (**Table 13.21**) is 639,762 and using the average baseline mortality rate of 0.157 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 100,443. Therefore, the addition of 87 individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.087%.

560. This level of potential cumulative effect is considered to be of **low magnitude during the breeding bio-season**, as it represents only a slight increase to baseline mortality rate levels despite being just under 90 estimated collisions.

561. During the post-breeding migration bio-season, a total of 70 (69.8) kittiwakes may be subject to mortality (**Table 13.67**). The BDMPS for the post-breeding migration season (**Table 13.21**) is 911,586 and using the average baseline mortality rate of 0.157 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 143,119. Therefore, the addition of 70 individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.049%.

562. This level of potential cumulative effect is considered to be of **low magnitude during the post-breeding migration bio-season**, as it represents only a slight increase to baseline mortality rate levels despite being 70 estimated collisions.

563. The annual cumulative total of kittiwakes subject to mortality due to collision is estimated to be 474 (473.2) individuals, with 22 from the Offshore Project (**Table 13.68**). Using the largest BDMPS population of 911,586 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.157, the natural predicted mortality is 143,119 individuals per annum. The addition of 474 predicted mortalities would increase baseline mortality by 0.331%. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 5,100,000 (**Table 13.21**) across all seasons is 800,700 individuals per annum. On a biogeographic scale, the addition of 474 mortalities would increase baseline mortality rate by 0.059%.

564. This level of cumulative effect annually is considered to be of **low magnitude on an annual basis at the BDMPS and bio-geographic scales** respectively. This is due to the limited increase to baseline mortality level of under 0.1% and well under the threshold of 1% considered by SNCBs to require further detailed population level assessments.

13.13.3.2.2 Significance of effect

565. Given the magnitude of the annual impact has been determined to be low cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of kittiwakes, which can be concluded as not significant in EIA terms.

13.13.3.2.3 Further Mitigation

566. No measures to mitigate for cumulative collision risk are deemed required as the potential cumulative effect is **not significant**.

Table 13.63 Annual cumulative collision mortality estimates for kittiwake.

Developments	Return migration	Breeding	Post-breeding migration	Annual	Tier
Consented					1
Arklow	-	-	-	-	1
Burbo Bank Ext	-	-	-	20.7	1
Barrow	-	-	-	0	1
Burbo Bank	-	-	-	0	1
Gwynt y Môr	-	-	-	0	1
North Hoyle	-	-	-	0	1
Ormonde	-	-	-	0	1
Rampion 1	39.7	67.1	14.7	121.5	1
Rhyl Flats	-	-	-	0	1
Robin Rigg	-	-	-	0	1
Walney Phase 1	-	-	-	0	1
Walney Phase 2	-	-	-	0	1
Walney Extension	-	-	-	187.6	1
West of Duddon Sands	-	-	-	0	1
Erebus	19.1	0.8	37.6	57.5	3
Twin Hub	-	-	-	0	3
Total (Consented)	58.8	67.9	52.3	387.3	
White cross	13.5	5.2	2.8	21.47	4
Total (Consented + White cross)	72.3	73.1	55.1	408.8	
Awel y Mor	28.4	12.3	13.11	53.81	4
Morecambe OWF	-	-	-	-	5

Developments	Return migration	Breeding	Post-breeding migration	Annual	Tier
Morgan OWF	-	-	-	-	5
Mona OWF	-	-	-	-	5
Rampion 2 (PIER)	7.3	1.7	1.6	10.6	5
Total (All developments)	108.0	87.1	69.8	473.2	

13.13.3.3 Herring gull

13.13.3.3.1 Potential magnitude of impact

567. During the breeding bio-season, a total of three (3.1) herring gulls may be subject to mortality (Table 13.70). The BDMPS for the breeding bio-season (Table 13.21) is 201,629 and using the average baseline mortality rate of 0.172 (Table 13.22), the natural predicted mortality in the breeding bio-season is 34,680. Therefore, the addition of three individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.009%.

568. This level of potential cumulative effect is considered to be of **negligible magnitude during the breeding bio-season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

569. During the non-breeding bio-season, a total of three (2.5) herring gulls may be subject to mortality (**Table 13.71**). The BDMPS for the non-breeding bio-season (**Table 13.21**) is 173,299 and using the average baseline mortality rate of 0.172 (**Table 13.22**), the natural predicted mortality in the non-breeding bio-season is 29,807. Therefore, the addition of three individual mortalities would represent an increase in mortality relative to the baseline mortality of 0.008%.

570. This level of potential cumulative effect is considered to be of **negligible magnitude during the non-breeding bio-season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

571. The annual cumulative total of herring gull subject to mortality due to collision is estimated to be 73.7 (74) individuals, with 0.3 from the Offshore Project (**Table 13.72**). Using the largest BDMPS population of 173,299 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.172, the natural predicted mortality is 29,807 individuals per annum. The addition of 74 predicted mortalities would increase baseline mortality by 0.247%. When

considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 1,098,000 (**Table 13.21**) across all seasons is 188,856 individuals per annum. On a biogeographic scale, the addition of 74 mortalities would increase baseline mortality rate by 0.039%.

572. This level of cumulative effect annually is considered to be of **low and negligible magnitude on an annual basis at the BDMPS and bio-geographic scales** respectively. This is due to the limited increases to baseline mortality levels being well under the threshold of 1% considered by SNCBs to require further detailed population level assessments

13.13.3.3.2 Significance of effect

573. Given the magnitude of the annual impact has been determined to be low cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of herring gulls, which can be concluded as not significant in EIA terms.

13.13.3.3.3 Further Mitigation

574. No measures to mitigate for cumulative collision risk are deemed required as the potential cumulative effect is **not significant**.

Table 13.64 Annual cumulative collision mortality estimates for herring gull.

Developments	Breeding	Non-breeding	Annual	Tier
Consented	-	-		
Arklow	-	-	-	1
Burbo Bank Ext	-	-	13.9	1
Barrow	-	-	-	1
Burbo Bank	-	-	-	1
Gwynt y Môr	-	-		1
North Hoyle	-	-	-	1
Ormonde	-	-	-	1
Rhyl Flats	-	-	-	1
Robin Rigg	-	-	-	1
Walney Phase 1	-	-	-	1
Walney Phase 2	-	-	-	1
Walney Extension	-	-	54.2	1
West of Duddon Sands	-	-	-	1
Erebus	2.3	1.5	3.8	3
Twin Hub	-	-	-	3

Developments	Breeding	Non-breeding	Annual	Tier
Total (Consented)	2.3	1.5	71.9	
White cross	0.0	0.3	0.3	4
Total (Consented + White cross)	2.3	1.8	72.2	
Awel y Mor	0.8	0.7	1.5	4
Morecambe OWF	-	-	-	5
Morgan OWF	-	-	-	5
Mona OWF	-	-	-	5
Total (All developments)	3.1	2.5	73.7	

13.13.3.4 Great black-backed gull

13.13.3.4.1 Potential magnitude of impact

575. During the breeding bio-season, a total of eight (8.4) great black-backed gulls may be subject to mortality (**Table 13.65**). The BDMPS for the breeding bio-season (**Table 13.21**) is 23,071 and using the average baseline mortality rate of 0.093 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 2,146. The addition of eight mortalities would represent an increase in mortality relative to the baseline mortality of 0.391%.

576. This level of cumulative effect is considered to be of **negligible magnitude during the breeding bio-season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

577. During the non-breeding season, a total of 28 (27.8) great black-backed gulls may be subject to mortality. The BDMPS for the non-breeding season (**Table 13.21**) is 17,742 and using the average baseline mortality rate of 0.093 (**Table 13.22**), the natural predicted mortality in the non-breeding season is 1,650. The addition of 28 mortalities would represent an increase in mortality relative to the baseline mortality of 1.685%. However, despite a 1% increase in baseline mortality rate being exceeded, the Offshore Project does not contribute any impact during the non-breeding season.

578. This level of cumulative effect is initially considered to be of **low magnitude during the non-breeding season**, as although the threshold of 1% considered by SNCBs to require further detailed population level assessments is exceeded the Offshore Project's does not contribute to such an impact..

579. The annual cumulative total of great black-backed full subject to mortality due to collision is estimated to be 65 (64.4) individuals, with 0.7 from the Offshore Project. Using the largest BDMPS population of 17,742 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.093, the natural predicted mortality is 1,650 individuals per annum. The addition of 65 predicted mortalities would increase baseline mortality by 3.903%. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 235,000 (**Table 13.21**) across all seasons is 21,855 individuals per annum. On a biogeographic scale, the addition of 65 mortalities would increase baseline mortality rate by 0.295%.

580. As the increase in the BDMPS baseline mortality rate exceeds 1%, The level of impact has been considered further. PVA was undertaken by Awel y Mör (APEM, 2022c) in relation to the Southwest and English Channel BDMPS and for a combined Western Waters BDMPS due to the location of the cumulative projects (the same projects included within **Table 13.65**) considered within the assessment having likely connectivity to both regions. Both the Counterfactual of Population Growth Rate (CPGR) and Counterfactual of Final Population Size (CFPS) were presented and have therefore been used for further consideration of the potential impacts. However, as density dependence was not included within the model the accuracy of the CFPS can be considered low for inferring population level effects. This is because density independent modelling doesn't account for population regulation leading to the final predicted impacted population sizes being wholly unsuitable for interpretation. Furthermore, it should be noted that although both CPGR and CFPS may predict reductions in the overall growth rate or population size, this does not necessarily mean the population is predicted to decline under such scenarios. To understand what influence the predicted CPGR and CFPS may have on a given population, inference should be made against the known population trends for a receptor.

581. When considering the cumulative total of 65 additional predicted mortalities per annum (**Table 13.65**), the closest modelled run predicted a reduction in growth rate of 0.44% per annum and a reduction in the final population size of 12.82% over a 30 year time for the Southwest and English Channel BDMPS. The Offshore Project's contribution to such population level effects would be a reduction in growth rate of <0.01% per annum and a reduction in the final population size of 0.14% over a 30 year time for the Southwest and English Channel BDMPS. Regardless of the receptors current population trend, when considering such a minimal increase

in impact on the growth rate and final population size this predicted impact would almost certainly be indistinguishable from natural fluctuations in the population.

582. Furthermore, the majority of impacts (~85%) are due to the projects which have been operational within the region for a significant period of time (over five years). It is therefore likely that any impacts from such projects is already considered within the baseline environment for the region. It is also likely that the consented worst case design scenario included within the cumulative assessments highly overestimates the actual impacts of such projects in comparison to the as built designs (TCE, 2017).This level of potential cumulative effect annually is initially considered to be of **medium and negligible magnitude annually at the BDMPS and bio-geographic scales**, respectively. For the cumulative effect at the BDMPS level this is due to the increase to baseline mortality levels being over the threshold of 1% considered by SNCBs to require further detailed population level assessments. However, following further assessment due to the immaterial level of potential change attributed to the Offshore Project, and the overall cumulative effect total being almost certainly overestimated, the cumulative effect is considered of **low magnitude at the BDMPS scale**.

13.13.3.4.2 Significance of effect

583. Given the magnitude of the impact has been determined to be low at the BDMPS level, the significance of the effect would be minor adverse at most regardless of the sensitivity of great black-backed gulls, which can be concluded as **not significant in EIA terms**.

13.13.3.4.3 Further Mitigation

584. No measures to mitigate cumulative collision risk are deemed required as the potential cumulative effect is **not significant**.

Table 13.65 Annual cumulative collision mortality estimates for great black-backed gull.

Developments	Breeding	Non-breeding	Annual	Tier
Consented				
Arklow	-	-	-	1
Burbo Bank Ext	-	-	-	1
Barrow	-	-	-	1
Burbo Bank	-	-	-	1
Gwynt y Môr	-	-	-	1
North Hoyle	-	-	-	1
Ormonde	-	-	-	1
Rampion 1	3.2	22.8	26.0	1
Rhyl Flats	-	-	-	1

Developments	Breeding	Non-breeding	Annual	Tier
Robin Rigg	-	-	-	1
Walney Phase 1	-	-	-	1
Walney Phase 2	-	-	-	1
Walney Extension	-	-	54.2	1
West of Duddon Sands	-	-	-	1
Erebus	0.0	0.7	0.7	3
Twin Hub	-	-	-	3
Total (Consented)	3.2	23.5	54.9	
White cross	0.7	0.0	0.7	4
Total (Consented + White cross)	3.9	23.5	55.6	
Awel y Mor	3.6	1.2	4.8	4
Morecambe OWF	-	-	-	5
Morgan OWF	-	-	-	5
Mona OWF	-	-	-	5
Rampion 2 (PIER)	0.9	3.1	4.0	5
Total (All developments)	8.4	27.8	64.4	

13.13.3.5 Lesser black-backed gull

13.13.3.5.1 Potential magnitude of impact

585. During the return migration bio-season, a total of one (1.2) lesser black-backed gull may be subject to mortality (**Table 13.66**). The BDMPS for the return migration bio-season (**Table 13.21**) is 163,304 and using the average baseline mortality rate of 0.124 (**Table 13.22**), the natural predicted mortality in the return migration season is 20,250. The addition of one mortality would represent an increase in mortality relative to the baseline mortality of 0.006%.

586. This level of cumulative effect is considered to be of **negligible magnitude during the return migration bio-season**, as it represents only a slight increase to baseline mortality rate levels due being only a single collision per annum.

587. During the breeding bio-season, a total of eight (7.6) lesser black-backed gulls may be subject to mortality. The BDMPS for the breeding bio-season (**Table 13.21**) is 163,117 and using the average baseline mortality rate of 0.124 (**Table 13.22**), the natural predicted mortality in the breeding bio-season is 20,234. The addition of

eight mortalities would represent an increase in mortality relative to the baseline mortality of 0.038%.

588. This level of change is considered to be of **negligible magnitude during the breeding bio-season**, as it represents only a slight increase to baseline mortality rate levels due to the small number of estimated collisions.

589. During the post-breeding migration bio-season, a total of less than a single (0.5) lesser black-backed gull may be subject to mortality. The BDMPS for the post-breeding migration bio-season (**Table 13.21**) is 163,304 and using the average baseline mortality rate of 0.124 (**Table 13.22**), the natural predicted mortality in the post-breeding migration bio-season is 20,250. The addition of less than one mortality would represent an increase in mortality relative to the baseline mortality of 0.002%.

590. This level of change is considered to be of **negligible magnitude during the post-breeding migration bio-season**, as it represents only a slight increase to baseline mortality rate levels due to being under a single collision per annum.

591. During the migration-free winter bio-season, no lesser black-backed gulls were predicted to suffer mortality with respect to collision risk. This level of potential cumulative effect is therefore considered to be of **no significance during the migration-free winter bio-season.**

592. The annual cumulative total of lesser black backed gulls subject to mortality due to collision is estimated to be 151 (151.3) individuals, with 0.3 from the Offshore Project. Using the largest BDMPS population of 163,304 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.124, the natural predicted mortality is 20,250 individuals per annum. The addition of 151 predicted mortalities would increase baseline mortality by 0.747%. When considering the annual potential level of change at the biogeographic scale, the natural predicted mortality for the biogeographic population of 864,000 (**Table 13.21**) across all seasons is 107,136 individuals per annum. On a biogeographic scale, the addition of 151 mortalities would increase baseline mortality rate by 0.141%.

593. The level of cumulative effect annually is considered to be of **negligible magnitude annually at the bio-geographic scales**. This is due to the limited increases to baseline mortality levels when compared to natural variation due to the small number of estimated collisions per annum.

13.13.3.5.2 Significance of effect

594. Given the magnitude of the impact has been determined to be negligible cumulatively, the significance of the effect would be minor adverse at most regardless of the sensitivity of lesser black-backed gulls, which can be concluded as **not significant in EIA terms**.

13.13.3.5.3 Further Mitigation

595. No measures to mitigate for cumulative collision risk are deemed required as the potential cumulative effect is **not significant**.

Table 13.66 Annual cumulative collision mortality estimates for lesser black-backed gull.

Developments	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	Tier
Consented	-	-	-	-		
Arklow	-	-	-	-	-	1
Burbo Bank Ext	-	-	-	-	26	1
Barrow	-	-	-	-	-	1
Burbo Bank	-	-	-	-	-	1
Gwynt y Môr	-	-	-	-	-	1
North Hoyle	-	-	-	-	-	1
Ormonde	-	-	-	-	-	1
Rhyl Flats	-	-	-	-	-	1
Robin Rigg	-	-	-	-	-	1
Walney Phase 1 and 2	-	-	-	-	58	1
Walney Extension	-	-	-	-	13	1
West of Duddon Sands	-	-	-	-	45	1
Erebus	0.0	6.2	0.5	-	6.7	
TwinHub	-	-	-	-	-	3
Total (Consented)	0.0	6.2	0.5	0.0	148.7	
White cross	0	0.3	0	0	0.3	4
Total (Consented + White cross)	0	6.5	0.5	0.0	149.0	
Awel y Mor	0	0.5	0	0	0.5	4
Morecambe OWF	-	-	-	-	-	5
Morgan OWF	-	-	-	-	-	5
Mona OWF	-	-	-	-	-	5

Developments	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	Tier
Rampion 2 (PIER)	1.2	0.6	0	0	1.8	5
Total (All developments)	1.2	7.6	0.5	0.0	151.3	

13.13.4 Cumulative Effect 3: Combined operational displacement and collision risk

13.13.4.1 Gannet

596. Due to gannet being scoped in for both displacement and collision risk assessments during the operation and maintenance phase, there is potential for these two impacts to cumulatively adversely affect gannet populations when combined. Previous sections have concluded a magnitude of minor adverse effect at most from collision risk cumulatively and a magnitude of minor adverse effect at most from displacement cumulatively. However, the combined impact of both cumulative collision risk and cumulative displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required.

597. It is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subject to displacement consequent mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment.

13.13.4.1.1 Potential magnitude of impact

598. As detailed in **Table 13.36** and **Table 13.43**, following the Applicant's evidence-led assessment the combined predicted mortality in the O&M phase (displacement and collision risk) equates to between 100 (100.1) and 106 (106.2) predicted additional mortalities per annum. Using the largest BDMPS population of 661,888 (**Table 13.21**), as a proxy for the annual BDMPS population, with an average baseline mortality rate of 0.188 (**Table 13.22**), the natural predicted mortality is 124,435 individuals per annum. The addition of 100 to 106 predicted mortalities would increase baseline mortality by 0.080 to 0.085% of the annual BDMPS population. When considering the annual potential level of change at the

biogeographic scale, the natural predicted mortality for the biogeographic population of 1,180,000 (**Table 13.21**) across all seasons is 221,840 individuals per annum. On a biogeographic scale, the addition of 100 to 106 predicted mortalities would increase baseline mortality by 0.045 to 0.048%. It should be noted that the impacts associated with both displacement and collision risk combined assessed in this simplistic manner are almost certainly an overestimate, as a bird which has been displaced from the Windfarm Site can no longer collide with a turbine and vice versa.

599. This level of potential impact is considered to be an impact of **negligible magnitude on an annual basis at both BDMPS and biogeographic scales**, as it represents no discernible increase to baseline mortality levels due to the small number of estimated mortalities from both displacement and collision combined.

13.13.4.1.2 Sensitivity of the receptor

600. As detailed in previous assessments for both displacement and collision risk combined for gannet, the overall sensitivity of this receptor is **medium**.

13.13.4.1.3 Significance of effect

601. Overall, the species' sensitivity is medium following the matrix approach set out in **Table 13.10** and the magnitude of impact is negligible. Therefore, the potential significance of effect from disturbance and displacement combined with collision risk on gannets has been determined to be minor adverse following the matrix approach (**Table 13.13**), which is **not significant in EIA terms**.

13.14 Summary of effects

602. **Table 13.67** and **Table 13.68** present a summary of the preliminary assessment of significant effects, any relevant embedded environmental measures and residual effects on offshore ornithology receptors.

Table 13.67 Summary of effects.

Potential Impact	Species	Magnitude	Sensitivity of Receptor	Effect Significance
Construction				
Disturbance and displacement: Windfarm Site	Guillemot	Negligible	Medium	Negligible (not significant)
	Razorbill			
	Puffin			
	Manx shearwater			
	Gannet			
Disturbance and displacement: Offshore Export Cable Corridor	All Receptors	Negligible		Negligible (not significant)
Barrier effects	All Receptors	Negligible		Minor (not significant)
Indirect impacts due to impacts on prey	All Receptors	Negligible		Minor (not significant)
Operation and Maintenance				
Disturbance and displacement: Windfarm Site	Guillemot	Negligible	Medium	Negligible (not significant)
	Razorbill			
	Puffin			
	Manx shearwater			
	Gannet			
Collision risk: Windfarm Site	Great black-backed gull Herring gull Lesser black-backed gull Gannet	Negligible	Medium	Negligible (not significant)
Combined operational displacement and collision risk	Gannet	Negligible	Medium	Negligible (not significant)
Entanglement with mooring lines	All Receptors	Negligible	Medium	Minor (not significant)
Barrier effects	All Receptors	Negligible	Medium	Minor (not significant)
Indirect impacts due to impacts on prey	All Receptors	Negligible	Medium	Negligible to Minor (not significant)

Potential Impact	Species	Magnitude	Sensitivity of Receptor	Effect Significance
Decommissioning				
Disturbance and displacement: Windfarm Site	All Receptors	Negligible	Medium	Negligible (not significant)
Disturbance and displacement: Offshore Export Cable Corridor	All Receptors	Negligible	Medium	Negligible (not significant)
Barrier effects	All Receptors	Negligible	Medium	Minor (not significant)
Indirect impacts due to impacts on prey	All Receptors	Negligible	Medium	Minor (not significant)

Table 13.68 Summary of effects for the cumulative assessment impacts

Potential Impact	Species	Magnitude	Sensitivity of Receptor	Effect Significance
Cumulative				
Disturbance and displacement: Windfarm Site	Guillemot	Negligible	Medium	Negligible (not significant)
	Razorbill			
	Puffin			
	Manx shearwater			
	Gannet			
Collision risk	Kittiwake	Low	Medium	Negligible (not significant)
	Great black-backed gull	Negligible		
	Herring gull	Low to negligible		
	Lesser black-backed gull	Low		
	Gannet	Low		

13.15 References

Alerstam, T. (1990) Bird Migration. Cambridge: Cambridge University Press.

APEM (2014). Assessing Northern Gannet Avoidance of Offshore Windfarms. APEM Report to East Anglia Offshore Wind Ltd. APEM, Stockport.

APEM (2017). Mainstream Kittiwake and Auk Displacement Report. APEM Scientific Report P000001836. Neart na Gaoithe Offshore Wind Limited, 04/12/17, v2.0 Final, 55 pp

APEM (2022a). Review of Evidence to Support Auk Displacement and Mortality Rates in Relation to Offshore Wind Farms.

APEM (2022c). Awel y Môr Offshore Wind Farm Volume 4, Annex 4.4: Migratory Collision Risk Modelling
APEM (2022c). Awel y Môr Offshore Wind Farm Volume 4, Annex 4.6 Offshore Ornithology: Population Viability Analysis.

Archer, M., Jones, P. H., & Stansfield, S. D. (2015). Departure of Manx Shearwater Puffinus puffinus fledglings from Bardsey, Gwynedd, Wales, 1998 to 2013.

Band, W. (2012). Using a collision risk model to assess bird collision risks for offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. http://www.bto.org/science/wetland-and-marine/soss/projects. Originally published Sept 2011, extended to deal with flight height distribution data March 2012.

BEIS (2020). New plans to make UK world leader in green energy [webpage]. Available at https://www.gov.uk/government/news/new-plans-to-make-uk-world-leader-in-green-energy. Accessed 01/02/2023.

BEIS (2021a). Draft National Policy Statement for Renewable Energy Infrastructure (EN-3). London, Stationery Office.

BEIS (2021b). Draft Overarching National Policy Statement for Energy (EN-1). London, Stationery Office.

Benjamins, S., Harnois, V., Smith, H.C.M., Johanning, L., Greenhill, L., Carter, C. and Wilson, B. (2014). Understanding the potential for marine megafauna entanglement risk from renewable marine energy developments. Scottish Natural Heritage Commissioned Report No. 791.Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G. and Hume, D. (2014). Mapping seabird sensitivity to offshore wind farms. PLoS ONE 9:e106366.

Birkhead, T.R. (1978) Attendance patterns of Guillemots Uria aalge at breeding colonies on Skomer Island.

Bowgen, K., Cook, A. (2018) Bird Collision Avoidance: Empirical evidence and impact assessments, JNCC Report No. 614, JNCC, Peterborough, ISSN 0963-8091

Box, J., Dean, M. and Oakley, M. (2017) An Alternative Approach to the Reporting of Categories of Significant Residual Ecological Effects in Environmental Impact Assessment. CIEEM In Practice 97, 47-50.

Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G. and Hume, D. (2014). Mapping seabird sensitivity to offshore wind farms. PLoS ONE 9:e106366.

Brown, T. M., Wilhelm, S. I., Mastromonaco, G. F., & Burness, G. (2023). A path forward in the investigation of seabird strandings attributed to light attraction. Conservation Science and Practice, 5(1), e12852.

Burns, F., Eaton, M.A., Balmer, D.E., Banks, A., Caldow, R., Donelan, J.L., Douse, A., Duigan, C., Foster, S., Frost, T., Grice, P.V., Hall, C., Hanmer, H.J., Harris, S.J., Johnstone, I., Lindley, P., McCulloch, N., Noble, D.G., Risely, K., Robinson, R.A. and Wotton, S. (2020). State of the UK's Birds 2020. British Trust for Ornithology.

Busche, M., & Garthe, S. (2016). Approaching population thresholds in presence of uncertainty: Assessing displacement of seabirds from offshore wind farms. Environmental Impact Assessment Review, 56, 31-42.Searle, K. R., Butler, A., Mobbs, D.C., Trinder, M., Waggitt, J., Evans. P. & F. Daunt 2020. Scottish Waters East Region Regional Sectoral Marine Plan Strategic Ornithology Study; final report. CEH report NEC07184.

Castro, J.J., Santiago, J.A. and Santana-Ortega, A.T. (2002). A general theory on fish aggregation to floating objects: An alternative to the meeting point hypothesis. Reviews in Fish Biology and Fisheries, 11, 255-277.

CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2019). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine Version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester.

Cleasby, I.R., Owen, E., Wilson, L.J. and Bolton, M. (2018). Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK: Technical Report. RSPB Research Report no. 63. RSPB Centre for Conservation Science, RSPB, The Lodge, Sandy, Bedfordshire, SG19 2DL.

Cook, A.S.C.P., Wright, L.J., and Burton, N.H.K. (2012) A review of flight heights and avoidance rates of birds in relation to offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS). http://www.bto.org/science/wetland-and-marine/soss/projects.

Cox, S.L., Miller, P.I., Embling, C.B., Scales, K.L., Bicknell, A.W.J., Hosegood, P.J., Morgan, G., Ingram, S.N. and Votier, S.C. (2016). Seabird diving behaviour reveals the functional significance of shelf-sea fronts as foraging hotspots. R. Soc. Open Sci. 3:160317 http://doi.org/10.1098/rsos.160317.

Cramp & Simmons (1977 - 1994). The Birds of the Western Palearctic. Oxford University Press: Oxford, UK.

Deakin, Z., Cook, A., Daunt, F., McCluskie, A., Morley, N., Witcutt, E., Wright, L., & Bolton, M. (2022). A review to inform the assessment of the risk of collision and displacement in petrels and shearwaters from offshore wind developments in Scotland. Published by The Scottish Government.

Dean, B., Freeman, R., Kirk, H. and Guilford, T. (2010). Tracking the Movements of Lundy's Shearwaters. Lundy Field Society (LFS) Annual Report, 2010.

Dean, B. (2012). The at-sea behaviour of the Manx Shearwater (Doctoral dissertation, Oxford University, UK).

Dean, B., Freeman, R., Kirk, H., Leonard, K., Phillips, R. A., Perrins, C. M., & Guilford, T. (2013). Behavioural mapping of a pelagic seabird: combining multiple sensors and a hidden Markov model reveals the distribution of at-sea behaviour. Journal of the Royal Society Interface, 10(78), 20120570.

DECC (2011a). Department of Energy and Climate Change – National Policy Statement for Energy (EN-1). London, Stationery Office.

DECC (2011b). Department of Energy and Climate Change – National Policy Statement for Renewable Energy Infrastructure (EN-3). London, Stationery Office.Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. and Grundy, D.S (eds) (2007). The Birds of Scotland. The Scottish Ornithologists' Club, Aberlady.

Desholm, M. and Kahlert, J. (2005) Avian Collision Risk at an Offshore Wind Farm. Biology Letters, 1, 296-298.

Dierschke, V., Furness, R.W. & Garthe, S. (2016). Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation, 202, 59-68.

Eaton, M., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud, D. and Gregory, R., 2015. Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds, 108(12), pp.708-746.

Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, A. Rodewald, C. Wood, I. Davies, A. Spencer. 2022. eBird Status and Trends, Data Version: 2021; Released: 2022. Cornell Lab of Ornithology, Ithaca, New York. Available at https://ebird.org/, accessed 14/02/2023.

Forrester, R. W., Andrews, I. J., McInerny, C .J., Murray, R .D., McGowan, R .Y., Zonfrillo, B., Betts, M .W., Jardine, D .C. and & Grundy, D. S (eds) (2007). The Birds of Scotland. The Scottish Ornithologists' Club, Aberlady.

Frost, T.M., Calbrade, N.A., Birtles, G.A., Hall, C., Robinson, A.E., Wotton, S.R., Balmer, D.E. and Austin, G.E. (2021). Waterbirds in the UK 2019/20: The wetland bird survey. Thetford: BTO, RSPB and JNCC, in association with WWT.

Furness, R.W., Wade, H.M., Robbins, A.M. and Masden, E.A. (2012). Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science, 69(8), 1466-1479.

Furness, R. W., Wade, H. M., & Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. Journal of environmental management, 119, 56-66.

Furness, R.W. (2015). Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164.

Garthe, S. & Hüppop, O. (2004) Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41: 724-734.

Gerlach, B., R. Dröschmeister, T. Langgemach, K. Borkenhagen, M. Busch, M. Hauswirth, T. Heinicke, J. Kamp, J. Karthäuser, C. König, N. Markones, N. Prior, S. Trautmann, J. Wahl & C. Sudfeldt (2019): Vögel in Deutschland – Übersichten zur Bestandssituation. DDA, BfN, LAG VSW, Münster.

Grecian W.J, Lane, J.V., Michelot, T., Wade, H.M. and Hamer Keith C. (2018). Understanding the ontogeny of foraging behaviour: insights from combining marine predator bio-logging with satellite-derived oceanography in hidden Markov models. J. R. Soc. Interface. 15:20180084 http://doi.org/10.1098/rsif.2018.0084.

Guilford, T., Meade, J., Freeman, R., Biro, D. Evans, T., Bonadonna, F., Boyle, D., Roberts, S. and Perrins, C. (2008). GPS tracking of the foraging movements of Manx Shearwaters *Puffinus puffinus* breeding on Skomer Island, Wales. Ibis. 150. 10.1111/j.1474-919X.2008.00805.x.

Guilford, T., Padget, O., Bond, S., & Syposz, M. M. (2019). Light pollution causes object collisions during local nocturnal manoeuvring flight by adult Manx Shearwaters Puffinus puffinus. Seabird, 31.

Harris, M.P. (1989) Variation in the correction factor used for converting counts of individual Guillemots Uria aalge into breeding pairs.

Hill, R., Hill, K., Aumüller, R., Schulz, A., Dittmann, T., Kulemeyer, C., & Coppack, T. (2014). Of birds, blades and barriers: Detecting and analysing mass migration events at alpha ventus. Ecological Research at the Offshore Windfarm Alpha Ventus: Challenges, Results and Perspectives, 111-131.

HM Government (2011). UK Marine Policy Statement. London, Stationery Office.

Horswill, C. & Robinson, R.A. (2015). Review of seabird demographic rates and density dependence.

JNCC, Natural England, SNH, NRW, NIEA. (2014) Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review. [Downloaded from: http://www.snh.gov.uk/docs/A1464185.pdf].

JNCC (2022). Joint SNCB Interim Displacement Advice note.

Johnston, A. *et al*. (2014). Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology, 51(1), pp. 31–41. doi: 10.1111/1365-2664.12191.

Johnstone, I.G., Hughes, J., Balmer, D.E., Brenchley, A., Facey, R.I., Lindley, P.J., Noble, D.G. and Taylor, R.C. (2022). Birds of Conservation Concern Wales 4: the population status of birds in Wales. Milvus: the Journal of the Welsh Ornithological Society. Available at: https://tinyurl.com/BoCCW4.

Kane, A., Pirotta, E., Wischnewski, S., Critchley, E. J., Bennison, A., Jessopp, M., & Quinn, J. L. (2020). Spatio-temporal patterns of foraging behaviour in a wide-ranging seabird reveal the role of primary productivity in locating prey. Marine Ecology Progress Series, 646, 175-188.

Kerlinger, P., Gehring, J. L., Erickson, W. P., Curry, R., Jain, A., & Guarnaccia, J. (2010). Night migrant fatalities and obstruction lighting at wind turbines in North America. The Wilson Journal of Ornithology, 122(4), 744-754.

Kincardine Offshore Windfarm (2016). Environmental Statement. Kincardine Offshore Windfarm Limited.

King, S., Maclean, I., Norman, T. and Prior, A. (2009). Developing Guidance on Ornithological Cumulative effect Assessment for Offshore Wind Farm Developers. Cowrie Ltd.

Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S., Wilson, L.J. and Reid. J.B. (2010). An Analysis of the Numbers and Distribution of Seabirds within the British Fishery Limit Aimed at Identifying Areas that Qualify as Possible Marine SPAs. JNCC Report, No. 431.

Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beuker, D. & Dirksen, S. (2011). Effect Studies Offshore Wind Farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds. Bureau Waardenburg Report No 10-219.

Langston, R.H.W (2010). Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39

Lawson, J., Kober, K., Win, I., Allcock, Z., Black, J. Reid, J.B., Way, L. and O'Brien, S.H. (2016). An assessment of the numbers and distribution of wintering waterbirds and seabirds in Liverpool Bay/Bae Lerpwl area of search. JNCC Report No 576. JNCC, Peterborough.

Leopold M.F. & Verdaat H.J.P., 2018. Pilot field study: observations from a fixed platform on occurrence and behaviour of common guillemots and other seabirds in offshore wind farm Luchterduinen (WOZEP Birds-2). Wageningen, Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C068/18. 27 pp.

Leopold, M.F., Dij kman, E.M., Teal, L. and the OWEZ Team. (2011). Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ) (T-0 & T-1, 2002-2010). IMARES report to Noordzee Wind, Wageningen.

Longcore, T., & Rich, C. (2004). Ecological light pollution. Frontiers in Ecology and the Environment, 2(4), 191-198.

MacArthur Green. (2021). Beatrice Offshore Wind Farm Year 1 Post-construction Ornithological Monitoring Report 2019. Available at : https://marine.gov.scot/data/mfrag-ornithology-post-construction-ornithological-monitoring-report-2019-28042021Zuur 2018

Maclean, I.M.D., Wright, L.J., Showler, D.A. and Rehfisch, M.M. (2009). A Review of Assessment Methodologies for Offshore Windfarms. British Trust for Ornithology, Thetford.

Marine Management Organisation (2022). White Cross Offshore Wind Farm Scoping Opinion. MMO Reference: EIA/2022/00002. Available at: https://marinelicensing.marinemanagement.org.uk/mmofox5/fox/live/

Masden, E. (2015) Developing an avian collision risk model to incorporate variability and uncertainty. Scottish Marine and Freshwater Science Vol 6 No 14. Edinburgh: Scottish Government, 43pp. DOI: 10.7489/1659-1.

Masden, E.A., Haydon, D.T., Fox, A.D. and Furness, R.W. (2010). Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. Marine Pollution Bulletin 60, 1085–1091. https://doi.org/10.1016/j.marpolbul.2010.01.016.

McGregor, R.M., King, S., Donovan, C.R., Caneco, B. and Webb, A. (2018) A Stochastic Collision Risk Model for Seabirds in Flight. HiDef BioConsult Scientific Report to Marine Scotland, 06/04/2018, Issue I, 59 pp.

Musgrove, A., Aebischer, N., Eaton, M., Hearn, R., Newson, S., Noble, D., Parsons, M., Risely, K. and Stroud, D. (2013). Population estimates of birds in Great Britain and the United Kingdom. British Birds 106: 64-100.

Natural England, 2014. Written Representations of Natural England. Hornsea Offshore Wind Farm — Project One Application. Planning Inspectorate Reference: EN010033 Available at: http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010033/2.%20Post-Submission/Representations/Written%20Representations/Natural%20England.pdf.

Natural England (2021a). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards: Phase III: Expectations for data analysis and presentation at examination for offshore wind applications: V1, DRAFT.

Natural England (2021b). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards: Expectations for pre-application baseline data for nature conservation and landscape receptors to support offshore wind applications.

Natural England (2021c). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards: Phase II: Expectations for pre-application engagement and best practice guidance for the evidence plan process.

Natural England (2022a). Highly Pathogenic Avian Influenza (HPAI) outbreak in seabirds and Natural England advice on impact assessment (specifically relating to offshore wind). Natural England statement, September 2022.

Natural England (2022b). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Natural England statement, August 2022.

Natural England (2023). Natural England SoS Consultation Response. Annex 1: Interim guidance on collision risk modelling avoidance rates.

Natural England and JNCC. (2012). Joint Natural England and JNCC Interim Advice Note – Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation of Offshore Wind farm Developments.

NatureScot. (2020). Seasonal definitions for birds in the Scottish Marine Environment. Short Guidance Note, Version 2, October 2020.

Norfolk Vanguard Ltd (2018). Norfolk Vanguard Offshore Wind Farm Environmental Statement Chapter 13 Offshore Ornithology.

Orsted (2021). Hornsea Four Environmental Statement (ES). Volume A2, Chapter 5 : Offshore & Intertidal Ornithology.

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022c). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp.

Parsons, M., Bingham, C., Allcock, Z. & Kuepfer, A. (2019). Summary of evidence of aggregations of Balearic shearwaters in the UK up to 2013. JNCC Report No. 642, JNCC, Peterborough, ISSN 0963-8091.

Pearce-Higgins, J.W. and Crick, H.Q.P. (2019). One-third of English breeding bird species show evidence of population responses to climatic variables over 50 years. Bird Study 66(2), pp. 159–172. doi: 10.1080/00063657.2019.1630360.

Pérez-Domínguez, R., Barrett, Z., Busch, M., Hubble, M., Rehfisch, M. & Enever, R. 2016. Designing and applying a method to assess the sensitivities of highly mobile marine species to anthropogenic pressures. Natural England Commissioned Reports, Number 213

Pentland Floating Offshore Wind Farm (2022). Environmental Impact Assessment Report. Highland Wind Limited.

Peschko, V.,Mendel, B., Mueller, S., Markones, N., Mercker, M. and Garthe, S. (2020). Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season. Marine Environmental Research. 162.

Phillips, J., Banks, A., Bolton, M., Brereton, T., Cazenave, P., Gillies, N., Padget, O., van der Kooij, J., Waggitt, J., Guilford, T., (2021). Consistent concentrations of critically endangered Balearic shearwaters in UK waters revealed by at-sea surveys. Ecology and Evolution 11.

Rebke, M., Dierschke, V., Weiner, C. N., Aumüller, R., Hill, K., & Hill, R. (2019). Attraction of nocturnally migrating birds to artificial light: The influence of colour, intensity and blinking mode under different cloud cover conditions. Biological Conservation, 233, 220-227.

Robinson, R.A. (2005). BirdFacts: profiles of birds occurring in Britain & Ireland. BTO, Thetford (http://www.bto.org/birdfacts, accessed on 01 February 2023).

Ronconi, R. A., Allard, K. A., & Taylor, P. D. (2015). Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. Journal of Environmental Management, 147, 34-45.

Royal Haskoning DHV (2013). Thanet Offshore Wind Farm Ornithological Monitoring 2012-2013 (Post-construction Year 3). Royal HaskoningDHV Report for Vattenfall Wind Power Limited.

Shoji, A., Dean, B., Kirk, H., Freeman, R., Perrins, C. M., & Guilford, T. (2016). The diving behaviour of the Manx Shearwater Puffinus puffinus. Ibis, 158(3), 598-606.

Skov, H., Heinanen, S., Norman, T., Ward, R., Mendez-Roldan, S., & Ellis, I. (2018). ORJIP Bird Avoidance behaviour and collision impact monitoring at offshore wind farms. The Carbon Trust. United Kingdom. 247 pp.

Searle, K., Mobbs, D., Butler, A., Bogdanova, M., Freeman, S., Wanless, S., and Daunt, F. (2014). Population consequences of diaplcement from proposed offshore wind energy developments for seabirds breeding at Scottish Spas (CR/2012/03). Final report to Marine Scotland Science.

Searle, K., Butler, A., Mobbs, D., Bogdanova, M., Wanless, S., Bolton, M. and Daunt, F. (2015). At-Sea Turnover of Breeding Seabirds-Final Report to Marine Scotland Science. Scottish Marine and Freshwater Science.

Searle, K., Mobbs, D., Butler, A., Furness, R., Trinder, M., and Daunt, F. (2018). Finding out the Fate of Displaced Birds. Scottish Marine and Freshwater Science Vol 9 No 8, 149pp.

Searle, K., Mobbs, D., Daunt, F., and Butler, A. (2019). A Population Viability Analysis Modelling Tool for Seabird Species. Centre for Ecology & Hydrology report for Natural England. Natural England Commissioned Report NECR274.

Searle, K., Butler, A., Mobbs, D.C., Trinder, M., Waggit, J., Evans, P., and Daunt, F. (2020). Scottish Waters East Region Sectoral Marine Plan Strategic Ornithology Study: final report. CEH report NEC07184.

SEER 2022. U.S. Offshore Wind Synthesis of Environmental Effects Research (SEER). Risk to Marine Life from Marine Debris & Floating Offshore Wind Cable Systems. Report by National Renewable Energy Laboratory and Pacific Northwest National Laboratory for the U.S. Department of Energy, Wind Energy Technologies Office. Available at https://tethys.pnnl.gov/seer [accessed 01/02/2023].

SNCBs, (2014) Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review.

SNCBs, (2017) Joint 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 (OWF) developments.

SNCBs, (2022) Joint 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 (OWF) developments (updated January 2022 to include reference to the Joint SNCB Interim Advice on the Treatment of Displacement for Red-Throated Diver).

Spivey, R. J., Stansfield, S., & Bishop, C. M. (2014). Analysing the intermittent flapping flight of a Manx Shearwater, Puffinus puffinus, and its sporadic use of a wave-meandering wing-sailing flight strategy. Progress in Oceanography, 125, 62-73.

Stanbury, A., Eaton, M.A., Aebischer, N.J., Balmer, D., Brown, A.F., Douse, A., Lindley, P., McCulloch, N., Noble, D.G. and Win, I. (2021). The status of our bird populations: the fifth. Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and the second IUCN Red List assessment of extinction risk for Great Britain British Birds, 114(12), 723-747

Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J. and Pienkowski, M.W. (1995). An atlas of seabird distribution in north-west European waters, JNCC, Peterborough, ISBN 1 873701 94 2.

Syposz, M., Padget, O., Willis, J., Van Doren, B. M., Gillies, N., Fayet, A. L., ... & Guilford, T. (2021). Avoidance of different durations, colours and intensities of artificial light by adult seabirds. Scientific Reports, 11(1), 18941.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A., Roos, S., Bolton, M., Langston, R. and Burton, N. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61.

The Crown Estate (2017). Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality.

The Crown Estate, Womble Bond Dickinson, (2021). Headroom in Cumulative Offshore Windfarm Impacts for Seabirds: Legal Issues and Possible Solutions (Offshore Wind Evidence and Change Programme).Tjørnløv, R.S., Skov, H., Armitage, M., Barker, M., Jørgensen, J.B., Mortensen, L.O., Thomas, K., Uhrenholdt, T. (2023). AOWFL. Resolving Key Uncertainties of Seabird Flight and Avoidance Behaviours at Offshore Wind Farms: Final Report for the study period 2020-2021.

Trektellen (2023). Available at https://www.trektellen.org/, accessed 14/02/23.

Vallejo, G. C., Grellier, K., Nelson, E. J., McGregor, R. M., Canning, S. J., Caryl, F. M. and McLean, N. (2017). Responses of two marine top predators to an offshore wind farm. Ecology and Evolution, 7(21), pp. 8698-8708.

Van de Kam, J., Ens, B., Piersma, T. and Zwarts, L. (2004). Shorebirds: an illustrated behavioural ecology. Brill.

Van Kooten, T., Soudijn, F., Tulp, I., Chen, C., Benden, D., & Leopold, M. (2019). The consequences of seabird habitat loss from offshore wind turbines, version 2: Displacement and population level effects in 5 selected species (No. C063/19). Wageningen Marine Research.

Vanermen, N., Courtens, W., Van De Walle, M., Verstraete, H., & Stienen, E. (2019). Seabird monitoring at the Thornton Bank offshore wind farm: Final displacement results after 6 years of post-construction monitoring and an explorative Bayesian analysis of common guillemot displacement using INLA. In Environmental impacts of offshore wind farms in the Belgian part of the North Sea: Marking a decade of monitoring, research and innovation (pp. 85-116).

Waggitt, J.J., Evans, P.G.H., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J., Felce, T., Fijn, R.C., GarciaBaron, I., Garthe, S., Geelhoed, S.C.V., Gilles, A., Goodall, M., Haelters, J., Hamilton, S., Hartny-Mills, L., Hodgins, N., James, K., Jessopp, M., Kavanagh, A.S., Leopold, M., Lohrengel, K., Louzao, M., Markones, N., Martínez-Cedeira, J., Ó Cadhla, O., Perry, S.L., Pierce, G.J., Ridoux, V., Robinson, K.P., Santos, M.B., Saavedra, C., Skov, H., Stienen, E.W.M., Sveegaard, S., Thompson, P., Vanermen, N., Wall, D., Webb, A., Wilson, J., Wanless, S., Hiddink, J.G., (2019). Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology.

Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T. (2020). Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), pp.253-269.

Wakefield, E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., ... and Bolton, M. (2017). Breeding density, fine-scale tracking, and large-scale modeling reveal the regional distribution of four seabird species. Ecological Applications, 27(7), 2074-2091.

Webb, A., Irwin, C., Mackenzie, M., Scott-Hayward, L., Caneco, B., & Donovan, C. (2017). Lincs wind farm: third annual post-construction aerial ornithological monitoring report. Unpublished report, HiDef Aerial Surveying Limited for Centrica Renewable Energy Limited. CREL LN-E-EV-013-0006-400013-007.

Welcker, J., Liesenjohann, M., Blew, J., Nehls, G., & Grünkorn, T. (2017). Nocturnal migrants do not incur higher collision risk at wind turbines than diurnally active species. Ibis, 159(2), 366-373.

Welsh Government (2019). Welsh National Marine Plan.

Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie S. (2002). The Migration Atlas. Movements of Birds of Britain and Ireland. British Trust for Ornithology.

Wildfowl and Wetlands Trust and MacArthur Green (2013). Strategic Assessment of collision risk of Scottish offshore wind farms to migrating birds. Report for Marine Scotland.

Wilson, L.J., Black, J., Brewer, M.J., Potts, J.M., Kuepfer, A., Win, I., Kober, K., Bingham, C., Mavor, R. and Webb, A. (2014) Quantifying usage of the marine environment by terns Sterna sp. around their breeding colony SPAs. JNCC Report No.500.

Woodward, I. *et al*. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. BTO research report number 724. Thetford.

Wright, L.J., Ross-Smith, V.H., Austin, G.E., Massimino, D., Dadam, D., Cook, A.S.C.P., Calbrade, N.A., and Burton, N.H.K. (2012). SOSS-05: Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species) (BTO Research Report No. 590), SOSS05. British Trust for Ornithology.

WWT (2014). Strategic Assessment of collision risk of Scottish offshore wind farms to migrating birds. Report for Marine Scotland by Wildfowl and Wetlands Trust and MacArthur Green.

Zuur, A.F. (2018). Effects of wind farms on the spatial distribution of guillemots. Unpublished report. Wageningen Marine Research T, 31 (0), 317.

Appendix 13.A: Offshore Ornithology Technical Report

White Cross Offshore Windfarm Environmental Statement

Appendix 13.A: Offshore Ornithology Technical Report

WHITE CROSS

Document Code:	FLO-WHI-REP-00002-13	
Contractor Document Number:	PC2978-RHD-ZZ-XX-RP-Z-0148	
Version Number:	0	
Date:	*Issue Date 10/03/2023*	
Prepared by:	*RHDHV, APEM*	*Electronic Signature*
Checked by:	*CB*	*Electronic Signature*
Owned by:	*PT*	*Electronic Signature*
Approved by Client :	*AP*	*Electronic Signature*

Version Number	**Reason for Issue / Major Changes**	**Date of Change**
0	For issue	10/03/2023

Table of Contents

Table of Figures

Table of Tables

Glossary of Acronyms

Acronym	Definition
CRM	Collision risk modelling
CV	Coefficient of variation
ES	Environmental Statement
HAT	Highest astronomical tide
km	Kilometre
LCI	Lower 95% confidence interval
m	Metre
NE	Natural England
OWF	Offshore Windfarm
PCH	Potential collision height
QA	Quality Assurance
rpm	Revolutions per minute
sCRM	Stochastic collision risk modelling
SD	Standard deviation
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage (now renamed NatureScot)
UCI	Upper 95% confidence interval
Y/N	Yes/no

Glossary of Terminology

Defined Terms	Description
Applicant	Offshore Wind Limited
Development Area	The area comprising the Onshore Development Area and the Offshore Development Area
Export Cable Corridor	The area in which the export cables will be laid, from the Offshore Substation Platform to the Onshore Substation comprising both the Offshore Export Cable Corridor and Onshore Export Cable Corridor.
Inter-array cables	Cables which link the wind turbines to each other and the Offshore Substation Platform
Landfall	Where the offshore export cables come ashore.
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure.
Offshore Development Area	The Windfarm Site and Offshore Export Cable Corridor to Landfall.
Offshore export cables	The cables which would bring electricity from the Offshore Substation Platform to the Landfall.
Offshore Export Cable Corridor	The proposed offshore area in which the export cables will be laid, from the perimeter of the Windfarm Site to Landfall.
Offshore infrastructure	All of the offshore infrastructure including wind turbines, Offshore Substation Platform(s) and all cable types.
the Offshore Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure assoCEAted with the export cable route and landfall (up to MHWS) including the cables and assoCEAted cable protection (if required).
Offshore Substation Platform(s)	A fixed structure located within the Windfarm Site, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Onshore Development Area	The onshore area above MHWS including the underground onshore export cables connecting to the Onshore Substation
Onshore Export Cables	The cables which bring electricity from Landfall to the Onshore Substation.
Onshore Export Cable Corridor	The proposed onshore area in which the export cables will be laid, from Landfall to the Onshore Substation
Onshore infrastructure	The combined name for all infrastructure associated with the Project from Landfall to grid connection.

Defined Terms	Description
the Onshore Project	The Onshore Project for the onshore TCPA application includes all elements onshore of MLWS. This includes the infrastructure assoCEAted with the offshore export cable (from MLWS), landfall, onshore export cable and assoCEAted infrastructure and new onshore substation (if required).
Onshore Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of the electrical transformers.
Platform link cable	This is an electrical cable which links one or more offshore platforms.
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities assoCEAted with the Project.
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present

1. Introduction

1. This technical report supports **Chapter 13: Offshore Ornithology** of the Environmental Statement (ES), which considers the potential impacts of the proposed White Cross Offshore Wind Farm (hereafter refer to as 'the Windfarm Site').

2. The report presents further details of several aspects of the assessment not included in the ES chapter:

- Information regarding the collection of baseline information from the site-specific surveys
- How these data were treated to produce robust density and abundance estimates of offshore ornithology receptors within the offshore study area and other reporting regions, and presentation of these by survey (**Annex 1**)
- Outputs of calculations to estimate the magnitude of potential displacement effects during operational phase for EIA (**Annex 2**) calculations
- CRM methodology, input and detailed output for species screened out of assessment (the latter being presented in **Annex 3**)
- Finally, the SNH (2018) Apportionment Results for Manx Shearwater are presented in **Annex 4**.

2. Data sources

3. The key data source was site specific surveys which aimed to characterise the baseline abundance and density of birds within the study area. Surveys recorded digital aerial video at high resolution over the study area, to capture activity of birds, marine mammals and other marine megafauna, plus human activity. The study area ('survey area') included the extent of the Offshore Development Area (Windfarm Site and Offshore Export Cable Corridor, plus buffers of extent 2km and 4km in all directions around the Windfarm Site. The total survey area was 230km^2. The total programme of monthly surveys spans 24 months from July 2020 to June 2022.

4. The baseline is also informed by literature sources as outlined with **Chapter 13: Offshore Ornithology.**

3. Survey methods

5. Monthly digital still aerial surveys of the Windfarm site and 4km buffer were undertaken between July 2020 to June 2022, in accordance with Natural England best practice guidance (Parker *et al.*, 2022a). The approach to surveys was discussed with stakeholders during pre-application consultation.

6. Nine parallel transects were placed 1.4km apart across the Windfarm site and with a 4km buffer. The transect length was such that surveys could be completed in a single day year-round, which is considered to be desirable (where possible) for this type of survey to minimise double counting of birds.

7. All surveys were flown at a height of approximately 400m above sea level, and were undertaken with sensors set to a resolution (or ground sampling distance) of 1.5cm. The camera system captured abutting still imagery along the survey transects. A grid-based survey design was employed to give a total coverage of 10% of the Windfarm site and 4km buffer per survey.

8. The dates, start and end times, and the approximate sunrise and sunset times for each survey day are presented in **Table 3.1**, along with the total length of transects used in subsequent analysis. Whilst the same transect lines were used for each survey, exact survey effort differed slightly between surveys due to minor differences in start and stop times for transects and minor deviations of the aircraft from the transect line. Surveys were generally carried out between approximately 0900 and 1500 year round, meaning that certain times of day were not sampled, as is typical for surveys of this nature. Some bias in the survey methodology is unavoidable. There is little scope to vary the time of day at which surveys occur, due to factors such as aircraft logistics, transit to and from the study area, the timing of windows for suitable light and weather, commencement of surveys sufficiently early to complete in a single day, and leaving time for survey completion in the event of any issues during the survey. It should be noted that this is not an issue restricted to White Cross, it is a potential issue at all offshore windfarms (OWFs).

Table 3.1 Survey dates, start and end times and coverage achieved from each survey. Sunrise and sunset times for the survey dates (for co-ordinate 51.106915 N, 5.3865161 W) are also included. All times are in Coordinated Universal Time.

Survey Number	Date	Survey start	Survey end	Sunrise	Sunset	Coverage analysed(%)
1	06-07-20	14:53	16:13	04:15	20:37	11.18
2	26-08-20	14:27	15:49	05:26	19:19	11.18
3	10-09-20	09:06	10:27	05:49	18:46	11.23
4	15-10-20	10:05	11:20	06:46	17:28	11.18
5	10-11-20	12:13	13:23	07:30	16:40	11.18
6	05-12-20	12:37	14:07	08:09	16:16	11.18
7	06-01-21	10:49	12:11	08:24	16:31	11.18
8	22-02-21	15:31	16:48	07:20	17:50	11.18
9	07-03-21	12:28	13:51	06:53	18:13	11.04

Survey Number	Date	Survey start	Survey end	Sunrise	Sunset	Coverage analysed(%)
10	03-04-21	13:06	14:21	05:52	18:58	11.18
11	01-05-21	10:09	11:38	04:54	19:44	11.18
12	08-06-21	09:05	10:36	04:08	20:34	11.18
13	02-07-21	13:58	15:17	04:12	20:39	11.18
14	17-08-21	10:18	11:32	05:12	19:39	11.18
15	03-09-21	16:58	18:35	05:38	19:02	11.18
16	01-10-21	15:57	17:12	06:22	17:59	11.18
17	07-11-21	10:48	12:02	07:25	16:45	11.18
18	21-12-21	10:43	12:21	08:23	16:17	11.18
19	05-01-22	13:06	14:17	08:24	16:30	11.18
20	03-02-22	13:25	14:47	07:56	17:16	11.18
21	10-03-22	13:27	16:27	06:47	18:18	11.18
22	09-04-22	10:20	13:12	05:40	19:08	11.18
23	11-05-22	12:33	13:47	04:38	19:59	11.26
24	01-06-22	09:24	10:39	04:12	20:27	11.23

4. Data analysis

4.1 Bird abundance and density estimates

4.1.1 Summary of Data Quality Control

9. Internal Quality Assurance (QA) was carried out on the data collected from each of the surveys. Images were assessed in batches with a different staff member responsible for each. Images containing birds and/or marine megafauna were reviewed and checked by the QA Manager. A minimum of 50% of birds and marine megafauna recorded were assessed to confirm all species were correctly identified. Images without birds and/or marine megafauna were removed and stored separately, and of these 'blank' images, 10% randomly selected for QA. If there was <90% agreement, the entire batch was re-analysed independently by a different member of staff.

4.1.2 Data Treatment

10. Following the review and identification of all objects, data were processed for estimating abundance and distribution of offshore ornithology receptors.

11. Geo-referenced locations of marine fauna contained within each individual digital still image were used to generate raw counts by survey. Marine fauna locations contained within the boundaries of the Windfarm Site and 4km buffer were extracted using a GIS.

12. Birds that were unable to be identified to the species level were apportioned based on the proportional densities of species making up the wider species group by survey. For example, if there were 10 unidentified "large auks" (a species group consisting of razorbills and guillemots), and the total number of identified razorbill and guillemots was 20 and 80 respectively, then two large auks would be apportioned to razorbills and eight would be apportioned to guillemots for a total population of 22 and 88 respectively. Apportioning is done separately for flying birds, sitting birds, and the combination of both behaviour types (all birds).

13. The raw counts were divided by the number of images collected to give the mean number of animals per image (i). Population estimates (N) for each survey month were subsequently generated by multiplying the mean number of animals per image by the total number of images required to cover the Survey Area (A) (i.e. N = i A).

14. Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper

and lower 95% confidence intervals of these 999 values were taken as the variability of the statistic over the population (Efron & Tibshirani, 1993).

15. A measure of precision was calculated using a Poisson estimator, suitable for a pseudo-Poisson over-dispersed distribution. This produced a coefficient of variation (CV) based on the relationship of the standard error to the mean.

16. All analyses and data manipulation were conducted in the R programming language (R Development Core Team, 2012) and non-parametric 95% confidence intervals were generated using the 'boot' library of function (Canty & Ripley, 2010). This resulted in species-specific monthly abundance estimates being calculated from the raw count data, with upper and lower confidence limits. Where appropriate, a level of precision is also presented for each monthly abundance estimate. Dividing the monthly abundance estimates by the size of the area covered calculates the associated density (e.g. animals perkm^2) for any given species.

17. Densities and abundances were reported for three reporting regions; the Windfarm Site, Windfarm Site plus 2km buffer, and Windfarm Site plus 4km buffer.

5. Breeding Season Apportioning

5.1 Introduction

18. To determine how potential impacts from the Offshore Project may affect seabird features of designated and whether an adverse effect on site integrity (AEoI) may occur, predicted impacts are apportioned to individual colonies. The level of potential connectivity between the Offshore Project and the qualifying features of designated sites may vary seasonally, therefore apportionment has been undertaken on a seasonal basis.

19. The following sections provide a summary of the apportionment process undertaken for the Offshore Project and the resulting seasonal apportionment rates for all designated sites screened in for assessment of LSE detailed in the Report to Inform Appropriate Assessment (RIAA).

5.2 Methodology

5.2.1 Breeding season

5.2.1.1 Apportionment to individual colonies

20. Only species with breeding season connectivity to SPAs have been considered for breeding season apportionment. These species are Manx shearwater and gannet.

21. Due to there being multiple colonies within foraging range of the Offshore Project, in order to attribute the correct proportion of adult breeding birds to different colonies appropriately the method used to determine any adult's bird origin followed the SNH (2018) apportionment methodology. Although Natural England's best practice guidance note (Parker *et al.*, 2022) recommends the use of a 'range-based approach', the guidance is unclear as to how to appropriately undertake breeding season apportionment following such an approach, therefore the SNH (2018) apportionment process has been followed instead, as used for previous projects within the Western Waters region.

22. The SNH (2018) apportionment methodology is based on considering a species' foraging range in addition to three colony-specific weighting factors:

- Colony size (in individuals)
- Distance of colony from the development site
- Sea area (the real extent of the open sea within the foraging range of the relevant species).

23. All colonies within mean-max plus one Standard Deviation (SD) foraging range (Woodward *et al.,* 2019) are included.

24. Foraging ranges are based on at sea distances taking into account land barriers to movements for species which are known to avoid commuting over land. The colony sizes of designated sites within foraging range were derived from the latest available colony size data available from the SMP database, except for:

25. Distance of colony from the development site area and sea area were calculated in QGIS. Distance to colony was calculated from the SPA boundary to the closest point of the array area taking the shortest at sea distance route possible. Sea area was calculated by buffering the SPA centroid by the seabirds mean max plus one SD foraging range then removing all area over land and areas where seabirds are unlikely to forage such as estuaries.

26. The three weighting factors noted above were incorporated the following equations for each colony:

- Proportion of foraging range at sea:
  - Sea area / Theoretical Foraging Area: Where Theoretical Foraging Area is the area of a circle with radius equal to the mean-max plus one SD foraging range. For a hypothetical colony on the edge of a continent with a perfectly straight coastline, the sea proportion would equal 0.5 (i.e., half the theoretical foraging area is sea; the other half is land).
- A colony-specific weighting is calculated as follows:
  - Colony Weight = (Colony Population / Sum of Populations) * (Sum of Distance2 / Colony Distance2) * (1/Colony Sea Proportion / Sum of 1/Sea Proportions).
- The proportion apportioned to each colony is calculated as:
  - Colony Weight / Sum of Colony Weights: the SNH (2018) apportionment input values and resulting apportionment to all colonies within mean max plus one SD for both species is presented in **Annex 4**.

5.2.1.2 Consideration of immature and sabbatical birds

27. During the breeding season there is potential not only for breeding adult birds within foraging range of the Offshore Project to have connectivity but also juvenile,

immature and sabbatical birds[1] which are not associated with any given colony, because of this these free roaming birds need to be accounted for when apportioning impacts.

28. The proportion of juvenile and immature birds comparatively to the number of breeding adults which may be connected to the Offshore Project can typically be calculated using the age ratios from the digital aerial surveys or from using generalised stable age structure data. In relation to the use of age ratios from the digital aerial survey data, there are a number of key issues with accurately identifying age of key seabirds as detailed below.

29. For Manx shearwater, adults and juveniles are similar in plumage and so there are no distinguishable features that can separate the age categories. The average breeding age for Manx shearwater is five years old (Horswill and Robinson, 2015), therefore the treatment that all 'adult type' appearance birds are breeding adults, as would be the case when using site-specific survey data, means it is highly likely to overestimate the proportion of breeding adult birds with the Offshore Project.

30. In relation to gannet, with juvenile (first calendar year birds) plumage being primarily grey/brown in colour with a lack of a distinct yellow head (Svensson *et al*. 2009) this makes them distinctly different to adult birds. For second calendar year birds, the grey-brown plumage on the head, underparts, uppertail-coverts and usually some of the lesser wing uppertail-coverts becomes white (Svensson *et al*. 2009), makes this age category readily distinguishable from adult birds. For third calendar year birds most tail-feathers and secondaries are usually black intermixed with white feathers, whilst the remaining body and head largely resemble the plumage of an adult bird, although these birds are still readily identifiable from adult birds, depending on the quality of the aerial digital video data and behaviour of the bird recorded (e.g. banking birds) might be difficult to observe and therefore this age category may be less regularly distinguished from adult birds. For fourth calendar year birds only the central tail-feathers and the odd scattered secondaries remain black, the rest of the bird's plumage resembles that of an adult bird, depending on the quality of the aerial digital video data and behaviour of the bird recorded (e.g. banking birds) might be difficult to observe and therefore this age category may be less regularly distinguished from adult birds. From fourth calendar year onwards the plumage of gannets remains indistinguishable, with the average age of first breeding at five years old. There is therefore potential to overestimate the proportion of breeding adult birds with the Offshore Project when using site-specific survey data.

[1] birds of breeding age but not participating in breeding activities during a breeding season

31. For the purpose of these assessments, the proportion of adult/ immature present in the Offshore Project area during the breeding season is based on using Appendix A of Furness (2015) stable age structure data. The data presented in Furness (2015) are considered to provide a more accurate representation of population age structure than site-specific survey data for reasons set out above. Furthermore, Furness (2015) draws upon a wide number of data sources gathered across multiple years in order to model population age structure, thus reducing the potential for any bias associated with the snapshot nature of site-based surveys. A summary of the adult/ immature age ratio for key seabirds is provided in **Table 5.1**.

32. Not all adult birds present in the Offshore Project area will be breeding birds. This is evidenced from adult sabbatical birds free roaming the UK waters whilst taking a break from breeding activities (Marine Scotland 2017). The sabbatical rate for key seabird populations were agreed by Marine Scotland for the Seagreen 1 OWF Appropriate Assessment and subsequently used for other projects such as Moray West and other Forth and Tay projects as including at least 10% of adult birds for gannet, so this minimum value has been applied for use in this assessment for this project. There is no data available or recommendation for a Manx shearwater sabbatical rate and so, as a precautionary measure, sabbatical rate was not included in Manx shearwater apportionment.

Table 5.1 Proportion of adult, immature and sabbatical birds included within the apportionment process.

Species	Adult / immature ratio	Sabbatical rate	Total breeding adult rate
Manx shearwater	63%/ 37%	NA	63%
Gannet	60%/ 40%	10%	54%

5.2.1.3 Final Breeding season apportionment

33. The final breeding season apportionment values for each designated site is provided in **Table 5.2**, accounting for the apportionment results in **Annex 4** and also the total breeding adult rate in **Table 5.1**.

5.2.1.4 Alternative migration-free breeding season Manx shearwater apportionment based on tracking data

34. The standard apportionment methodology outlined in **Section 5.2.1** uses the mean max plus one SD foraging range for Manx shearwater of 2,365.5km and is based on the full breeding bio-season of April to August, as defined in Furness 2015. Using this standard approach includes far northern colonies of Manx shearwater in Scotland. However, tracking data (Padjet *et al*., 2019) for Manx shearwater foraging trips from UK

colonies suggests that connectivity with the Offshore Project is likely to only exists with Manx shearwaters from south-western (colonies south of the Scottish border) colonies of the UK only (**Figure 5.1**). Therefore, as a precautionary measure an alternate apportionment process has been undertaken using the mean plus one SD foraging range due to tracking data suggesting the mean to be a more realistic reflection of potential connectivity. Apportionment for this scenario is based on the core migration-free breeding bio-season months of June to July (Furness, 2015), due to the full breeding season potentially including birds from more northernly colonies undertaking late return migration or early post migration, as suggested by site-specific flight directional data (**Figure 8.11**). The final migration-free breeding season apportionment values for each designated site is provided in **Table 5.2**, accounting for the apportionment results in **Annex 4** and also the total breeding adult rate in **Table 5.1**.

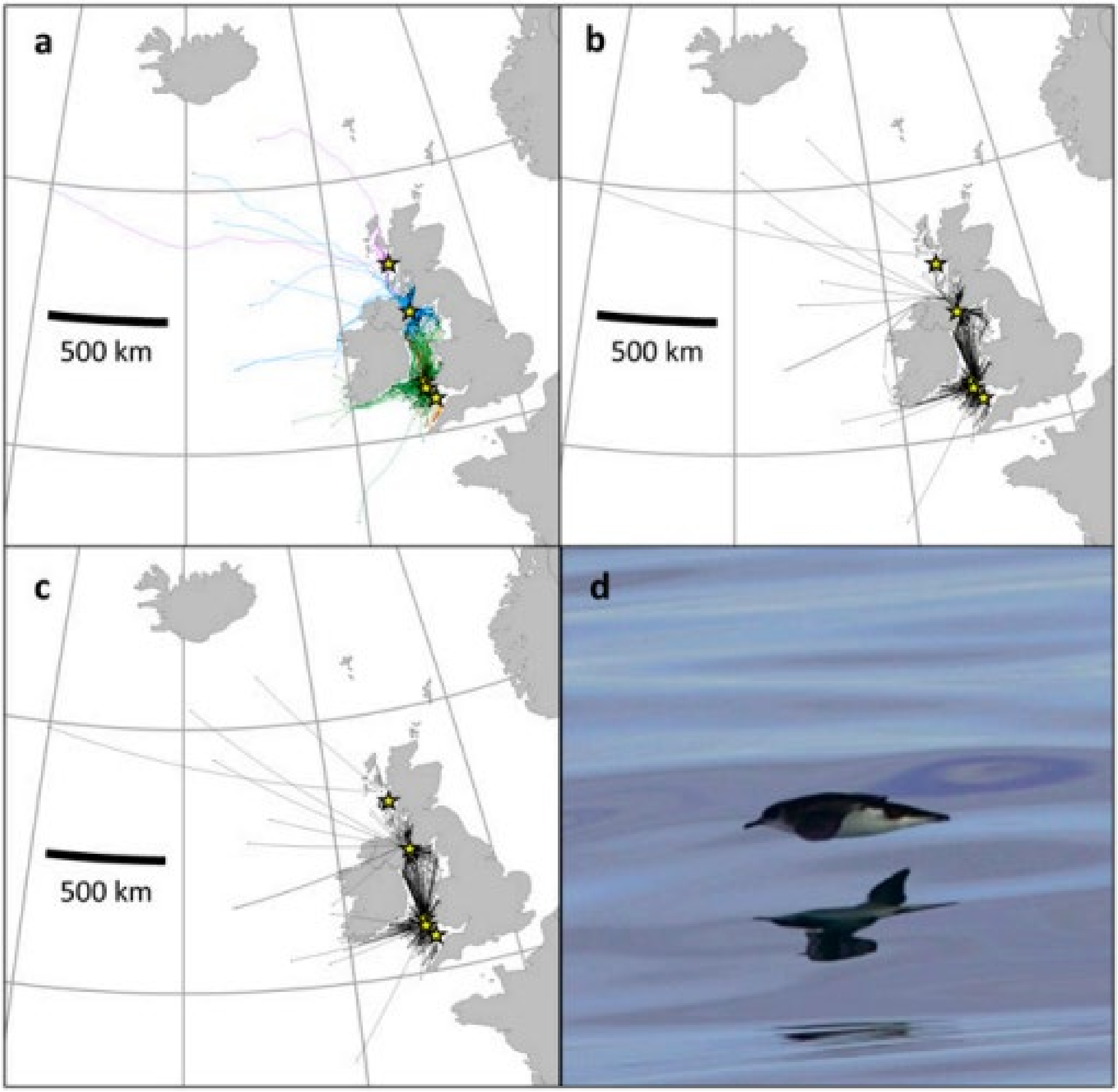


Figure 5.1 Padjet et al., (2019) Map of Manx shearwater foraging range tracking data. (A) Shows the GPS tracks of shearwater foraging trips after the algorithmically identified start of homing behaviour. Track colours represent different colonies of origin

5.2.2 Non-breeding season

35. Outside of the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population.

36. This apportionment is based on calculating the proportion of the breeding adults within the UK Western Waters BDMPS population that can be attributed to the various SPAs as defined by Furness (2015), based on the data within that report. This follows Natural England's best practice guidance (Parker *et al*, 2022). It must be noted that the

colony counts in Furness (2015) may differ from the SPA citation populations for some species, but in order to provide a level of consistency within this assessment the same source is used for both the colony counts and the wider UK Western Waters population estimates. Following this approach to apportionment the proportion of the BDMPS populations for all features and designated sites screened in for assessment are provided in **Table 5.2**.

5.2.3 Apportionment Results

37. The seasonal apportionment values for all European sites qualifying features screened in for assessment are provided in **Table 5.2**.

Table 5.2 Seasonal apportioning rates of predicted impacts from the Offshore Project to European sites and qualifying features

Site	Feature	Full breeding season	Migration -free breeding season	Non-breeding season	Post-breeding migration season	Return migration season
Skomer, Skokholm and the Seas off Pembrokeshire SPA	Manx shearwater	60.32%	60.50%	NA	44.28%	44.28%
Aberdaron Coast and Bardsey Island SPA	Manx shearwater	0.28%	0.33%	NA	2.05%	2.05%
Copeland SPA	Manx shearwater	0.02%	NA	NA	0.03%	0.03%
Rum SPA	Manx shearwater	0.14%	NA	NA	15.18%	15.18%
St Kilda SPA	Manx shearwater	0.00%	NA	NA	0.61%	0.61%
Lundy SSSI	Manx shearwater	1.64%	1.71%	NA	0.70%	0.70%
Grassholm SPA	Gannet	52.08%	NA	NA	14.39%	11.87%
Saltee Islands SPA	Gannet	1.41%	NA	NA	0.35%	0.43%
Ailsa Craig SPA	Gannet	1.12%	NA	NA	9.94%	8.20%

6. Collision Risk Modelling

38. CRM was carried out using the stochastic CRM (sCRM) tool (McGregor *et al.*, 2018). This section should be read in conjunction with **Chapter 13: Offshore Ornithology,** which contains a range of details on the modelling, including species screened into and out of the assessment and input parameters.

39. Input parameters for the wind turbine array were derived from the Project Description (see **Chapter 5: Project Description**). This presents numerous options for the Offshore Project. To compare relative estimated impacts on birds of all five turbine scenarios considered for the Offshore Project, CRM was carried out using the stochastic CRM tool for all five scenarios for gannet, herring gull, great black-backed gull, lesser black-backed gull, and kittiwake (i.e. species covered by Natural England (2022) Phase III Best Practice for Data Analysis and Presentation at Examination. For all species, the worst-case turbine array scenario was identified to be the 6x18MW turbine site design (highest estimated annual collisions for a given species). sCRM was completed for this scenario and the 6x15MW turbine site design scenario (identified by the applicant as the site design most likely to be progressed). The Offshore Project parameters used in the model are presented in **Table 6.1** and **Table 6.2**.

Table 6.1 Turbine parameters used in the sCRM

Parameter		
Turbine	15MW	18MW
Number of turbines	7	6
Number of blades	3	3
Max blade width (m)	7	12
Average blade pitch (deg)	3	3
Rotor diameter (m)	236	262
Rotor radius (m)	118	131
Rotation speed (rpm)	8.4	7.0
Hub height above HAT (m)	140	153
Air gap above HAT (m)	22	22
Tidal offset (m)	0	0
Latitude[1]	51.10	51.10
Large array correction (Y/N)	N	N
Wind farm width	n/a	n/a
Notes **Standard deviation was 0 for all above parameters** **At central point**		

Table 6.2 Monthly operation parameters used in the sCRM

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind availability (%)	97.2692	96.7214	96.0733	93.7401	93.5612	91.5476	92.1755	91.5579	93.6508	96.1534	96.5046	97.3566
Mean downtime (%)	3	3	3	3	3	3	3	3	3	3	3	3
SD downtime	0	0	0	0	0	0	0	0	0	0	0	0

6.1.1.1 Seabird Densities

40. The sCRM tool requires that the mean flying bird density estimates for the Windfarm site and the estimated standard deviations for each data point, are processed into monthly estimates. The mean density for a given month was calculated as the mean of the mean densities for all surveys carried out in that month. These calculations included "zero" data points from surveys during which no records of the species in question were made. To estimate standard deviation of flight density per month, the mean of the standard deviations for all surveys in that month, was calculated.

6.1.1.2 Flight Height

41. Flight height can be incorporated into CRM in four different ways:

- Option 1: basic model (i.e. % birds at Potential Collision Height (PCH)), typically using site-specific or area-specific data;
- Option 2: basic model (i.e. % birds at PCH) using generic flight height distribution data ("Corrigendum," 2014; Johnston *et al.*, 2014);
- Option 3: extended model (i.e. modelled flight height distributions across rotor height) using generic flight height distribution data ("Corrigendum," 2014; Johnston *et al.*, 2014); and
- Option 4: as option 3 but using site-specific or area-specific data.

42. Collision risk has been calculated using Option 2 of the CRM and maximum-likelihood published flight height distributions ("Corrigendum," 2014; Johnston *et al.*, 2014). Option 2 has been selected as this is considered to provide the most realistic results, using the available data; this approach was discussed and agreed with Natural England during pre-application consultation.

6.1.1.3 Avoidance Rates

43. The avoidance rates and associated variation suggested for use by the SNCBs with Options 1 and 2 of CRM (UK SNCBs, 2014) were recommended following the publication of Cook *et al*. (2014). For all species, CRMs are undertaken using Option 2 of the CRM (i.e. basic version, with Johnston *et al*. (2014) and "Corrigendum" (2014) flight height data) with the recommended avoidance rates applied.

44. For herring gull, great black-backed gull and lesser black-backed gull, the avoidance rate used was 0.995 (SD 0.0005).

45. For gannet, and kittiwake, the avoidance rate used was 0.989 (SD 0.001).

46. For all other species screened in (guillemot, puffin, common tern, fulmar, Manx shearwater), the avoidance rate used was 0.980 (SD 0.001).

6.1.1.4 Nocturnal Activity

47. As recommended by Natural England (2022) Phase III Best Practice for Data Analysis and Presentation at Examination Table 14.4, the following nocturnal activity factors were used as input parameters to the stochastic CRM for each species: For Gannet, 0.1 and 0.2 (i.e., 10% and 20%). For kittiwake, lesser black-backed gull, herring gull and great black-backed gull: 0.25 and 0.50.

48. Standard deviation in all cases was 0 (zero).

6.1.1.5 Seabird Biometric Parameters

49. The biometric parameters of the offshore ornithology receptors used for CRM are presented in **Table 6.3**.

Table 6.3 Biometric and bird behaviour parameters (plus standard deviation (SD) values) for offshore ornithology receptors screened into CRM for White Cross

Species	Flight Type	Body Length (m)	Wingspan (m)	Flight Speed (m/s)
Gannet[1]	Gliding	0.94 (SD 0.0325)	1.72 (SD 0.0375)	14.9 (SD 0)
Great black-backed gull[1]	Flapping	0.71 (SD 0.035)	1.58 (SD 0.0375)	13.7 (SD 1.2)
Herring gull[1]	Flapping	0.60 (SD 0.0225)	1.44 (SD 0.03)	12.8 (SD 1.8)
Kittiwake[1]	Flapping	0.39 (SD 0.005)	1.08 (SD 0.0625)	13.1 (SD 0.4)
Lesser black-backed gull[1]	Flapping	0.58 (SD 0.03)	1.42 (SD 0.0375)	13.1 (SD 1.9)
Notes:				

Species	Flight Type	Body Length (m)	Wingspan (m)	Flight Speed (m/s)
[1] **Parameters from Natural England (2022) Phase III Best Practice for Data Analysis and Presentation at Examination Table 14.4. These are the same data used in Cook *et al*. (2014).**				

50. These input parameters have previously been used in other recent OWF assessments, and no more recent information has been considered for inclusion in the assessment.

7. Displacement

7.1 Seasonal mean peak abundance of seabirds

51. The 24 consecutive months of aerial surveys spanned all biological seasons of each given species (Furness 2015). The surveys spanned three calendar years (Jul-Dec 2020, entirety of 2021, Jan-Jun 2022). Abundance estimates within the Windfarm Site + 2km buffer area were used for estimating total populations potentially subjected to operational phase displacement, for all species assessed (gannet, guillemot, Manx shearwater, puffin, razorbill). When identifying peak abundance estimates for each biologically relevant season, two effective years of surveys were considered: 2021; and the combined partial years 2020 and 2022 which totalled a composite 12 months. The maximum mean, lower confidence interval and upper confidence interval abundance estimate in each season in each of these two 'years' was identified. The mean of each set of (two) seasonal peaks was used to produce mean peaks of mean, lower confidence interval and upper confidence interval abundance in each season for the species at Windfarm Site + 2km buffer. This approach (i.e. use of Site + 2km buffer) is consistent with Natural England best practice advice (Parker *et al.*, 2022b) and was discussed with Natural England during pre-application consultation.

52. For example, for gannet in **Section 8.4**, Furness (2015) identifies three biologically relevant seasons in UK waters: [Full] Breeding season (Mar-Sep), Autumn migration (Oct-Nov) and Spring migration (Dec-Feb). For the breeding season, the maximum values for mean, LCI and UCI estimated abundance in the Windfarm Site + 2km area in 2021, were variously in May (max LCI) and August (Mean and UCI); and for the composite year 2020/2022 all occurred in September 2020. The mean peak breeding season abundance, plus lower and upper confidence intervals, was the mean of the two means, plus mean of the LCI values and mean of the UCI values identified, respectively.

7.2 Displacement and mortality

53. The seasonal peak mean populations were considered to be the total number of individuals available to experience displacement by the Offshore Project. In displacement matrixes, displacement values were 10 to 100% and mortality values were 1 to 100%. Of these, values considered to apply and for consideration in assessment were:

- Gannet: 60-80% Displacement, 1% Mortality
- Auks and shearwaters: 30-70% Displacement, 1-10% Mortality.

8. Results

8.1 Ornithology Baseline – Windfarm Site and 4km buffer area (study area)

8.1.1 Summary

The following bird species were recorded during baseline surveys within the Windfarm Site and surrounding 4km buffer area (**Table 8.1**). Occurrence, estimated abundance and seasonal distribution for each species are outlined in species accounts provided in the following sections.

Table 8.1 Bird species apportioned population estimates within the windfarm site + 4km buffer total area in 24 months of baseline surveys (July 2020 to June 2022), with species-specific seasons delineated. Upper row: 2021, lower row: 2022 and 2020 composite

Species	J	F	M	A	M	J	J	A	S	O	N	D
Common gull*	0	0	0	0	0	0	0	0	0	0	16	0
	0	0	0	0	0	0	0	0	0	0	0	0
Common tern	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	68	0	0	0	0
Fulmar	8	63	39	0	7	0	0	16	8	0	0	8
	0	149	8	8	15	15	0	30	16	0	0	598
Gannet	16	39	140	117	220	103	0	248	128	149	8	23
	8	110	124	410	23	130	429	166	417	206	8	120
Great black-backed gull	8	0	16	0	0	0	0	0	0	8	0	0
	0	258	0	0	0	15	23	0	0	0	8	136
Great skua	0	0	0	0	0	0	0	0	0	8	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
Guillemot	671	1673	1259	206	6209	74	334	0	0	596	886	843
	1038	1308	4051	2174	1224	475	302	0	1010	0	73	672
Herring gull	0	0	0	8	7	0	23	0	0	0	0	31
	0	916	0	0	0	8	0	0	0	0	0	175
Kittiwake	1500	94	194	0	15	0	16	8	15	0	109	141

Species	J	F	M	A	M	J	J	A	S	O	N	D
	370	634	782	15	0	183	0	0	71	297	39	120
Lesser black-backed gull	0	0	0	0	22	8	23	48	23	0	0	0
	0	932	8	8	0	30	0	0	0	0	0	136
Manx shearwater	0	0	31	1489	27301	2817	202	0	23	0	0	0
	0	0	54	2212	990	2217	10143	1834	260	0	0	0
Puffin	0	0	9	20	26	0	0	0	0	0	0	0
	0	0	0	163	28	0	9	0	0	0	83	0
Razorbill	826	10	134	10	27	0	10	0	0	38	10	0
	79	118	116	98	28	120	0	0	120	0	93	918
Sandwich tern	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	8	0	0	0

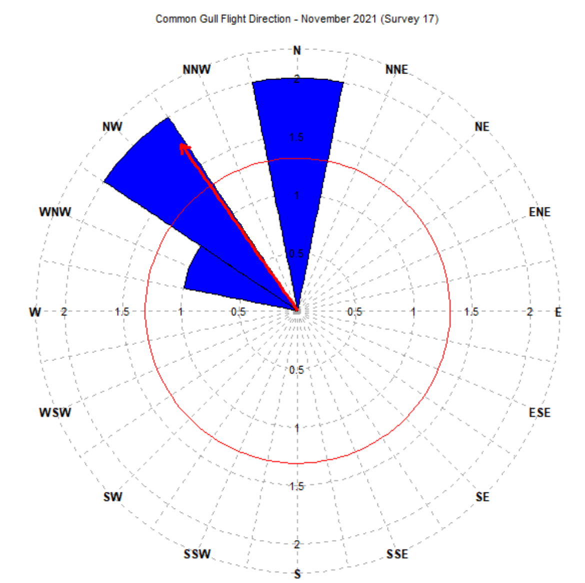
All species seasons delineated based on Furness (2015) except for common gull (*) based on SNH (2014).
Darkest blue = full breeding season (i.e. breeding season including months overlapping with migration months)
Paler blue = migration season(s)
Unshaded = non-breeding season, or 'winter' season when species has migration seasons.

8.1.2 Species Accounts

54. When referring to the seasonal presence of offshore ornithology receptors, the sections below consider the aerial survey study area only. Seasonal presence of a species behaving in a particular way (e.g. flying) within a particular region within the Windfarm site and 4km buffer may vary, which is reflected in the assessment.

8.1.2.1 Common gull

55. Common gull was recorded on a single occasion during the baseline surveys in November 2021 (i.e. the species was absent on 23 of 24 surveys). This falls within the non-breeding season for this species (August to April). On the single occasion it was recorded during a survey, it was present in very low densities (<0.1 bird/km^2) in the buffer zones of the survey area only.



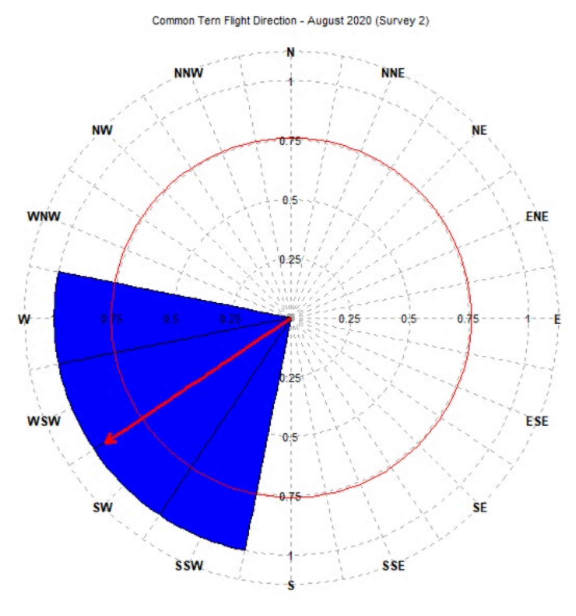
Number of Observations	5
Mean Vector (µ)	325.868
Length of Mean Vector (r)	0.873
Rayleigh Test (Z)	3.814
Rayleigh Test (p)	0.013

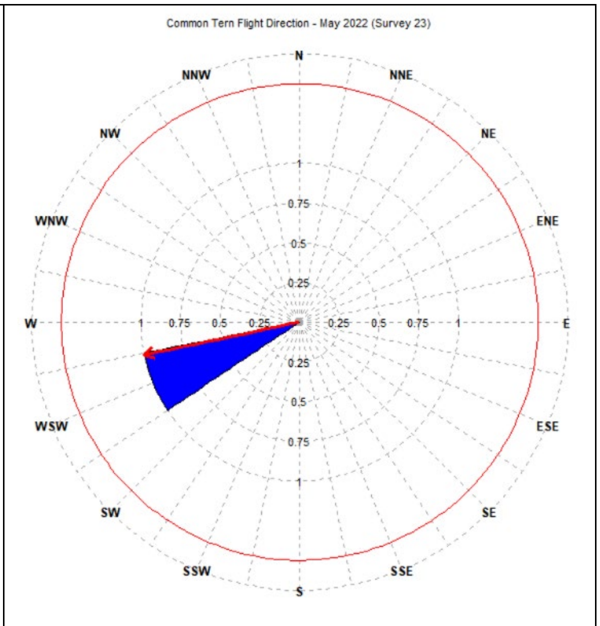
Figure 8.11a November 2021

Figure 8.1 Summary of flight direction of common gulls during survey period

8.1.2.2 Common tern

56. Common tern was recorded on a single occasion during the baseline surveys in August 2020 (i.e. the species was absent on 23 of 24 surveys). This falls within both the breeding season (May to August) and autumn migration season (late July to early September) for this species. It is presumed that the birds recorded were likely on passage, given the absence of the species from all other baseline surveys. On the single occasion it was recorded during a survey, it was present at a density of approximately 1.5 birds/km^2 in the Windfarm Site.



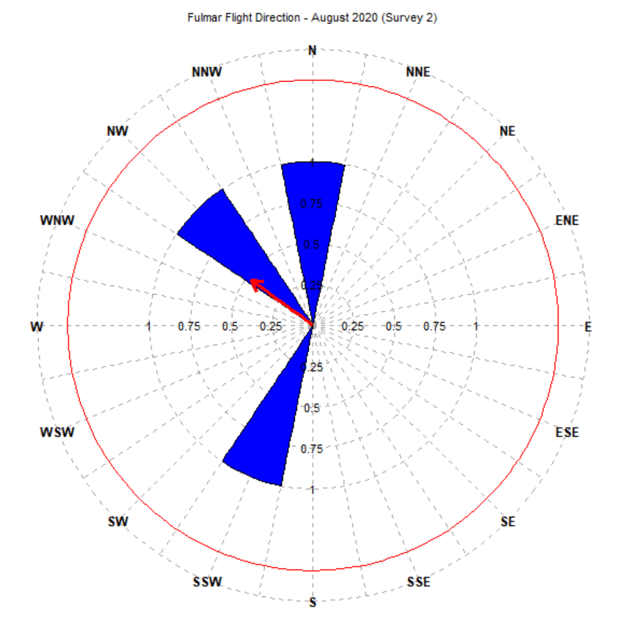


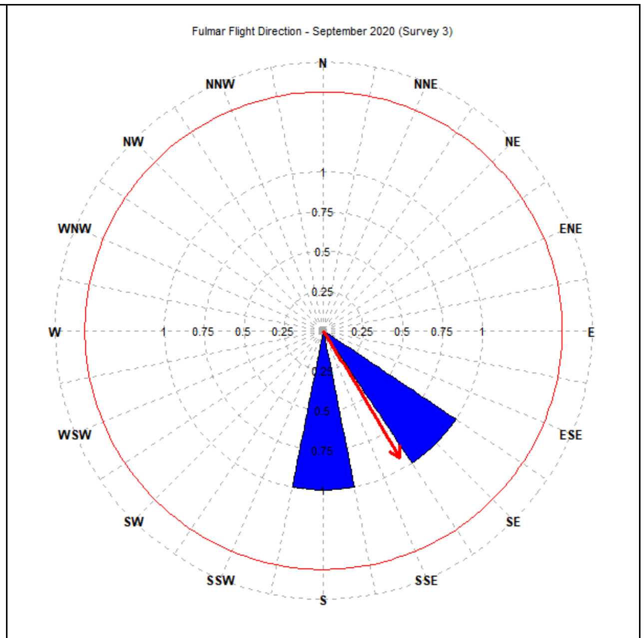
Number of Observations	4	Number of Observations	1
Mean Vector (μ)	236.403	Mean Vector (μ)	258.599
Length of Mean Vector (r)	0.943	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	3.555	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.016	Rayleigh Test (p)	0.512
Figure 8.2a August 2020		**Figure 8.2b May 2022**	

Figure 8.2 Summary of flight direction of common terns during survey period

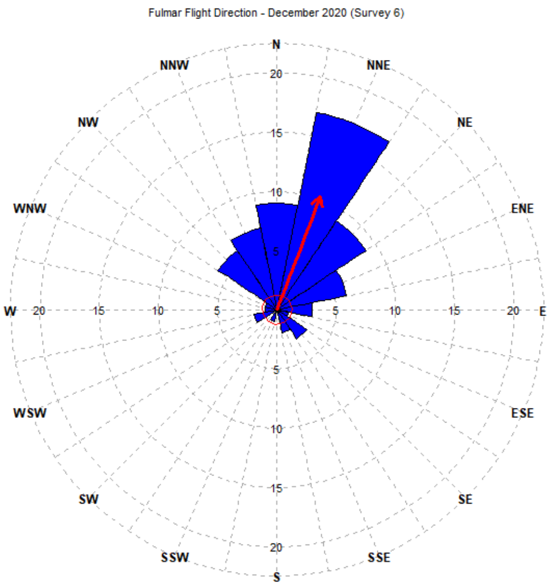
8.1.2.3 Fulmar

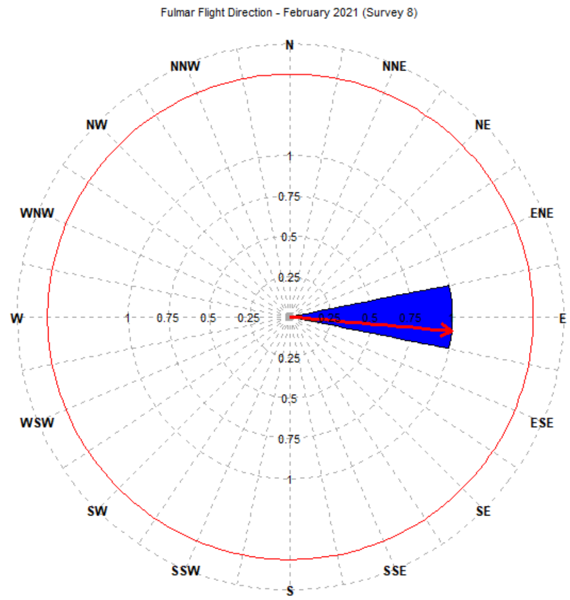
Fulmar was recorded on 15 of the 24 baseline surveys, in the breeding season (January to August) and in both migration seasons (September to October, December). Densities within the Windfarm Site itself were generally very low (<0.2 birds/km^2), but the December 2020 survey recorded densities of over 2 birds/km^2 both within the Windfarm Site and across the wider survey area (Windfarm Site + 4km).



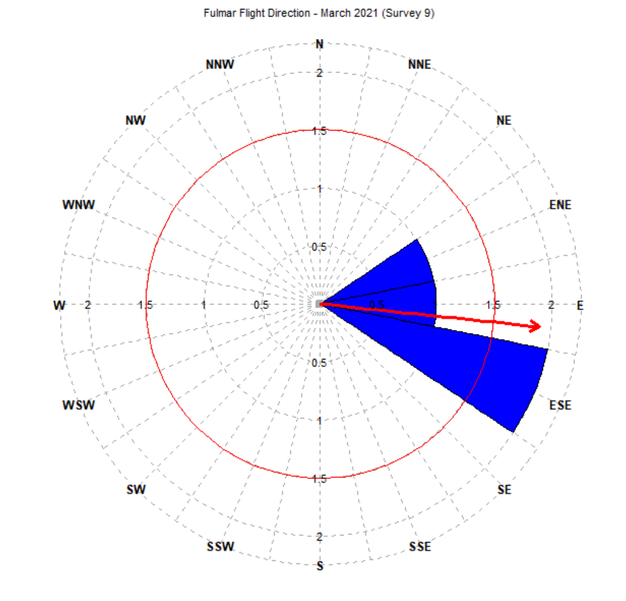


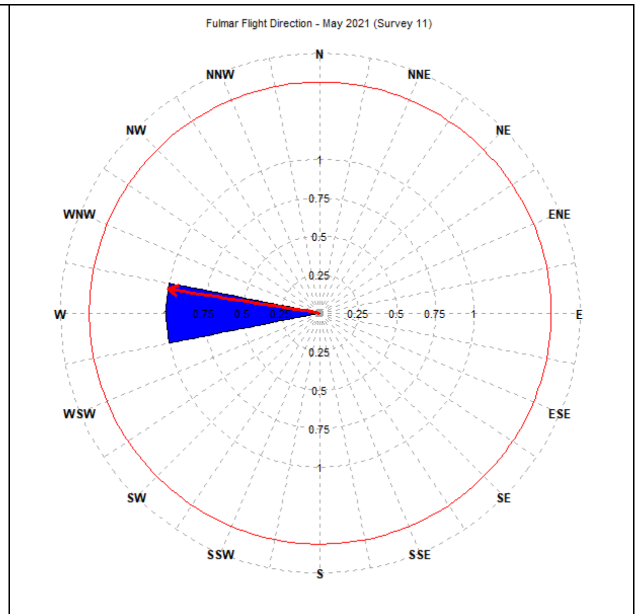
Number of Observations	3	Number of Observations	2
Mean Vector (μ)	306.590	Mean Vector (μ)	149.521
Length of Mean Vector (r)	0.464	Length of Mean Vector (r)	0.929
Rayleigh Test (Z)	0.646	Rayleigh Test (Z)	1.725
Rayleigh Test (p)	0.567	Rayleigh Test (p)	0.195
Figure 8.3a August 2020		**Figure 8.3b September 2020**	



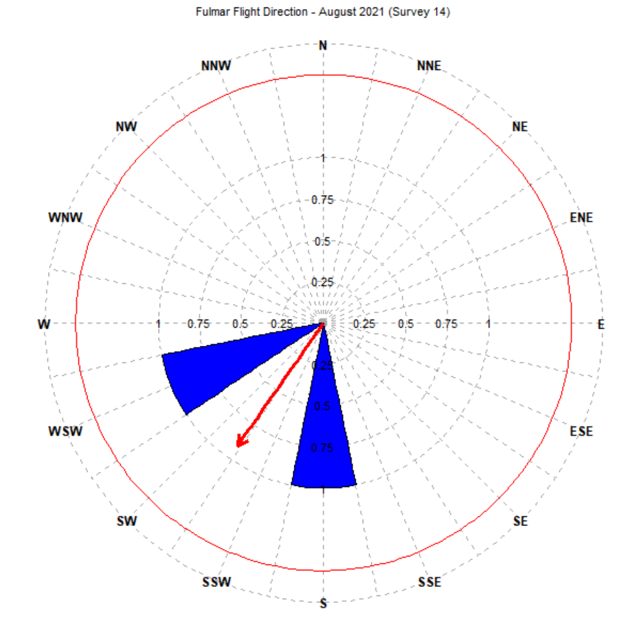


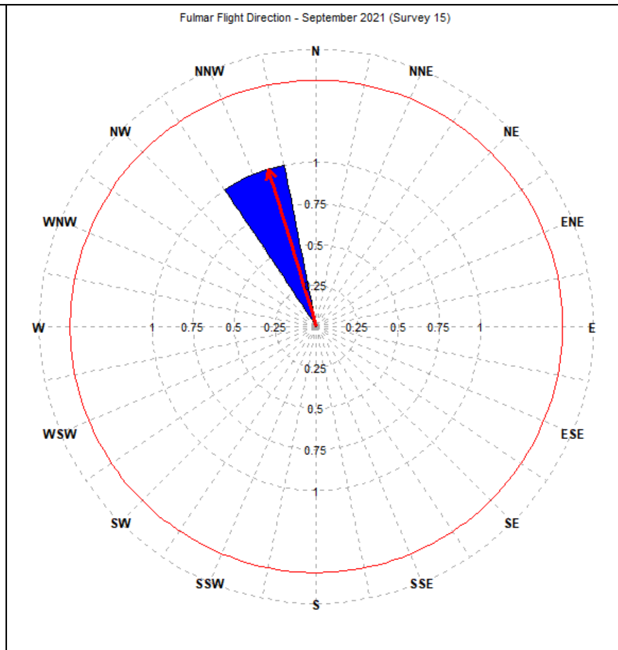
Number of Observations	68	Number of Observations	1
Mean Vector (µ)	21.554	Mean Vector (µ)	95.696
Length of Mean Vector (r)	0.599	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	24.413	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	0.512
Figure 8.3c December 2020		**Figure 8.3d February 2021**	



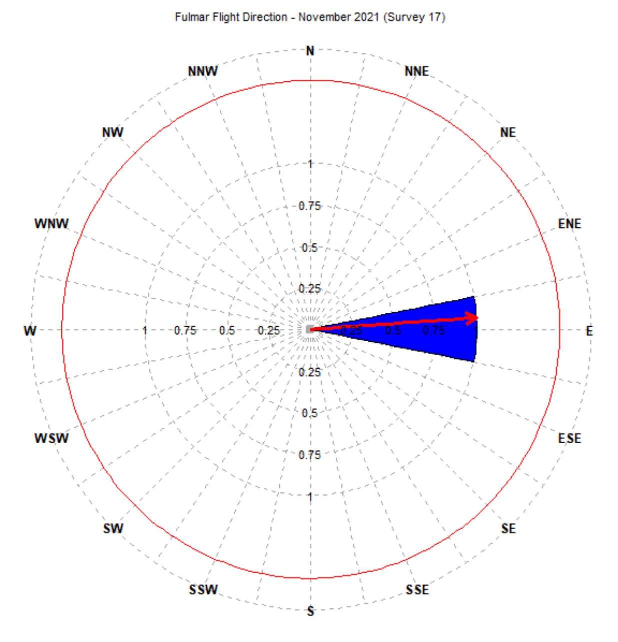
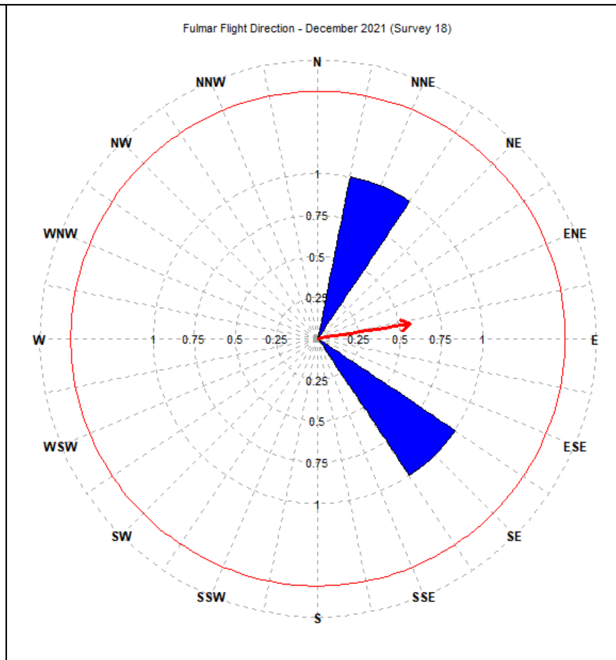


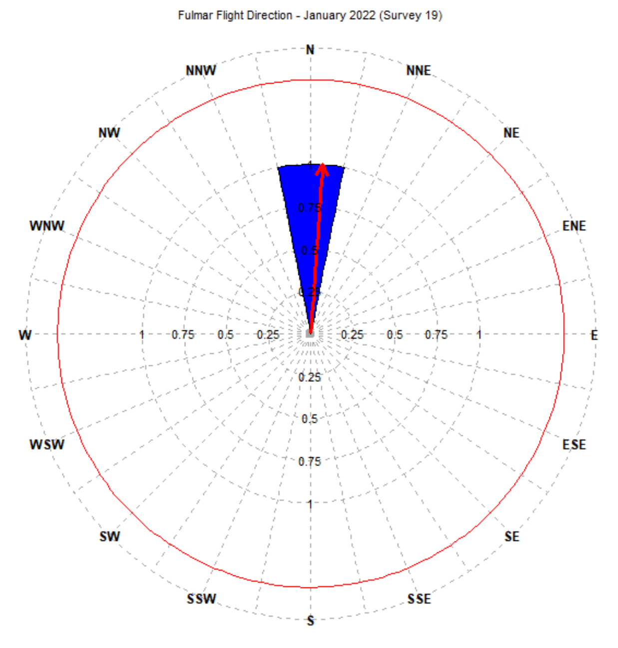
Number of Observations	4	Number of Observations	1
Mean Vector (μ)	96.289	Mean Vector (μ)	279.177
Length of Mean Vector (r)	0.951	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	3.618	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.015	Rayleigh Test (p)	0.512
Figure 8.3e March 2021		**Figure 8.3.f May 2021**	

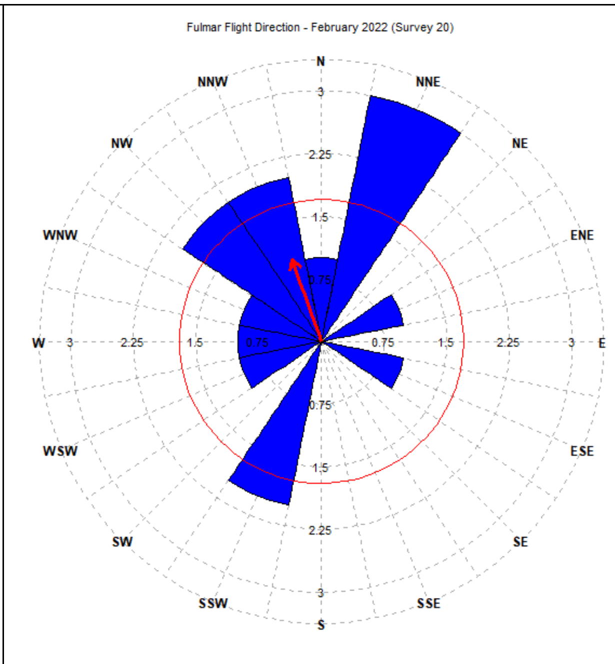




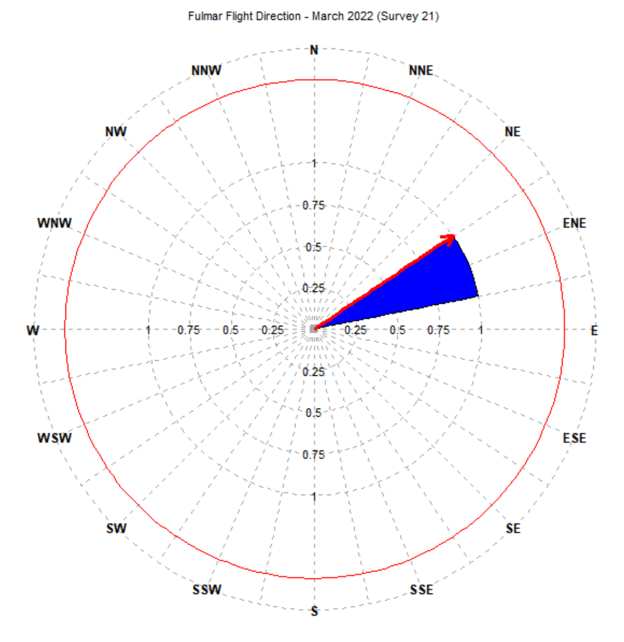
Number of Observations	2	Number of Observations	1
Mean Vector (μ)	215.822	Mean Vector (μ)	343.048
Length of Mean Vector (r)	0.909	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.654	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.212	Rayleigh Test (p)	0.512
Figure 8.3g August 2021		**Figure 8.3h September 2021**	

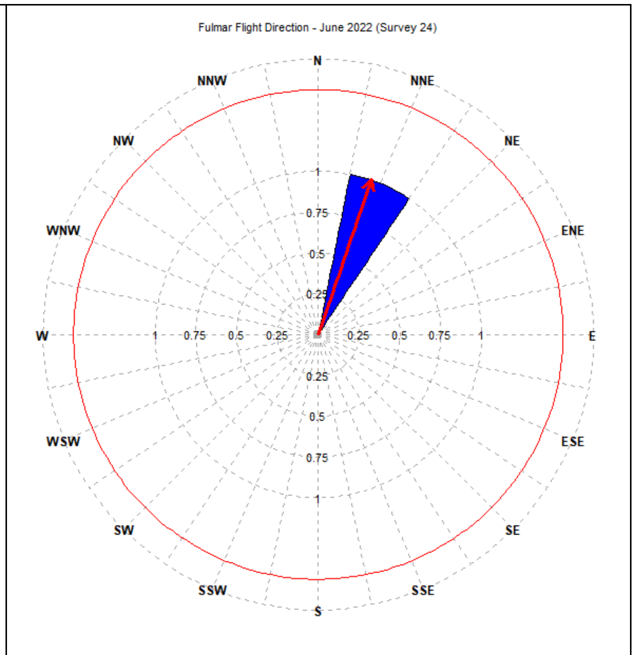
			
Number of Observations	1	Number of Observations	2
Mean Vector (μ)	86.731	Mean Vector (μ)	81.414
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.570
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	0.651
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.588
Figure 8.3i November 2021		**Figure 8.3j December 2021**	





Number of Observations	1	Number of Observations	15
Mean Vector (μ)	4.833	Mean Vector (μ)	340.574
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.346
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	1.798
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.167
Figure 8.3 Error! Reference source not found.**k January 2022**		**Figure 8.3l**Error! Reference source not found. **February 2022**	



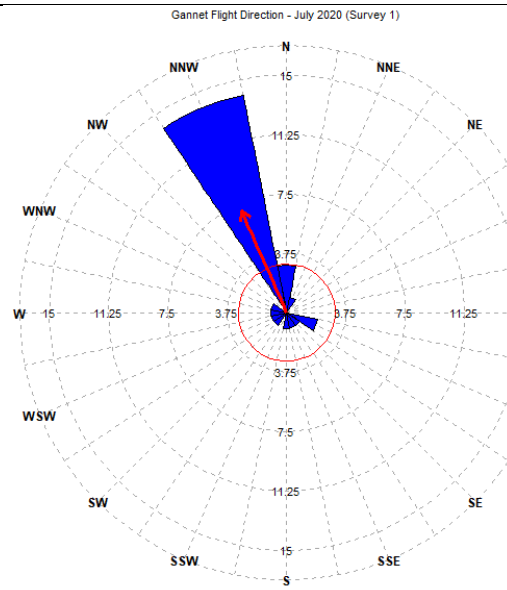


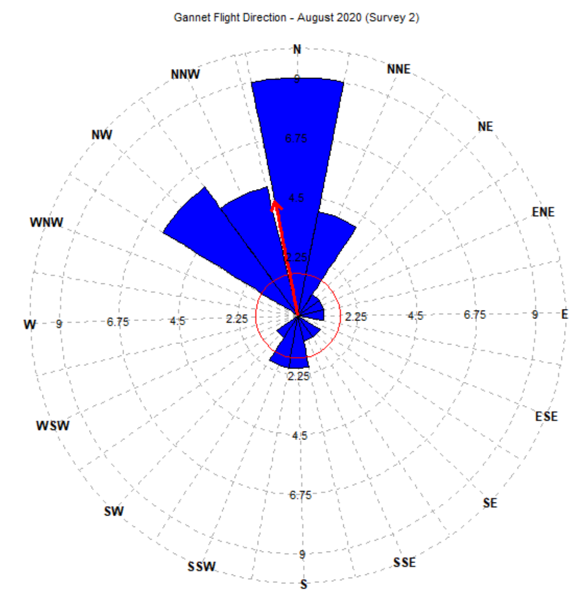
Number of Observations	1	Number of Observations	1
Mean Vector (μ)	56.558	Mean Vector (μ)	19.251
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.512
Figure 8.3m March 2022		**Figure 8.3n June 2022**	

Figure 8.3 Summary of flight direction of fulmars during survey period

8.1.2.4 Gannet

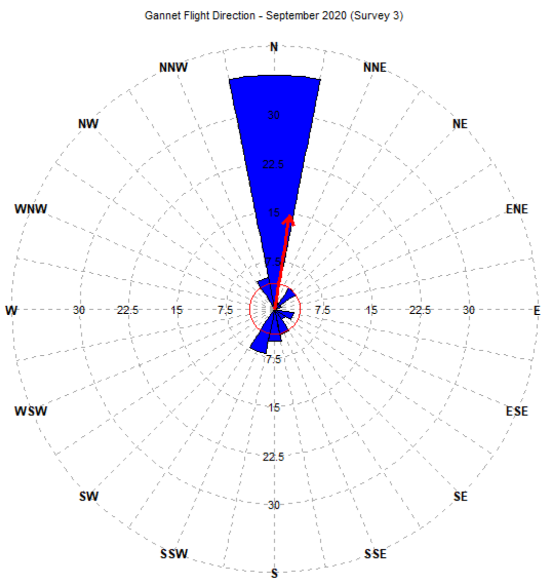
Gannet was recorded within the windfarm area on 17 of the 24 surveys, and within the Windfarm Site + 4km buffer area on 23 surveys (i.e. in all calendar months). Densities recorded in this full survey area were higher during breeding months (March to September, commonly >0.5 birds/km^2) than during migration seasons (October to November, December to February).





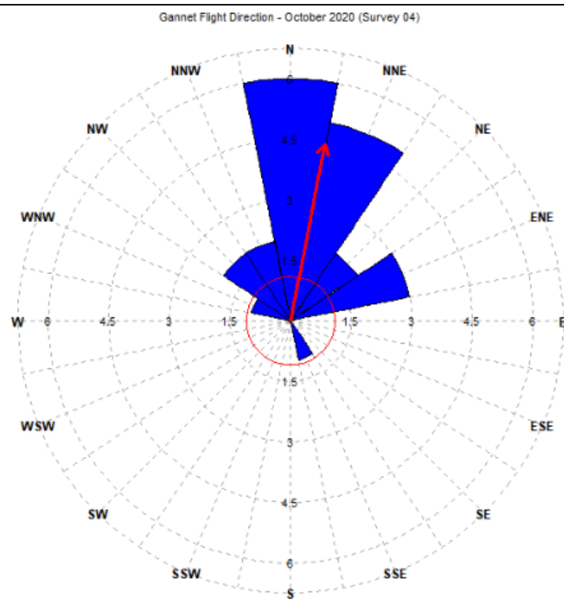
57.

Number of Observations	27	Number of Observations	34
Mean Vector (μ)	336.518	Mean Vector (μ)	351.128
Length of Mean Vector (r)	0.504	Length of Mean Vector (r)	0.492
Rayleigh Test (Z)	6.859	Rayleigh Test (Z)	8.241
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	<0.001
Figure 8.4a July 2020		**Figure 8.4b August 2020**	



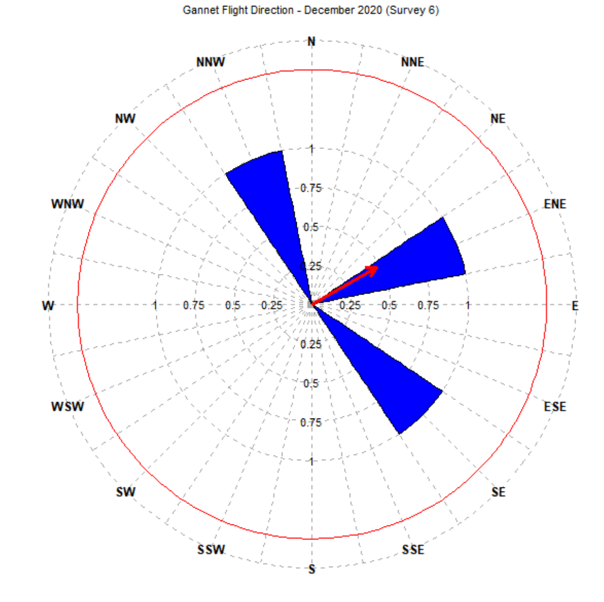
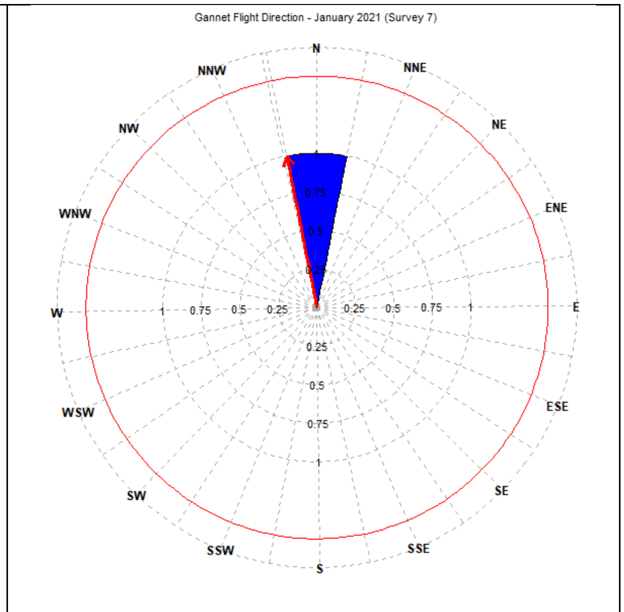
Number of Observations	68
Mean Vector (μ)	9.088
Length of Mean Vector (r)	0.404
Rayleigh Test (Z)	11.107
Rayleigh Test (p)	<0.001

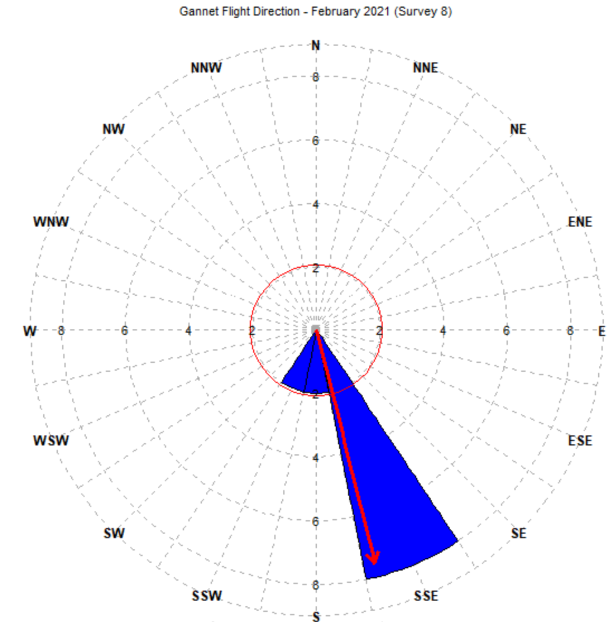
Figure 8.4c September 2020

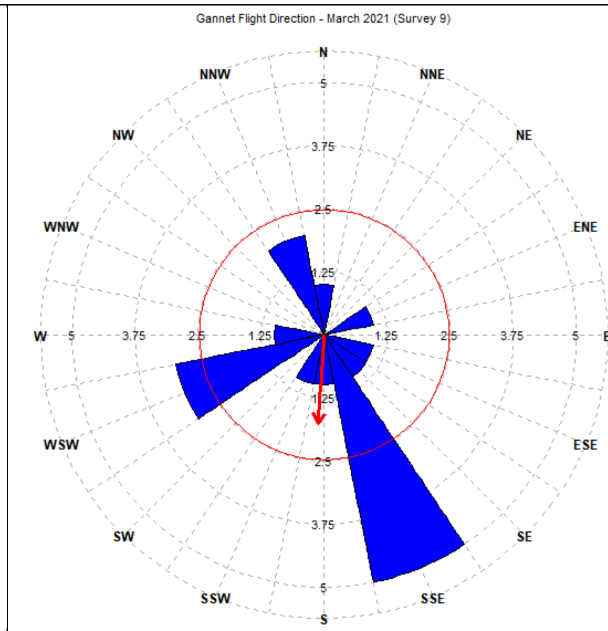


Number of Observations	22
Mean Vector (μ)	11.929
Length of Mean Vector (r)	0.741
Rayleigh Test (Z)	12.075
Rayleigh Test (p)	<0.001

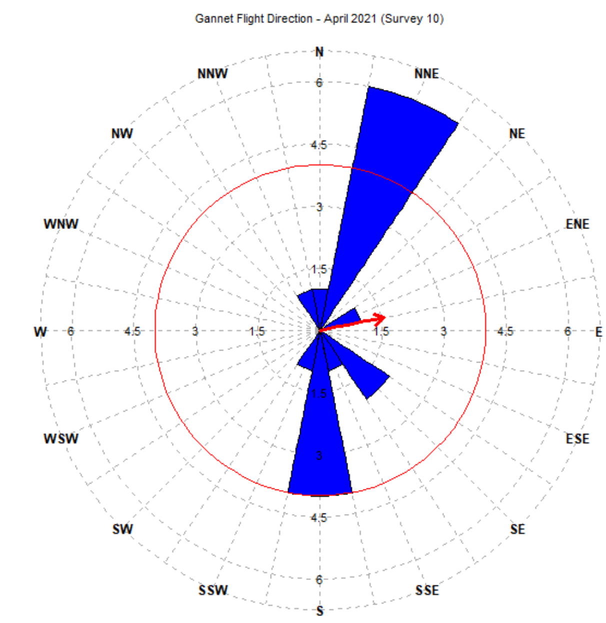
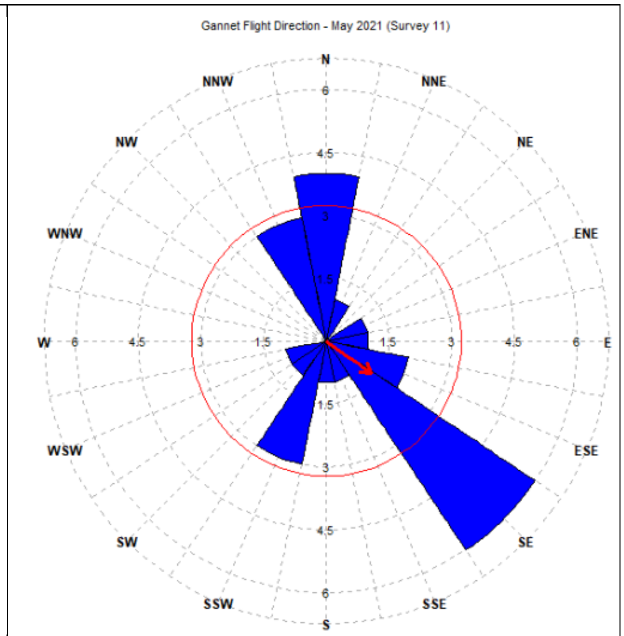
Figure 8.4d October 2020

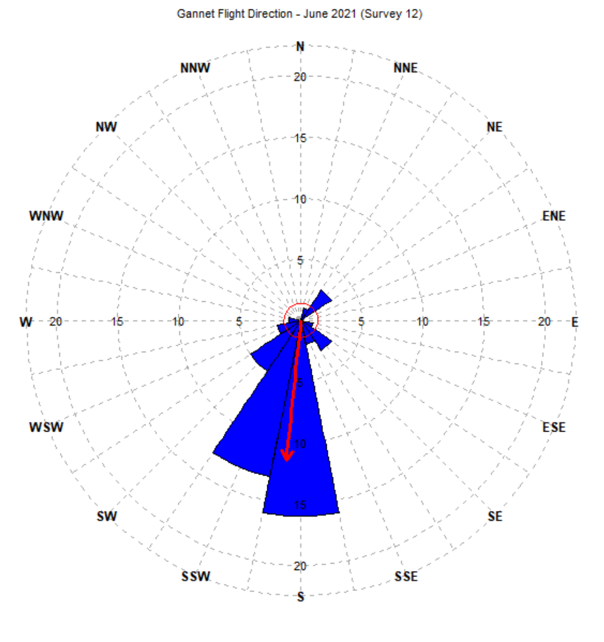
			
Number of Observations	3	Number of Observations	1
Mean Vector (μ)	60.719	Mean Vector (μ)	350.686
Length of Mean Vector (r)	0.475	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	0.677	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.550	Rayleigh Test (p)	0.512
Figure 8.4e December 2020		**Figure 8.4f January 2021**	





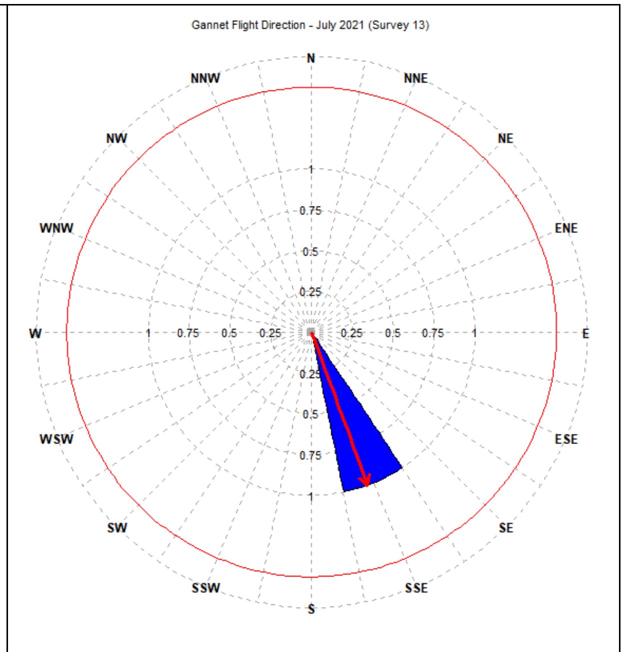
Number of Observations	12	Number of Observations	17
Mean Vector (μ)	166.133	Mean Vector (μ)	184.697
Length of Mean Vector (r)	0.945	Length of Mean Vector (r)	0.354
Rayleigh Test (Z)	10.726	Rayleigh Test (Z)	2.130
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	0.118
Figure 8.4g February 2021		**Figure 8.4h March 2021**	

			
Number of Observations	17	Number of Observations	25
Mean Vector (µ)	79.837	Mean Vector (µ)	126.175
Length of Mean Vector (r)	0.263	Length of Mean Vector (r)	0.222
Rayleigh Test (Z)	1.179	Rayleigh Test (Z)	1.229
Rayleigh Test (p)	0.312	Rayleigh Test (p)	0.295
Figure 8.4i April 2021		**Figure 8.4j May 2021**	



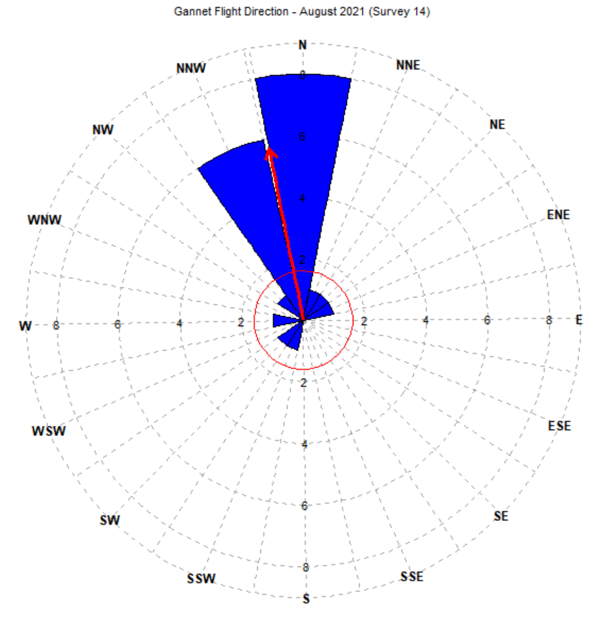
Number of Observations	47
Mean Vector (μ)	186.983
Length of Mean Vector (r)	0.721
Rayleigh Test (Z)	24.430
Rayleigh Test (p)	<0.001

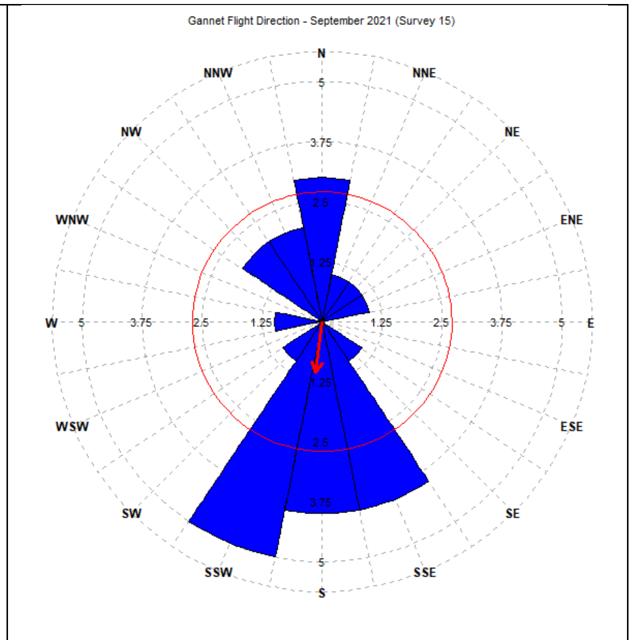
Figure 8.4k June 2021



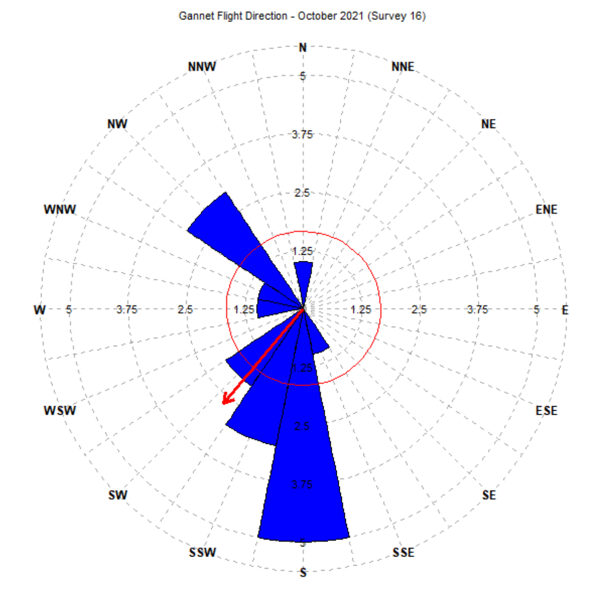
Number of Observations	1
Mean Vector (μ)	160.742
Length of mean vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

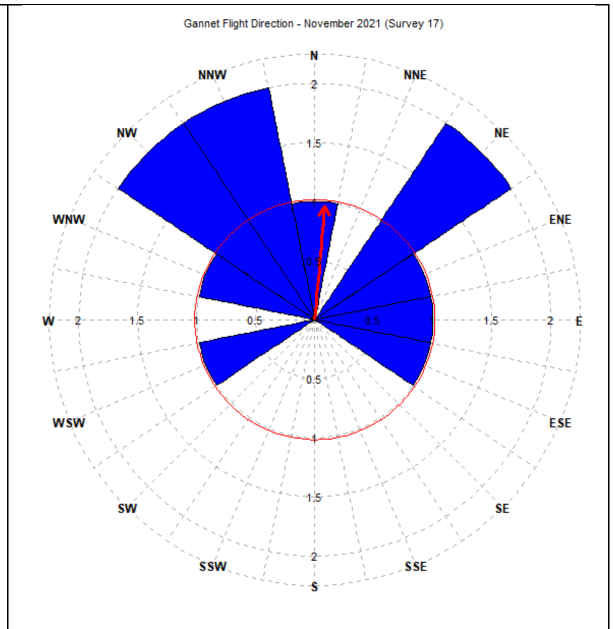
Figure 8.4l July 2021





Number of Observations	21	Number of Observations	26
Mean Vector (μ)	350.770	Mean Vector (μ)	187.211
Length of Mean Vector (r)	0.709	Length of Mean Vector (r)	0.212
Rayleigh Test (Z)	10.564	Rayleigh Test (Z)	1.170
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	0.313
Figure 8.4m August 2021		**Figure 8.4n September 2021**	

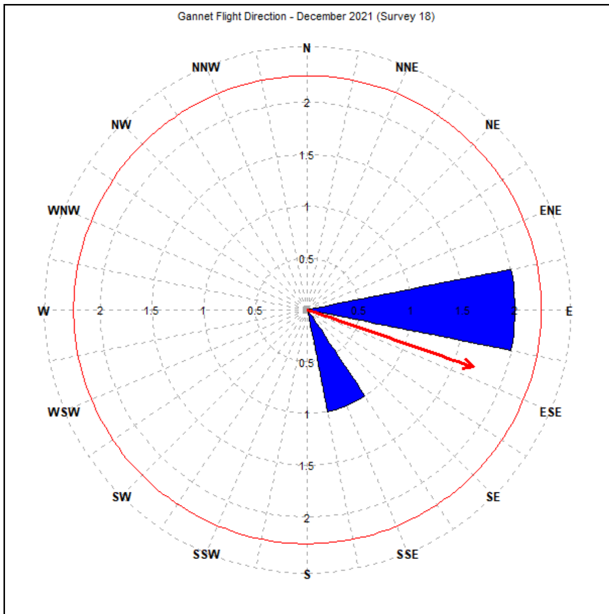


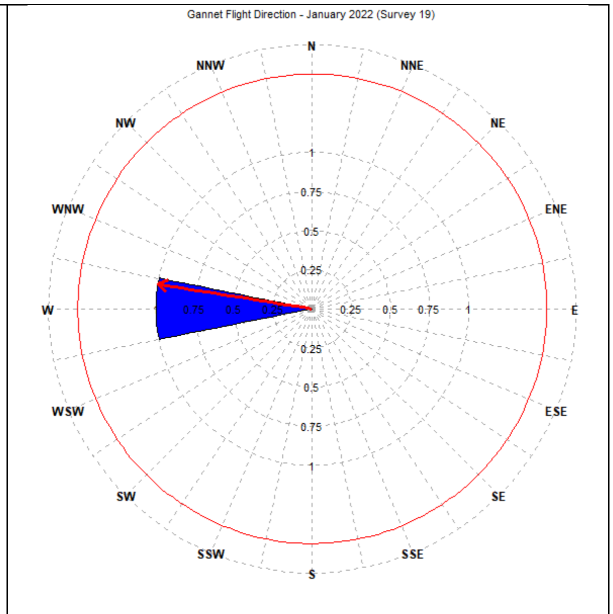


Number of Observations	17	Number of Observations	12
Mean Vector (μ)	220.334	Mean Vector (μ)	5.522
Length of Mean Vector (r)	0.531	Length of Mean Vector (r)	0.482
Rayleigh Test (Z)	4.794	Rayleigh Test (Z)	2.789
Rayleigh Test (p)	0.007	Rayleigh Test (p)	0.058

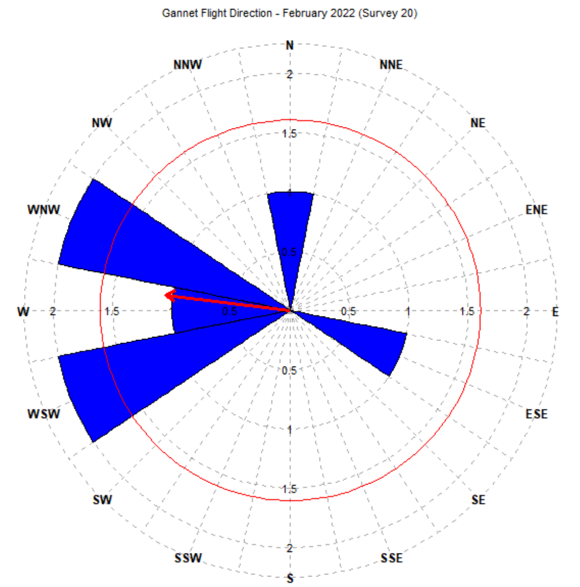
Figure 8.4o October 2021

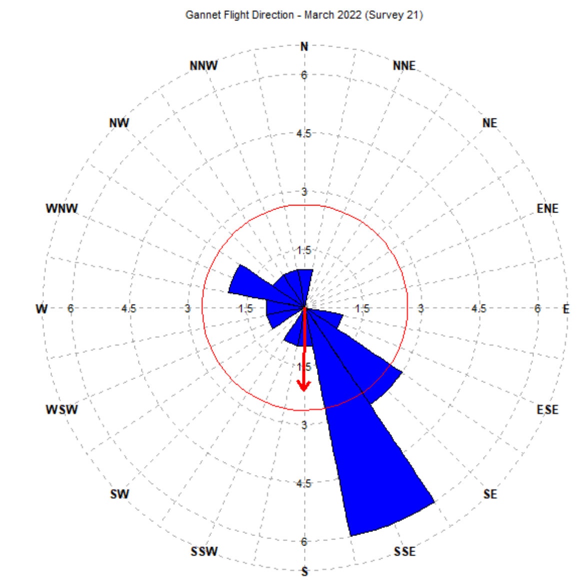
Figure 8.4p November 2021



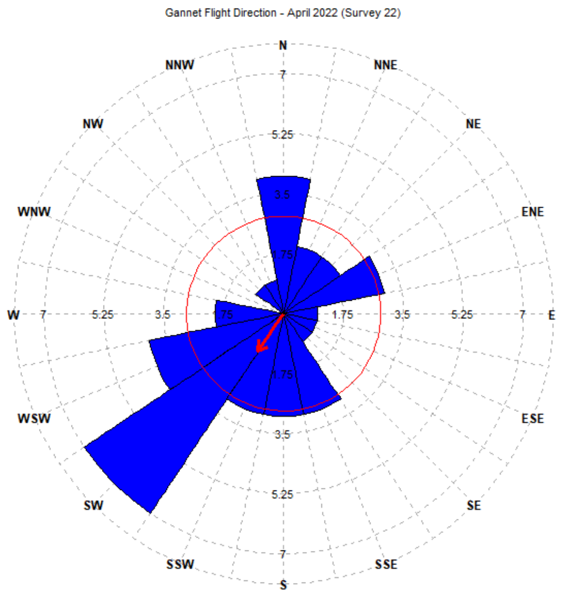


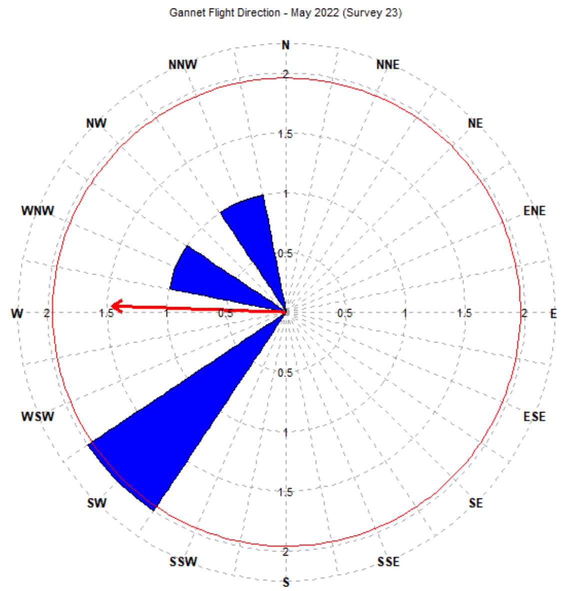
Number of Observations	3	Number of Observations	1
Mean Vector (µ)	109.335	Mean Vector (µ)	279.040
Length of Mean Vector (r)	0.845	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	2.143	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.114	Rayleigh Test (p)	0.512
Figure 8.4q December 2021		**Figure 8.4r January 2022**	



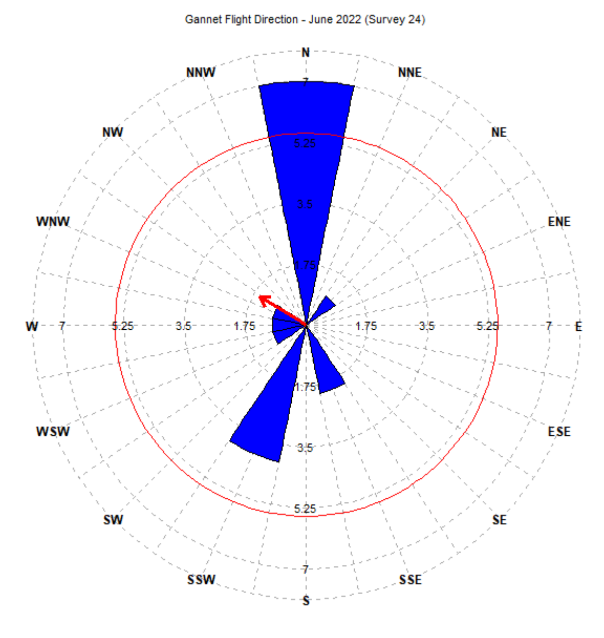


Number of Observations	7	Number of Observations	19
Mean Vector (μ)	277.247	Mean Vector (μ)	181.628
Length of Mean Vector (r)	0.532	Length of Mean Vector (r)	0.356
Rayleigh Test (Z)	1.982	Rayleigh Test (Z)	2.411
Rayleigh Test (p)	0.138	Rayleigh Test (p)	0.089
Figure 8.4s February 2022		**Figure 8.4t March 2022**	





Number of Observations	38	Number of Observations	4
Mean Vector (µ)	215.616	Mean Vector (µ)	272.423
Length of Mean Vector (r)	0.193	Length of Mean Vector (r)	0.730
Rayleigh Test (Z)	1.420	Rayleigh Test (Z)	2.130
Rayleigh Test (p)	0.243	Rayleigh Test (p)	0.117
Figure 8.4u April 2022		**Figure 8.4v May 2022**	



Number of Observations	17
Mean Vector (μ)	301.884
Length of Mean Vector (r)	0.223
Rayleigh Test (Z)	0.846
Rayleigh Test (p)	0.435

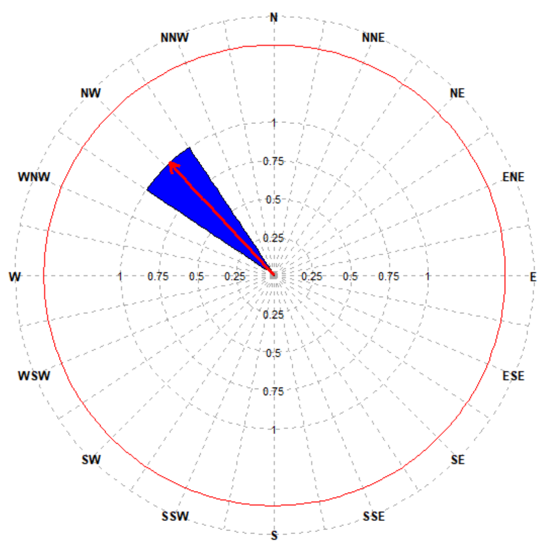
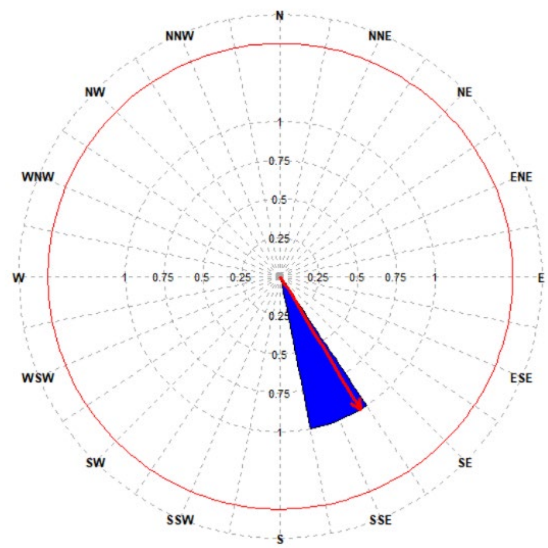
Figure 8.4w June 2022

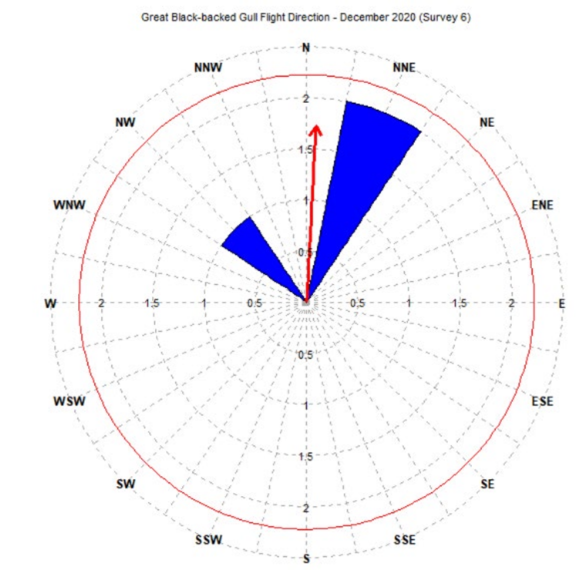
Figure 8.4 Summary of flight direction of gannets during survey period

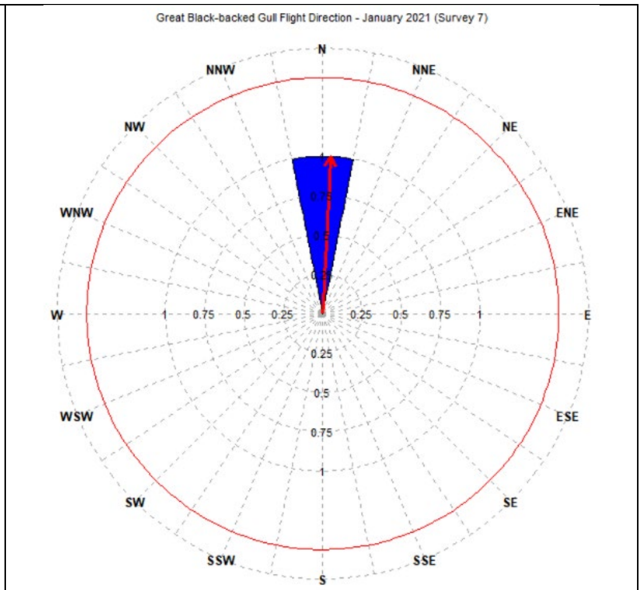
8.1.2.5 Great black-backed gull

58. Great black-backed gull was recorded on eight of the 24 baseline surveys, which mainly occurred within the non-breeding season (September to March). With the exception of a single survey (February 2022), densities in all reporting regions, including the Windfarm Site itself, were very low (<0.2 birds/km^2). The February 2022 survey recorded densities of almost 2 birds/km^2 in the buffer zones, though in this survey, the species was absent from the Windfarm Site.

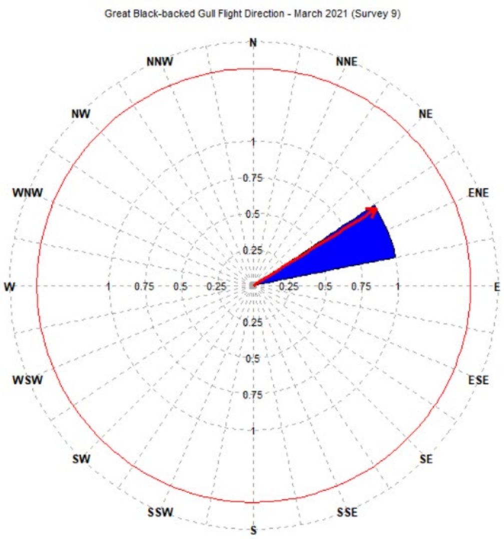
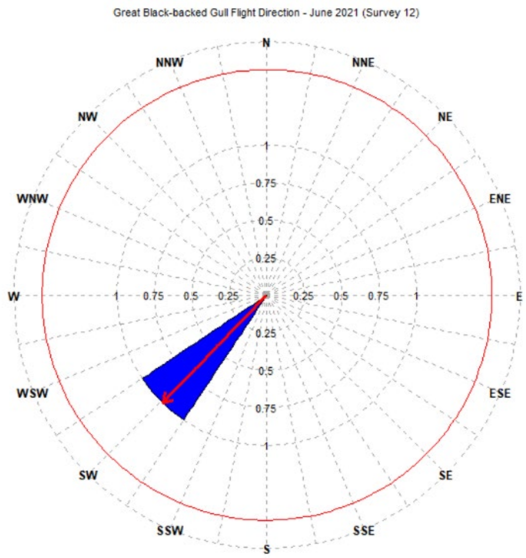
59. Further interrogation of the raw data shows the reason for this peak to be a multispecies assemblage of herring gull, great black-backed gull, kittiwake, lesser black-backed gull and gannet associated with a fishing vessel recorded in the Windfarm Site+2km buffer zone.

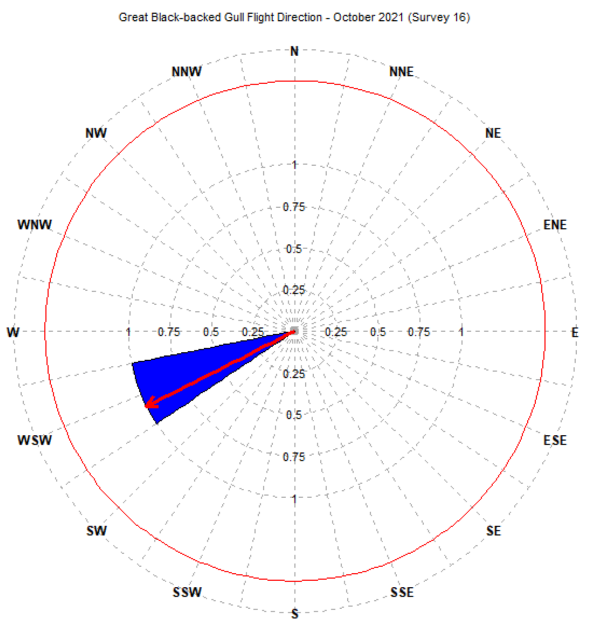
			
Number of Observations	1	Number of Observations	1
Mean Vector (µ)	317.856	Mean Vector (µ)	149.977
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.512
Figure 8.5a July 2020		**Figure 8.5b November 2020**	

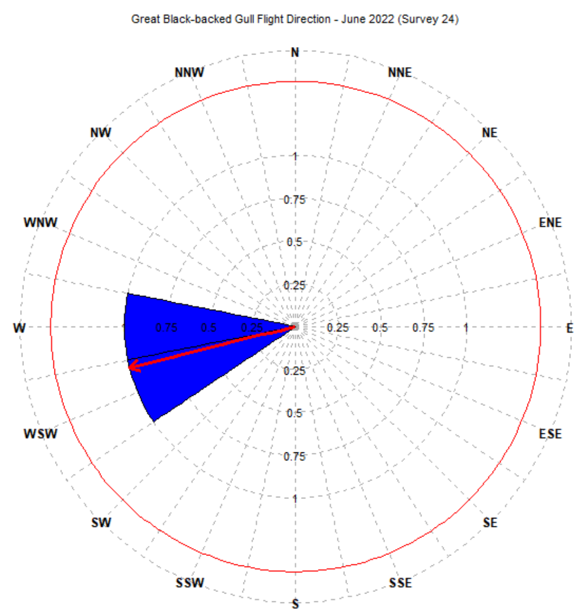




Number of Observations	3	Number of Observations	1
Mean Vector (μ)	3.857	Mean Vector (μ)	3.955
Length of Mean Vector (r)	0.859	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	2.215	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.104	Rayleigh Test (p)	0.512
Figure 8.5c December 2020		**Figure 8.5d January 2021**	

	
Number of Observations 1 Mean Vector (μ) 58.246 Length of Mean Vector (r) 1.000 Rayleigh Test (Z) 1.000 Rayleigh Test (p) 0.512	Number of Observations 1 Mean Vector (μ) 224.617 Length of Mean Vector (r) 1.000 Rayleigh Test (Z) 1.000 Rayleigh Test (p) 0.512
Figure 8.5e March 2021	**Figure 8.5f June 2021**



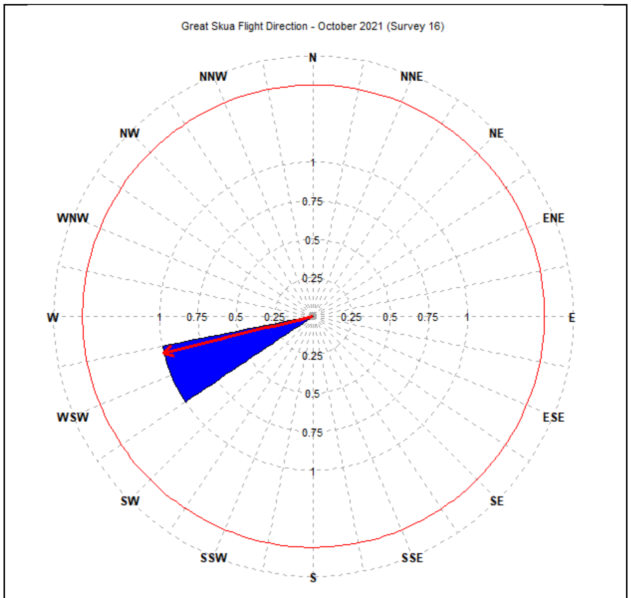


Number of Observations	1	Number of Observations	2
Mean Vector (μ)	243.766	Mean Vector (μ)	256.068
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.999
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	1.996
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.138
Figure 8.5g October 2021		**Figure 8.5h June 2022**	

Figure 8.5 Summary of flight direction of great black-backed gulls during survey period

8.1.2.6 Great skua

60. Great skua was recorded on only one of the 24 baseline surveys, and only outside the Windfarm Site area (i.e. only within the surrounding 2km or 4km buffer areas). The survey visit in question was October 2021 which lies within the autumn migration season for the species. The density estimate for the species was very low (<0.1 birds/km^2).



Number of Observations	1
Mean Vector (μ)	256.153
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

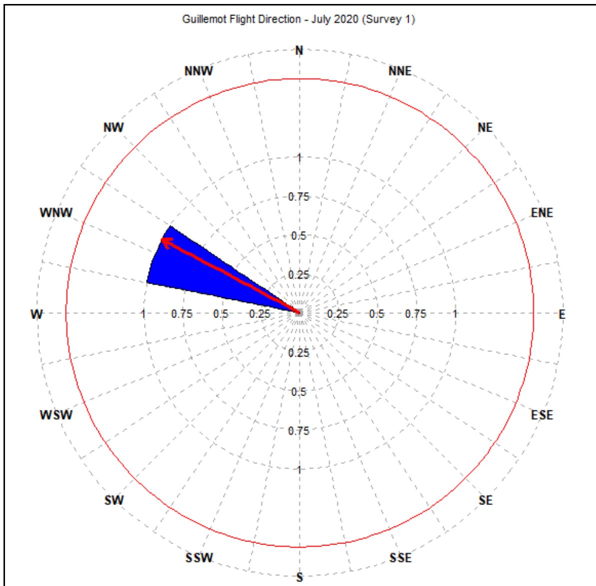
October 2021

Figure 8.6 Summary of flight direction of great skua during survey period

8.1.2.7 Guillemot

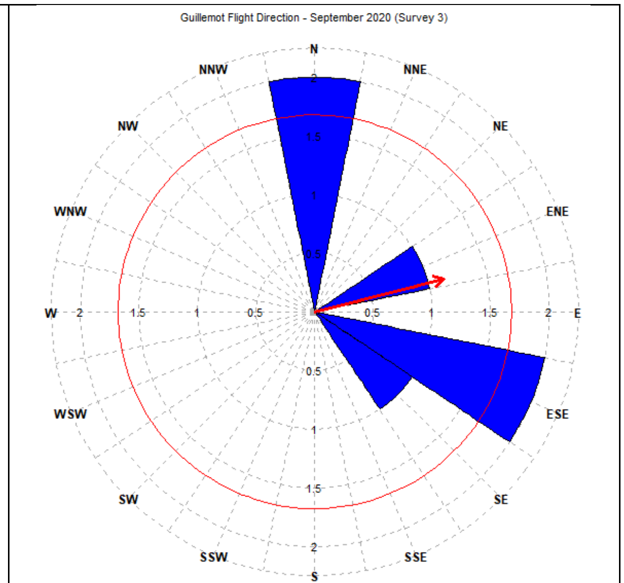
61. Guillemot was recorded within the Windfarm Site area in 18 of the 24 baseline surveys, and in 20 surveys within the Windfarm Site area + 4km buffer zone. The species was recorded in all calendar months except August – i.e., all breeding months (March to July) and all but one non-breeding months (August to February).

62. Mean densities within the Windfarm Site area were a minimum of 0.49 birds/km^2 when present, and in two surveys (May 2021 and March 2022, i.e. early breeding season) exceeded 20 birds/km^2.



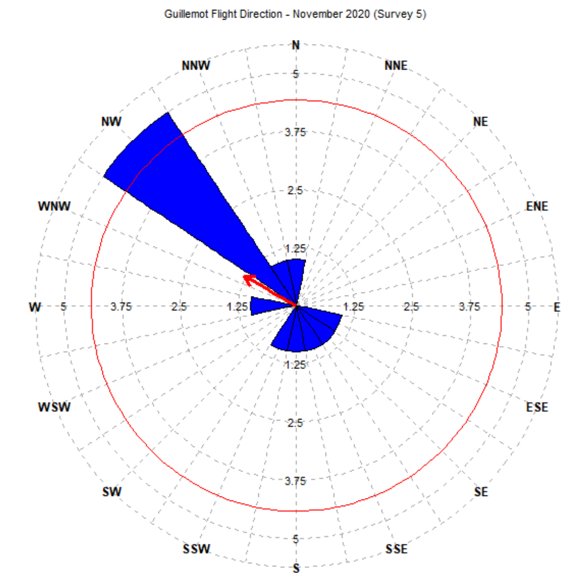
Number of Observations	1
Mean Vector (µ)	298.406
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

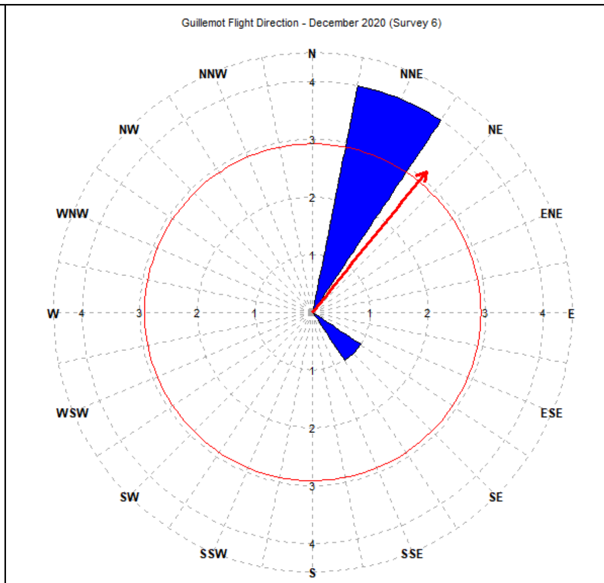
Figure 8.7a July 2020



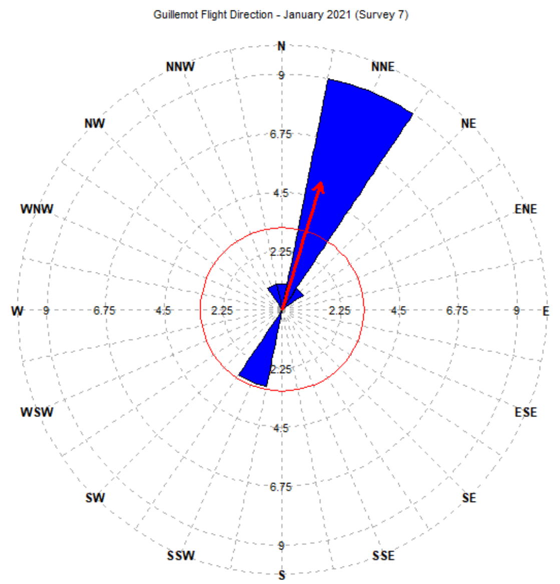
Number of Observations	6
Mean Vector (µ)	76.881
Length of Mean Vector (r)	0.568
Rayleigh Test (Z)	1.936
Rayleigh Test (p)	0.145

Figure 8.7b September 2020



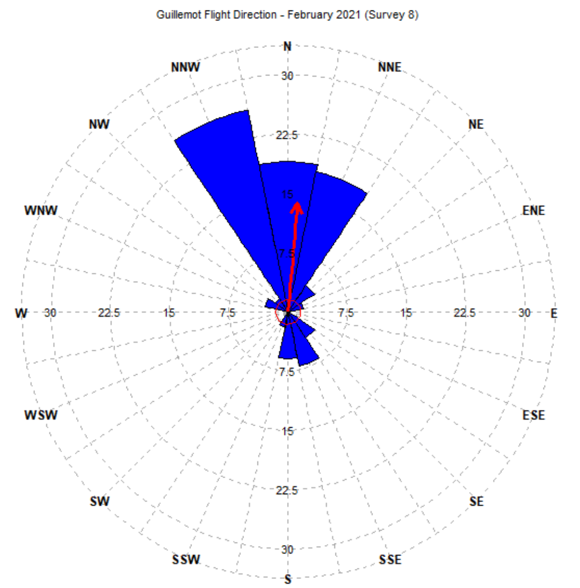


Number of Observations	13	Number of Observations	5
Mean Vector (μ)	299.428	Mean Vector (μ)	39.785
Length of Mean Vector (r)	0.256	Length of Mean Vector (r)	0.784
Rayleigh Test (Z)	0.852	Rayleigh Test (Z)	3.075
Rayleigh Test (p)	0.435	Rayleigh Test (p)	0.037
Figure 8.7c November 2020		**Figure 8.7d December 2020**	



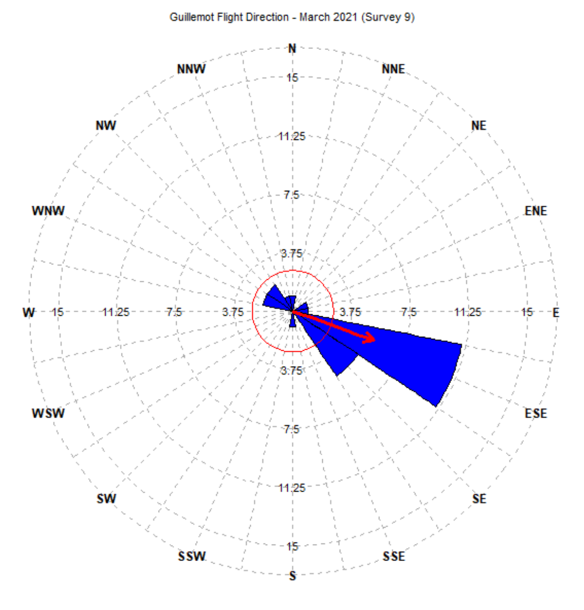
Number of Observations	15
Mean Vector (μ)	17.452
Length of Mean Vector (r)	0.564
Rayleigh Test (Z)	4.775
Rayleigh Test (p)	0.006

Figure 8.7e January 2021



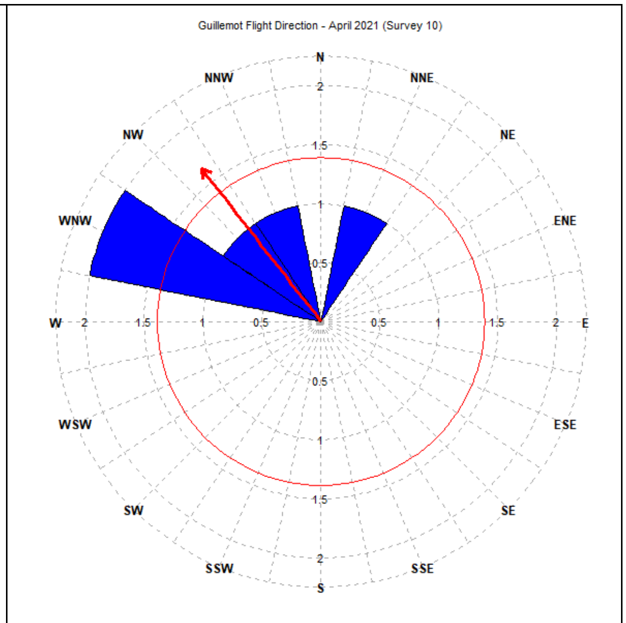
Number of Observations	93
Mean Vector (μ)	5.163
Length of Mean Vector (r)	0.530
Rayleigh Test (Z)	26.094
Rayleigh Test (p)	<0.001

Figure 8.7f February 2021



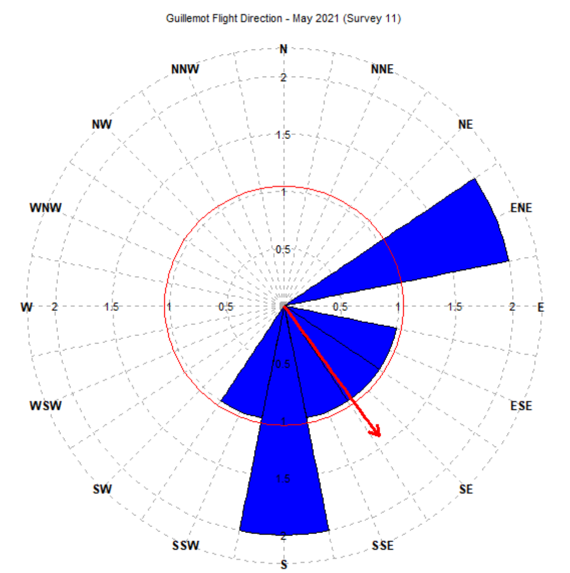
Number of Observations	25
Mean Vector (µ)	110.926
Length of Mean Vector (r)	0.502
Rayleigh Test (Z)	6.290
Rayleigh Test (p)	0.001

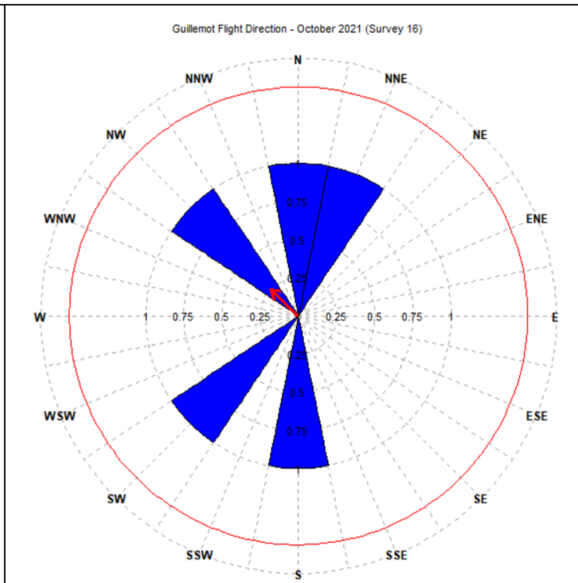
Figure 8.7g March 2021



Number of Observations	5
Mean Vector (µ)	322.671
Length of Mean Vector (r)	0.824
Rayleigh Test (Z)	3.396
Rayleigh Test (p)	0.024

Figure 8.7h April 2021

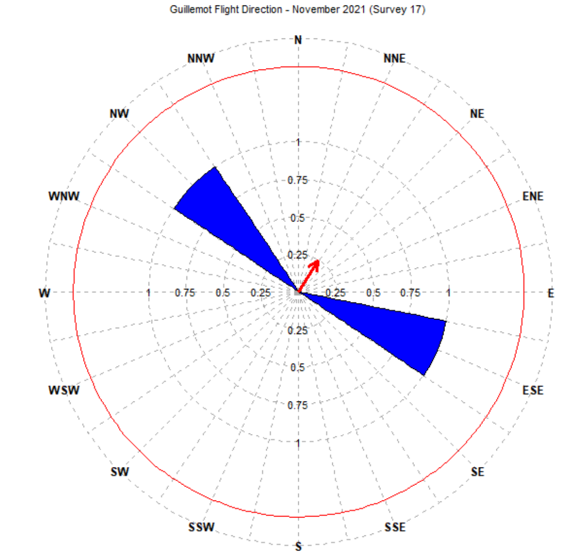
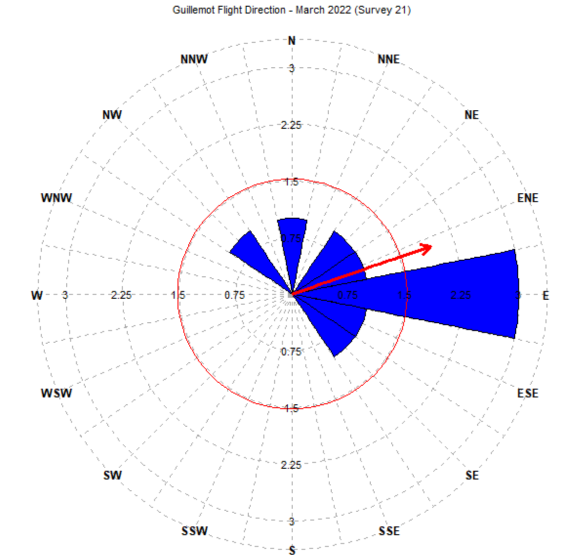


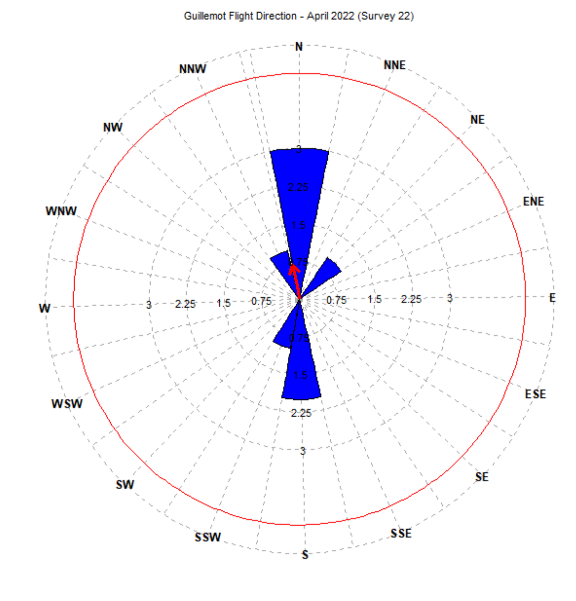


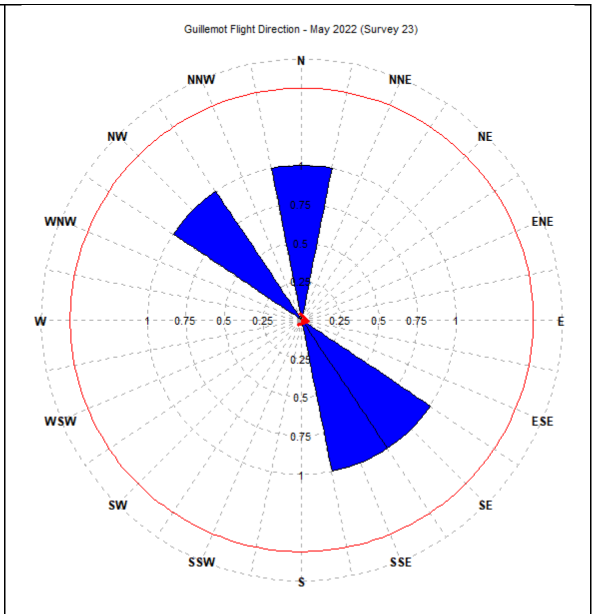
Number of Observations	8	Number of Observations	5
Mean Vector (μ)	144.165	Mean Vector (μ)	314.845
Length of Mean Vector (r)	0.704	Length of Mean Vector (r)	0.250
Rayleigh Test (Z)	3.961	Rayleigh Test (Z)	0.314
Rayleigh Test (p)	0.014	Rayleigh Test (p)	0.750

Figure 8.7i May 2021

Figure 8.7j October 2021

	
Number of Observations 2	Number of Observations 9
Mean Vector (μ) 32.152	Mean Vector (μ) 71.586
Length of Mean Vector (r) 0.238	Length of Mean Vector (r) 0.645
Rayleigh Test (Z) 0.114	Rayleigh Test (Z) 3.739
Rayleigh Test (p) 0.916	Rayleigh Test (p) 0.019
Figure 8.7k November 2021	**Figure 8.7l March 2022**





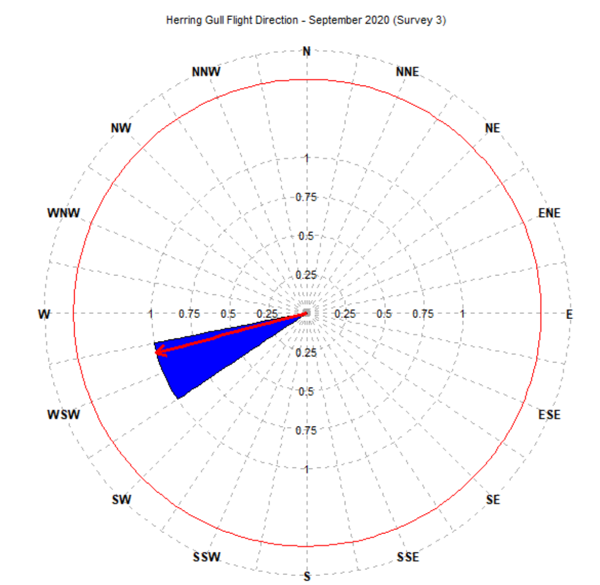
Number of Observations	8	Number of Observations	4
Mean Vector (μ)	351.678	Mean Vector (μ)	101.390
Length of Mean Vector (r)	0.236	Length of Mean Vector (r)	0.042
Rayleigh Test (Z)	0.446	Rayleigh Test (Z)	0.007
Rayleigh Test (p)	0.654	Rayleigh Test (p)	0.994
Figure 8.7m April 2022		**Figure 8.7n May 2022**	

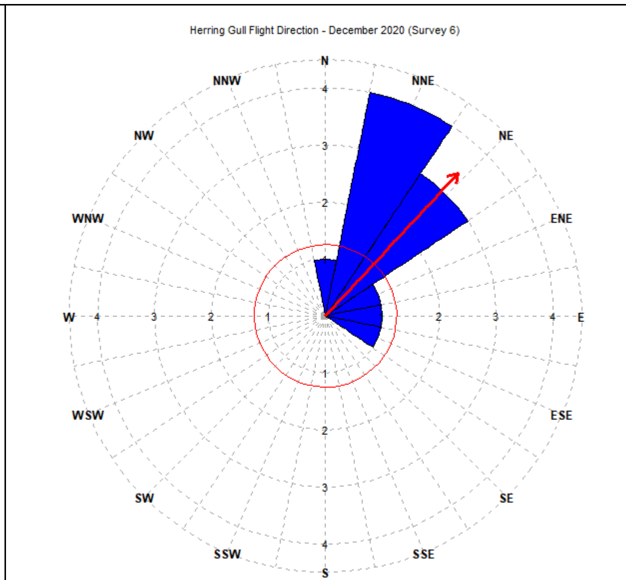
Figure 8.7 Summary of flight direction of guillemots during survey period

8.1.2.8 Herring gull

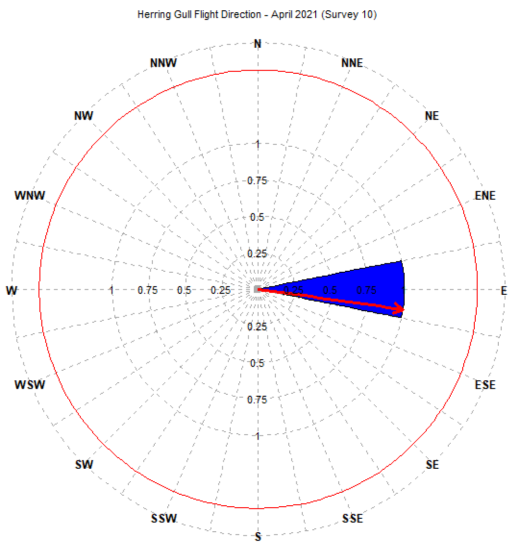
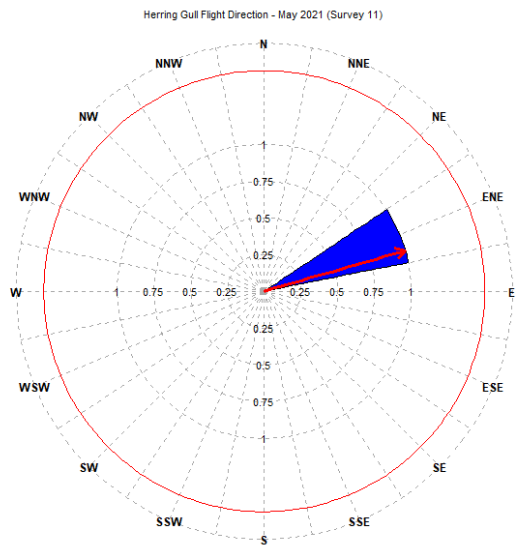
63. Herring gull was recorded on seven of the 24 baseline surveys within both the breeding (March to August) and non-breeding (September to February) seasons. However, the species was only recorded within the Windfarm Site itself on a single occasion.

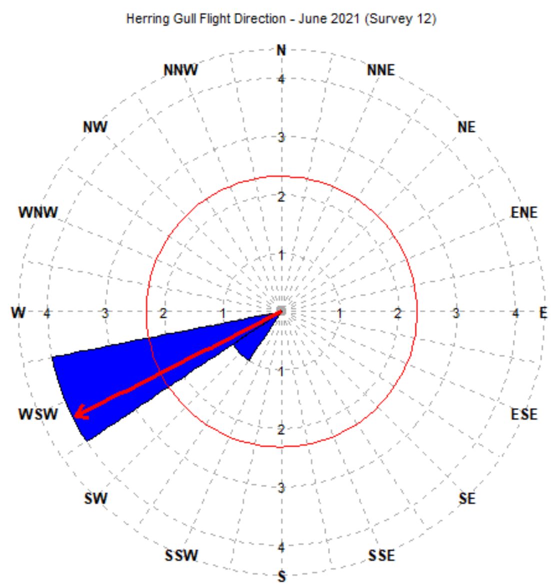
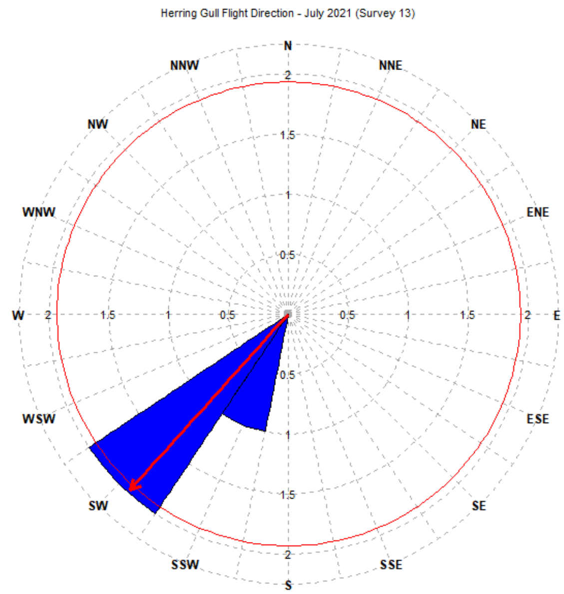
64. Densities of birds were for the most part low (i.e. <0.5 birds/km^2), with the exception of a single survey (February 2022). Further interrogation of the raw data shows the reason for this peak to be a multispecies assemblage of herring gull, great black-backed gull, kittiwake, lesser black-backed gull and gannet associated with a fishing vessel recorded in the Windfarm Site+2km buffer zone.

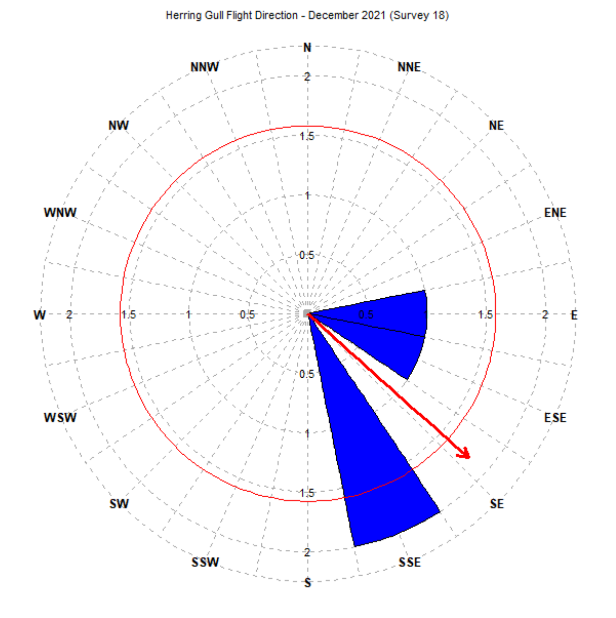
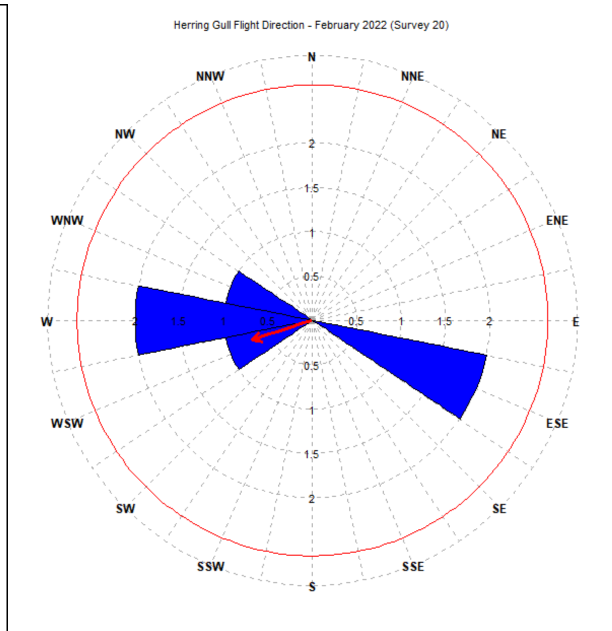


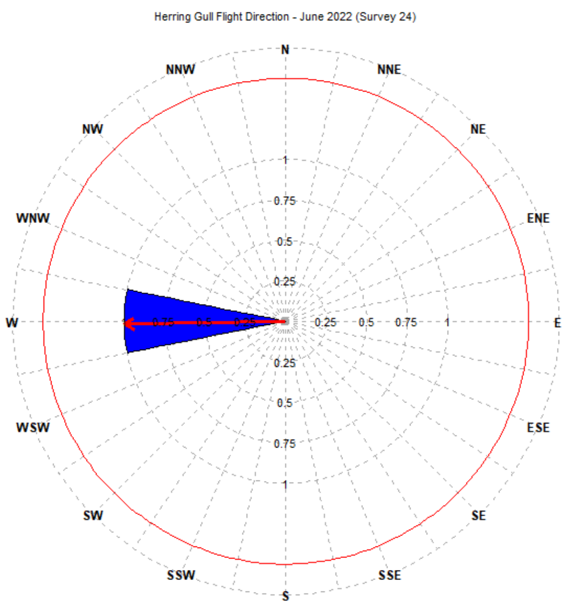


Number of Observations	1	Number of Observations	11
Mean Vector (μ)	255.978	Mean Vector (μ)	43.670
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.855
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	8.043
Rayleigh Test (p)	0.512	Rayleigh Test (p)	<0.001
Figure 8.8a September 2020		**Figure 8.8b December 2020**	

	
Number of Observations 1	Number of Observations 1
Mean Vector (µ) 98.220	Mean Vector (µ) 74.511
Length of Mean Vector (r) 1.000	Length of Mean Vector (r) 1.000
Rayleigh Test (Z) 1.000	Rayleigh Test (Z) 1.000
Rayleigh Test (p) 0.512	Rayleigh Test (p) 0.512
Figure 8.8c April 2021	**Figure 8.8d May 2021**

			
Number of Observations	5	Number of Observations	3
Mean Vector (µ)	243.914	Mean Vector (µ)	222.577
Length of Mean Vector (r)	0.988	Length of Mean Vector (r)	0.987
Rayleigh Test (Z)	4.879	Rayleigh Test (Z)	2.920
Rayleigh Test (p)	0.002	Rayleigh Test (p)	0.038
Figure 8.8e June 2021		**Figure 8.8f July 2021**	

			
Number of Observations	4	Number of Observations	6
Mean Vector (μ)	132.190	Mean Vector (μ)	252.594
Length of Mean Vector (r)	0.906	Length of Mean Vector (r)	0.359
Rayleigh Test (Z)	3.283	Rayleigh Test (Z)	0.773
Rayleigh Test (p)	0.025	Rayleigh Test (p)	0.481
Figure 8.8g December 2021		**Figure 8.8h February 2022**	



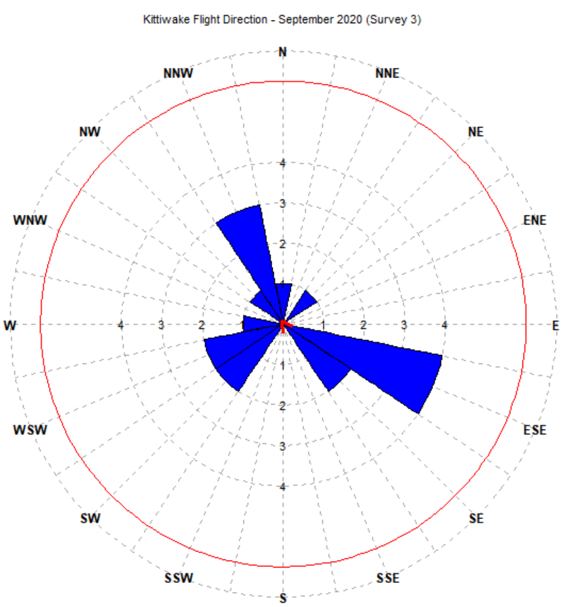
Number of Observations	1
Mean Vector (μ)	269.156
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512
Figure 8.8i June 2022	

Figure 8.8 Summary of flight direction of herring gulls during survey period

8.1.2.9 Kittiwake

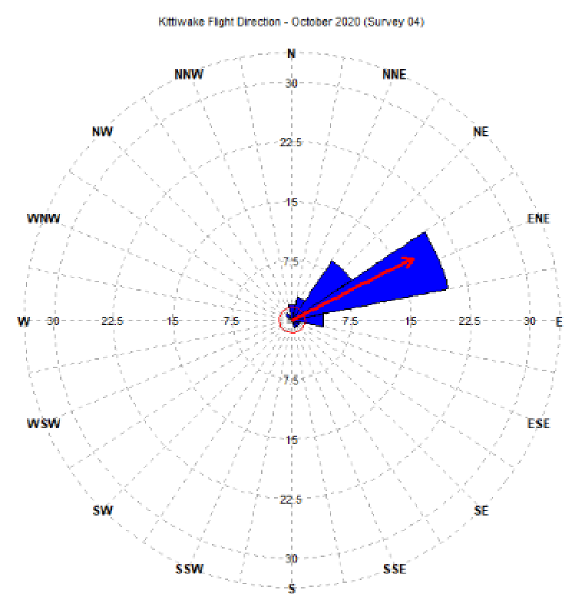
65. Kittiwakes were recorded in 22 of 24 baseline surveys, and were present in both the Windfarm Site and 2km and 4km buffers. They were not recorded in surveys carried out in June 2021 and October 2021.

66. Kittiwakes occurred in relatively low numbers during the autumn migration season (August to December), with densities of <1 bird/km^2 across the survey area. The highest densities of birds were present during the spring migration season (January to March), with densities of up to approximately 3.5 birds/km^2 reported. Except for March (which straddles the spring migration and breeding seasons), during which the peak density of birds was recorded in the Windfarm Site, densities were low during much of the breeding season (March to August), generally <0.5 birds/km^2.



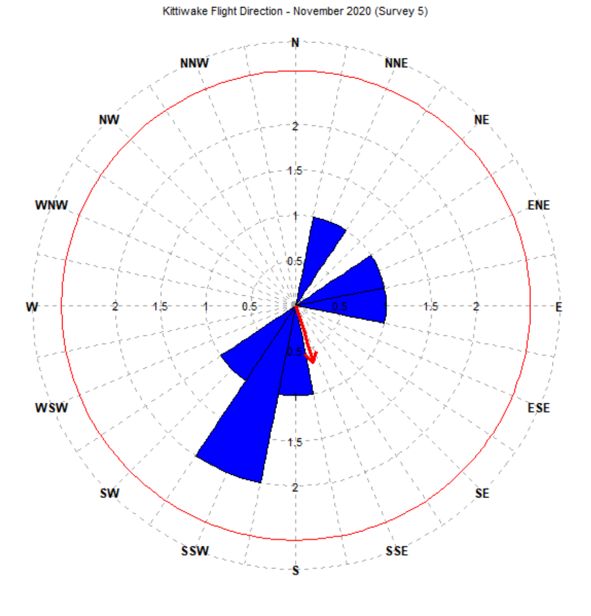
Number of Observations	17
Mean Vector (µ)	325.573
Length of Mean Vector (r)	0.018
Rayleigh Test (Z)	0.005
Rayleigh Test (p)	0.995

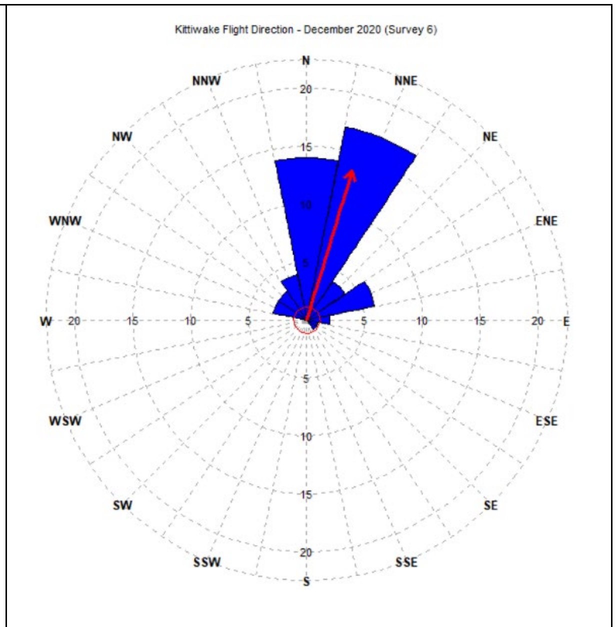
Figure 8.9a September 2020



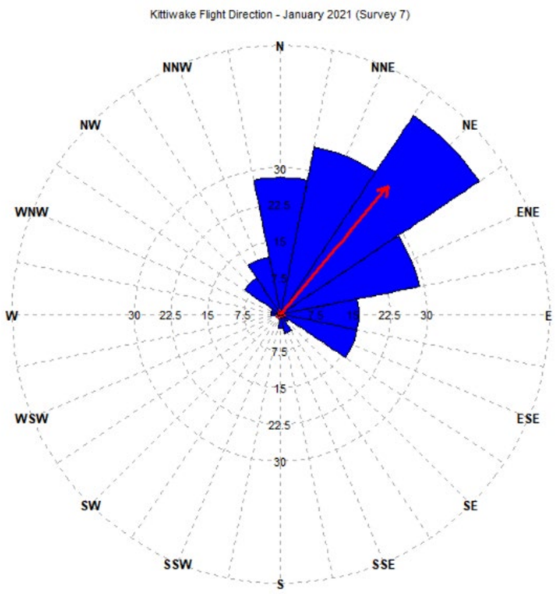
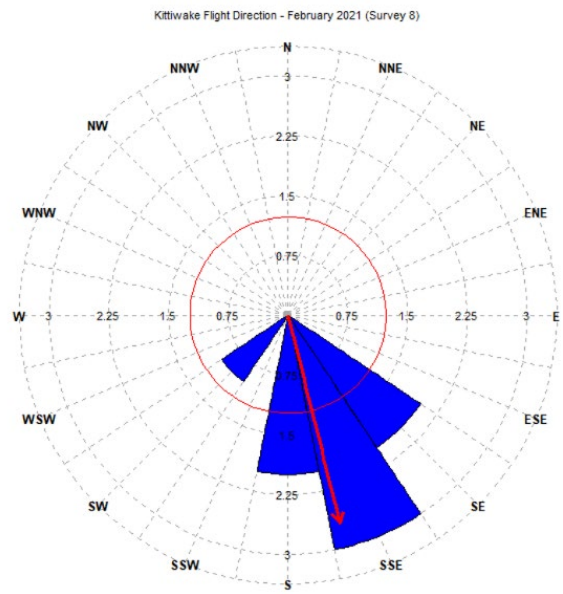
Number of Observations	42
Mean Vector (µ)	63.013
Length of Mean Vector (r)	0.855
Rayleigh Test (Z)	30.679
Rayleigh Test (p)	<0.001

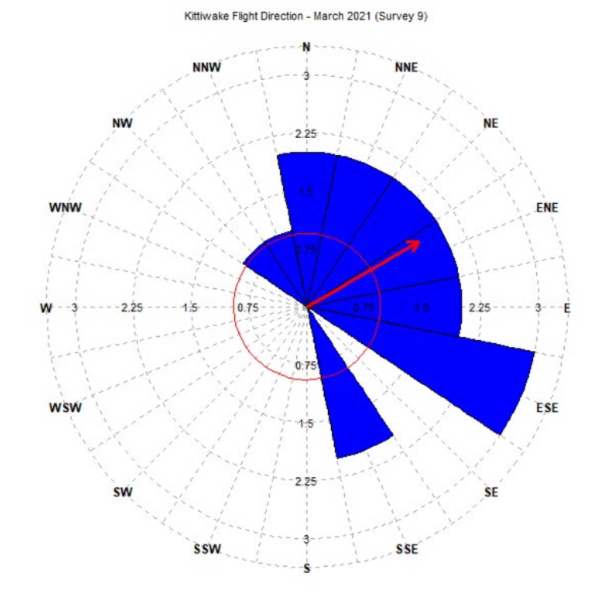
Figure 8.9b October 2020

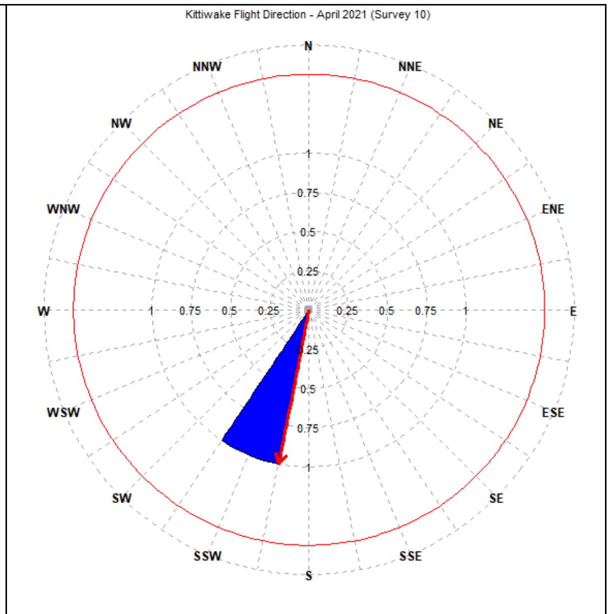




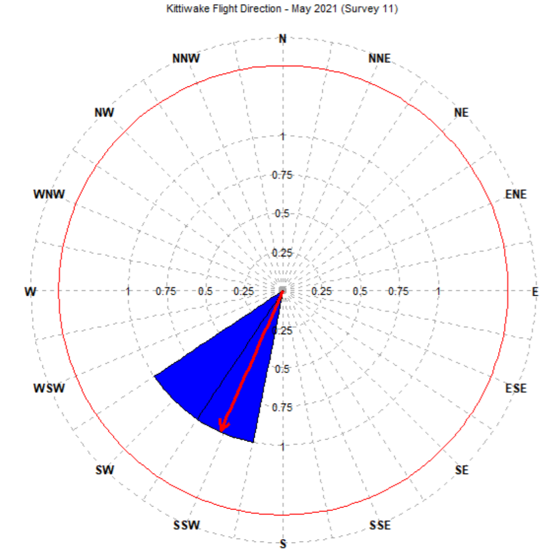
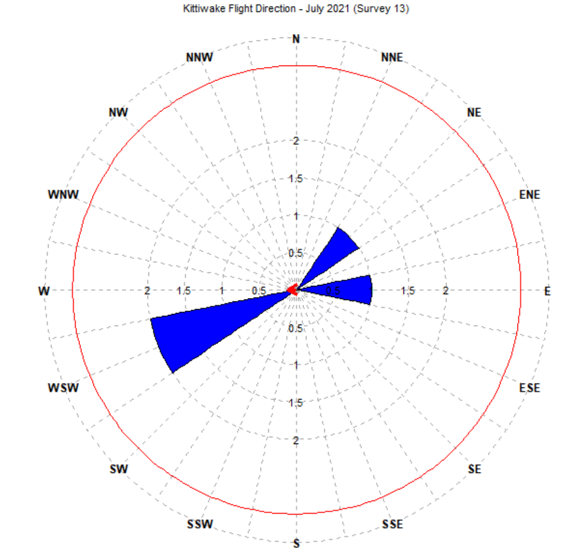
Number of Observations	7	Number of Observations	55
Mean Vector (μ)	163.942	Mean Vector (μ)	17.004
Length of Mean Vector (r)	0.329	Length of Mean Vector (r)	0.793
Rayleigh Test (Z)	0.757	Rayleigh Test (Z)	34.571
Rayleigh Test (p)	0.486	Rayleigh Test (p)	<0.001
Figure 8.9c November 2020		**Figure 8.9d December 2020**	

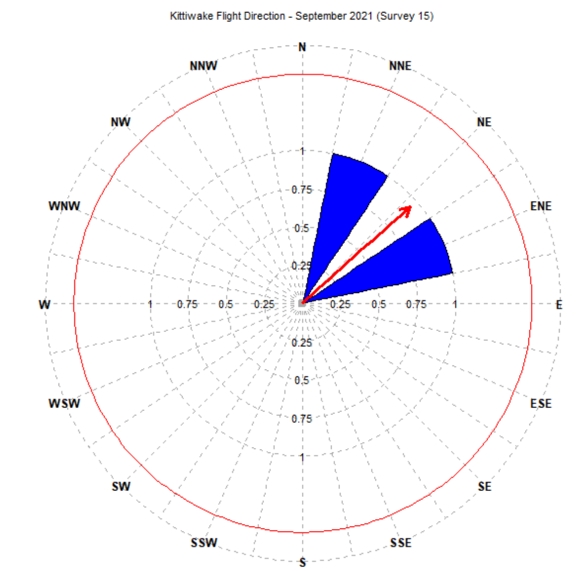
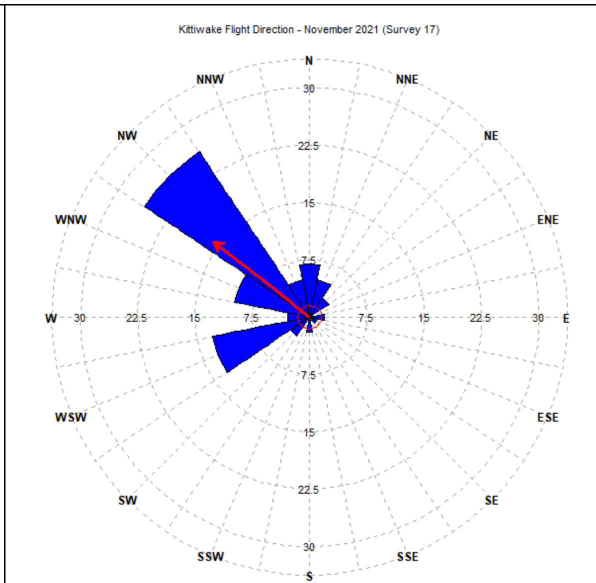
			
Number of Observations	208	Number of Observations	8
Mean Vector (μ)	40.805	Mean Vector (μ)	166.979
Length of Mean Vector (r)	0.698	Length of Mean Vector (r)	0.895
Rayleigh Test (Z)	101.280	Rayleigh Test (Z)	6.403
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	<0.001
Figure 8.9e January 2021		**Figure 8.9f February 2021**	



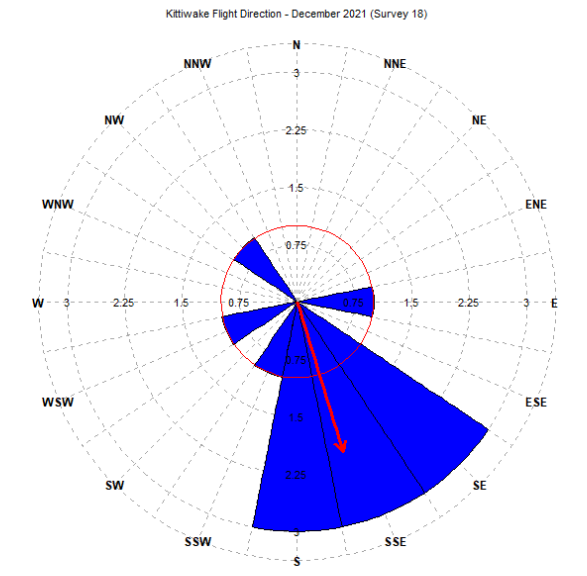
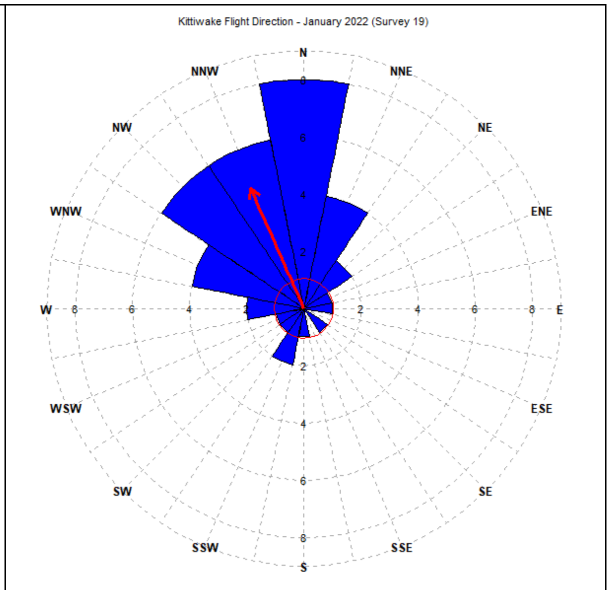


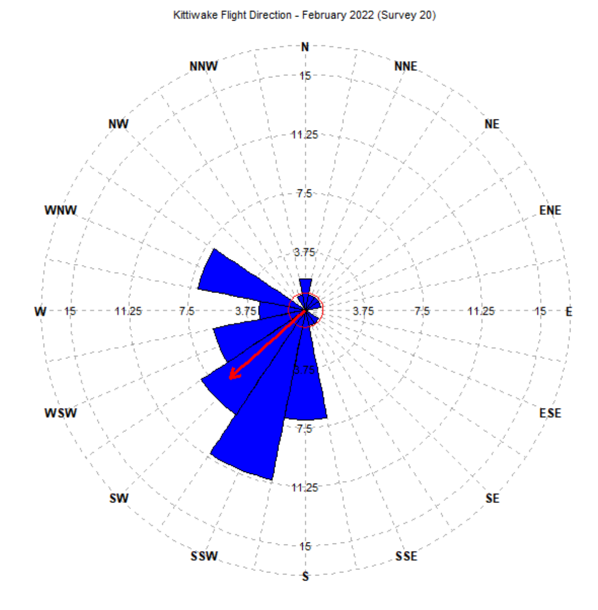
Number of Observations	17	Number of Observations	1
Mean Vector (μ)	60.345	Mean Vector (μ)	191.511
Length of Mean Vector (r)	0.555	Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	5.227	Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.004	Rayleigh Test (p)	0.512
Figure 8.9g March 2021		**Figure 8.9h April 2021**	

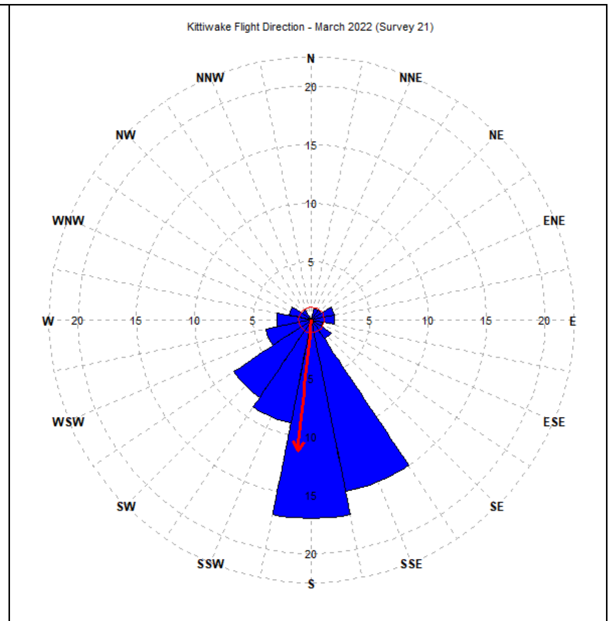
	
Number of Observations 2 Mean Vector (μ) 204.778 Length of Mean Vector (r) 0.987 Rayleigh Test (Z) 1.949 Rayleigh Test (p) 0.147	Number of Observations 4 Mean Vector (μ) 268.474 Length of Mean Vector (r) 0.060 Rayleigh Test (Z) 0.015 Rayleigh Test (p) 0.987
Figure 8.9i May 2021	**Figure 8.9j July 2021**

Number of Observations	2	Number of Observations	81
Mean Vector (μ)	48.281	Mean Vector (μ)	308.4
Length of Mean Vector (r)	0.942	Length of Mean Vector (r)	0.612
Rayleigh Test (Z)	1.774	Rayleigh Test (Z)	30.364
Rayleigh Test (p)	0.184	Rayleigh Test (p)	<0.001
Figure 8.9k September 2021		**Figure 8.9l November 2021**	

December 2021		January 2022	
			
Number of Observations	13	Number of Observations	40
Mean Vector (μ)	163.625	Mean Vector (μ)	336.665
Length of Mean Vector (r)	0.682	Length of Mean Vector (r)	0.572
Rayleigh Test (Z)	6.053	Rayleigh Test (Z)	13.079
Rayleigh Test (p)	0.001	Rayleigh Test (p)	<0.001
Figure 8.9m December 2021		**Figure 8.9n January 2022**	

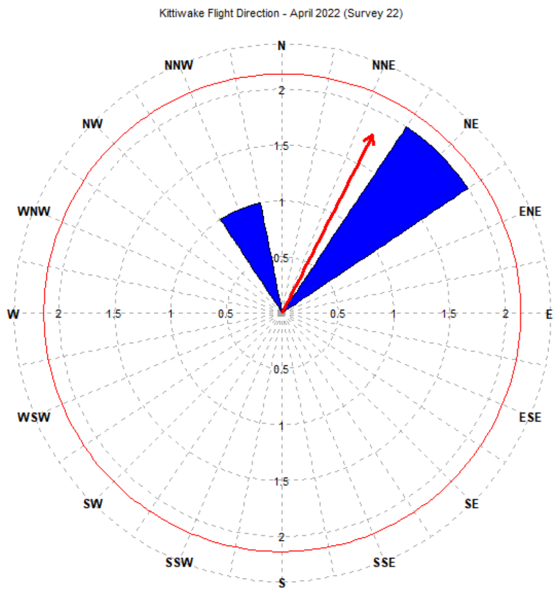
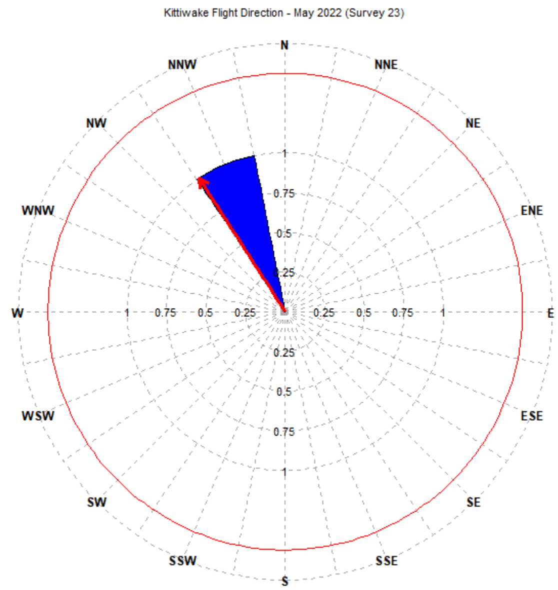


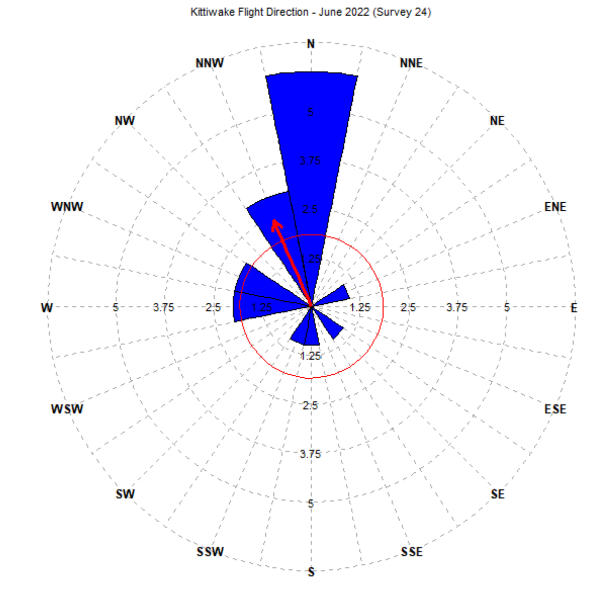


Number of Observations	50	Number of Observations	68
Mean Vector (μ)	228.701	Mean Vector (μ)	186.146
Length of Mean Vector (r)	0.588	Length of Mean Vector (r)	0.664
Rayleigh Test (Z)	17.299	Rayleigh Test (Z)	29.991
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	<0.001

Figure 8.9o February 2022

Figure 8.9p March 2022

	
Number of Observations 3	Number of Observations 1
327.211Mean Vector (µ) 27.315	Mean Vector (µ) 327.211
Length of Mean Vector (r) 0.892	Length of Mean Vector (r) 1.000
Rayleigh Test (Z) 2.389	Rayleigh Test (Z) 1.000
Rayleigh Test (p) 0.083	Rayleigh Test (p) 0.512
Figure 8.9q April 2022	**Figure 8.9r May 2022**



Number of Observations	17
Mean Vector (μ)	336.340
Length of Mean Vector (r)	0.478
Rayleigh Test (Z)	3.882
Rayleigh Test (p)	0.018

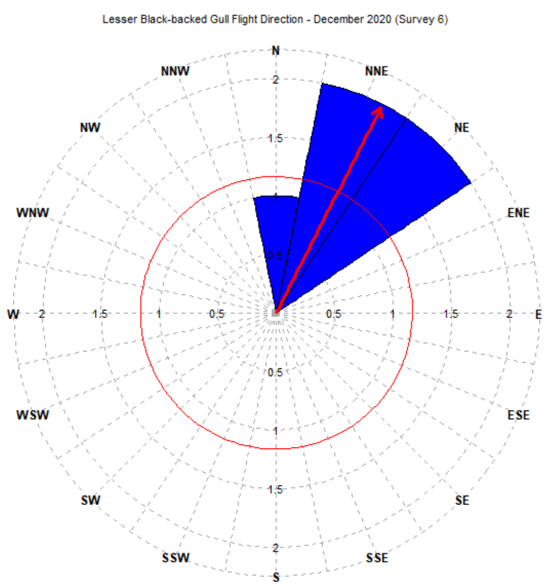
Figure 8.9s June 2022

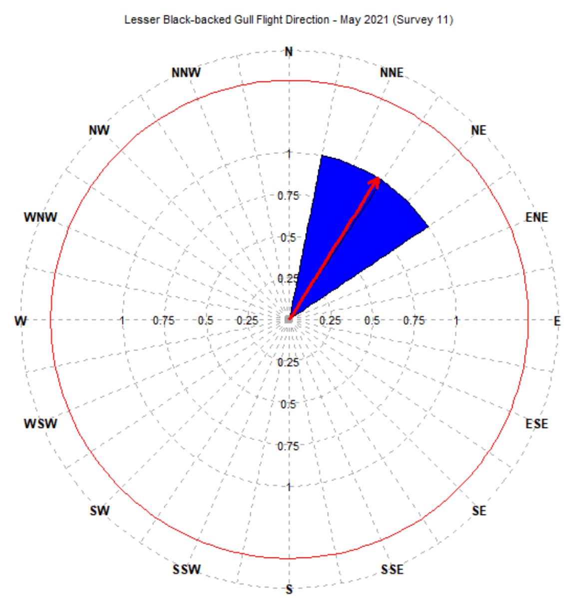
Figure 8.9 Summary of flight direction of kittiwakes during survey period

8.1.2.10 Lesser black-backed gull

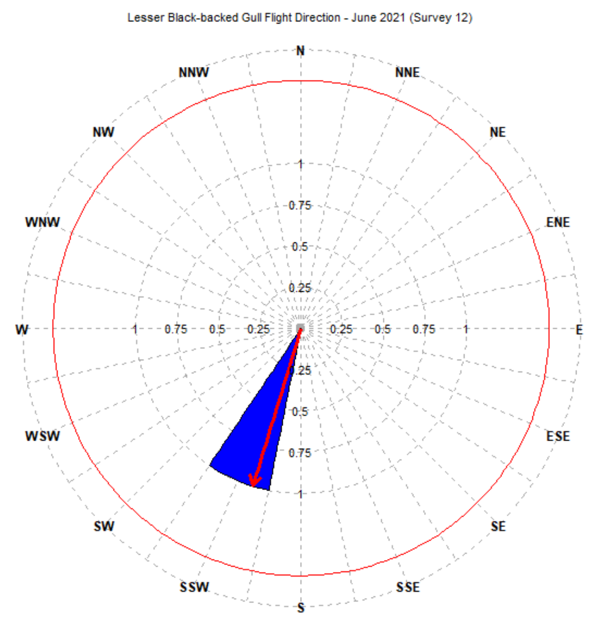
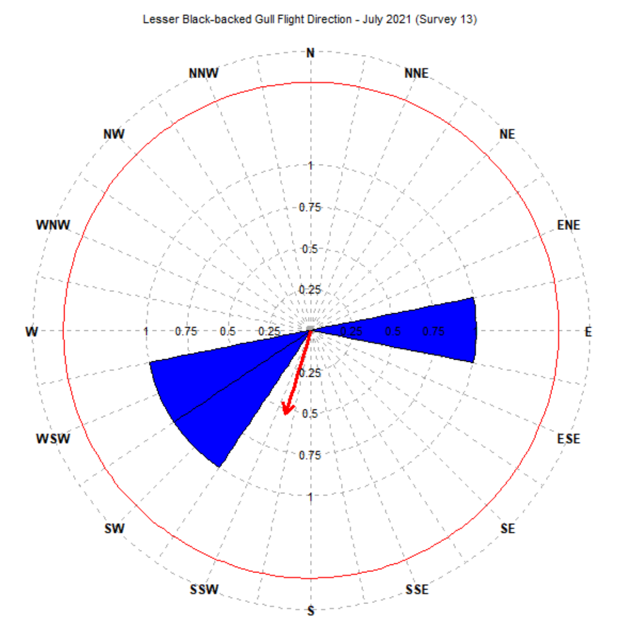
67. Lesser black-backed gull was recorded on 10 of the 24 baseline surveys, mainly within the breeding season (April to August), but also the autumn migration (August to October, winter (November to February), and spring migration (March to April) seasons.

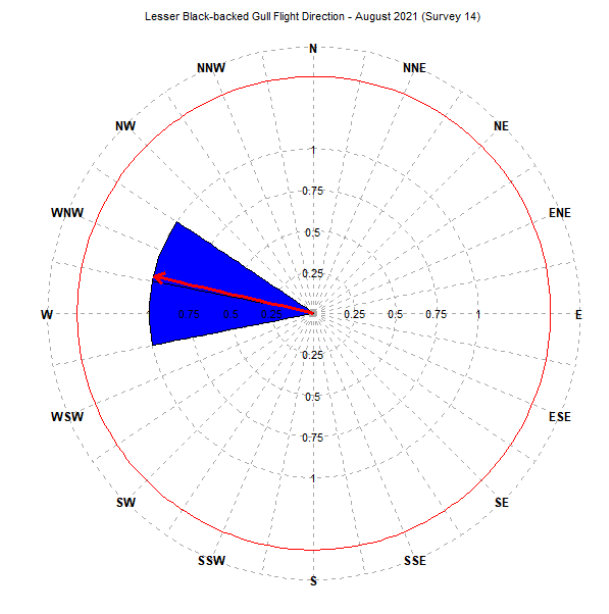
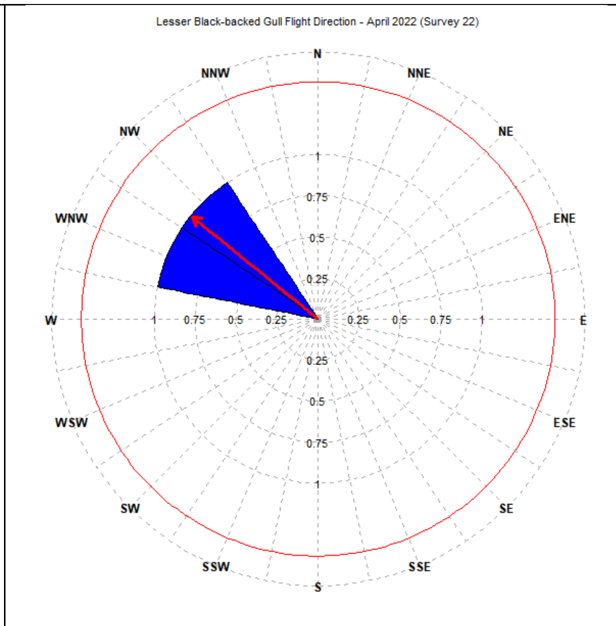
68. Densities of birds were for the most part low (i.e. <0.5 birds/km^2), with the exception of a single survey (February 2022). Further interrogation of the raw data shows the reason for this peak to be a multispecies assemblage of herring gull, great black-backed gull, kittiwake, lesser black-backed gull and gannet associated with a fishing vessel recorded in the Windfarm Site+2km buffer zone.

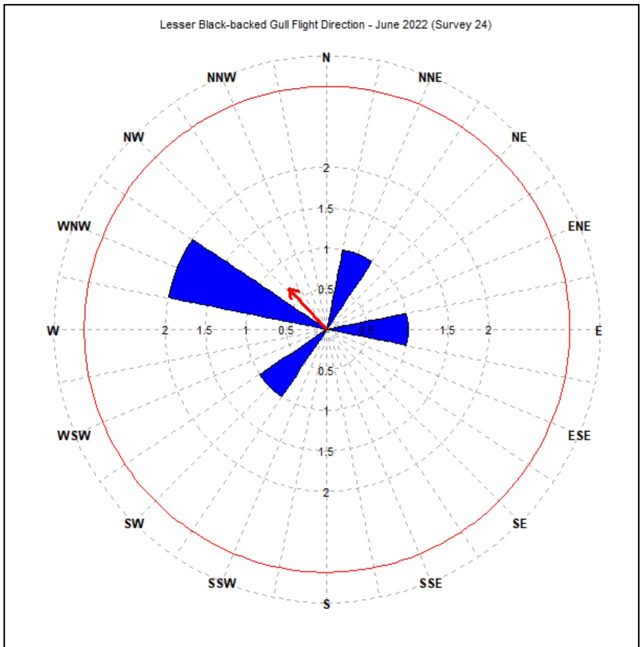




Number of Observations	5	Number of Observations	2
Mean Vector (μ)	27.594	Mean Vector (μ)	32.316
Length of Mean Vector (r)	0.983	Length of Mean Vector (r)	0.999
Rayleigh Test (Z)	4.835	Rayleigh Test (Z)	1.995
Rayleigh Test (p)	0.002	Rayleigh Test (p)	0.138
Figure 8.10a December 2020		**Figure 8.10b May 2021**	

			
Number of Observations	1	Number of Observations	3
Mean Vector (μ)	197.760	Mean Vector (μ)	197.669
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.530
Rayleigh Test (Z)	1.000	Rayleigh Test (Z)	0.842
Rayleigh Test (p)	0.512	Rayleigh Test (p)	0.471
Figure 8.10c June 2021		**Figure 8.10d July 2021**	

	
Number of Observations 2	Number of Observations 2
Mean Vector (μ) 283.774	Mean Vector (μ) 309.351
Length of Mean Vector (r) 0.994	Length of Mean Vector (r) 0.990
Rayleigh Test (Z) 1.975	Rayleigh Test (Z) 1.959
Rayleigh Test (p) 0.142	Rayleigh Test (p) 0.145
Figure 8.10e August 2021	**Figure 8.10f April 2022**



Number of Observations	5
Mean Vector (µ)	317.989
Length of Mean Vector (r)	0.345
Rayleigh Test (Z)	0.594
Rayleigh Test (p)	0.576

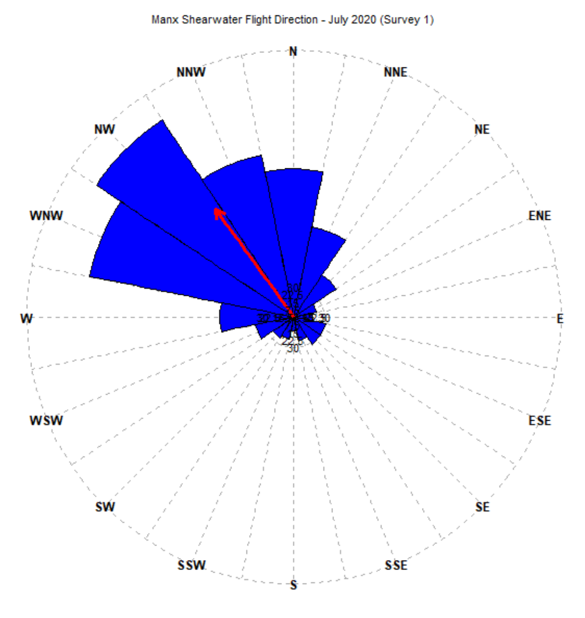
Figure 8.10g June 2022

Figure 8.10 Summary of flight direction of lesser black-backed gulls during survey period

8.1.2.11 Manx shearwater

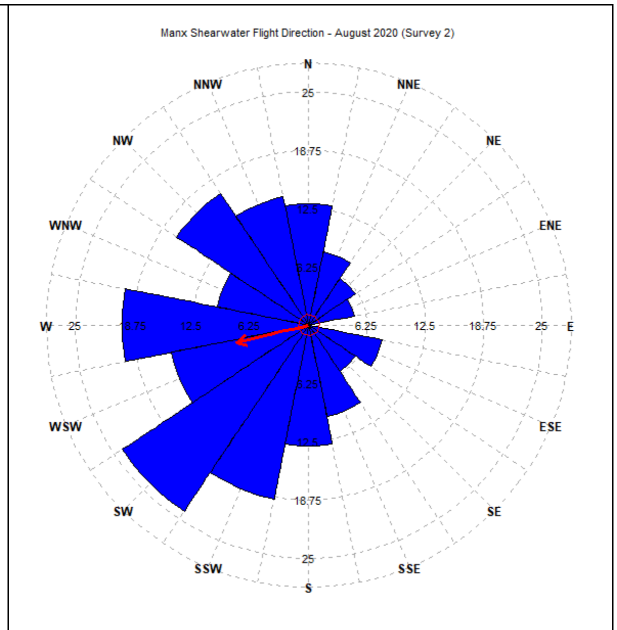
69. Manx shearwater was recorded in 13 of the 24 baseline surveys, and in all three biological seasons recognised for the species in UK waters – breeding season (April to August), autumn migration (September, October), and spring migration (March).

70. Densities of birds recorded within the Windfarm Site area during the breeding season (1.6 birds/km^2 to 173 birds/km^2) were one to three orders of magnitude larger than those recorded during migration seasons (<1.0 birds/km^2).



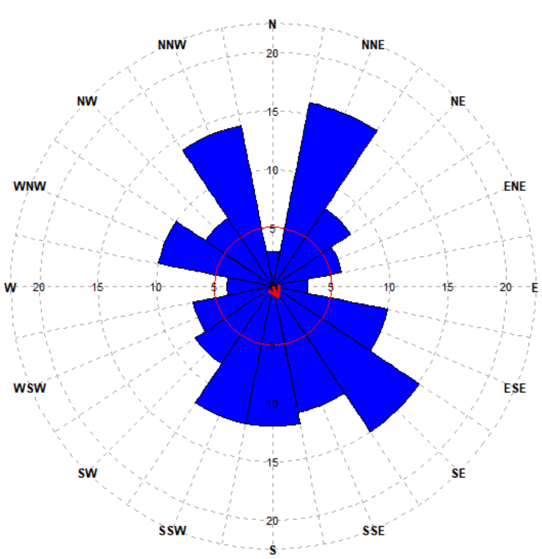
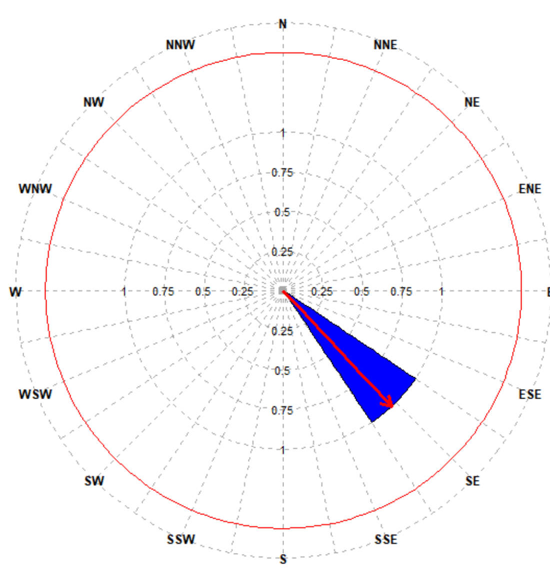
Number of Observations	1,191
Mean Vector (μ)	32.921
Length of Mean Vector (r)	0.561
Rayleigh Test (Z)	375.467
Rayleigh Test (p)	<0.001

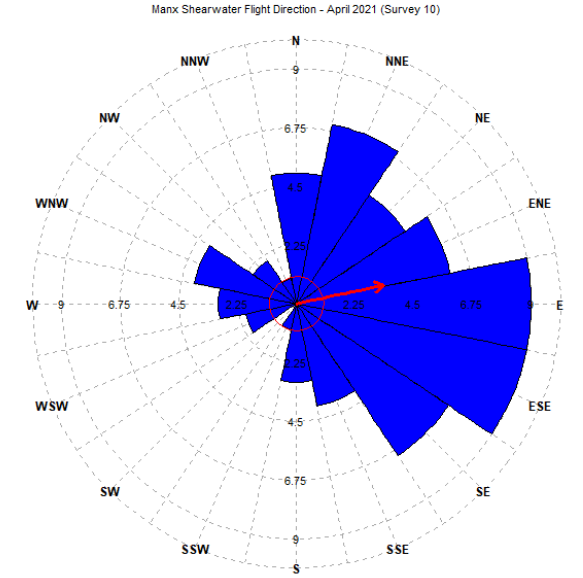
Figure 8.11a July 2020

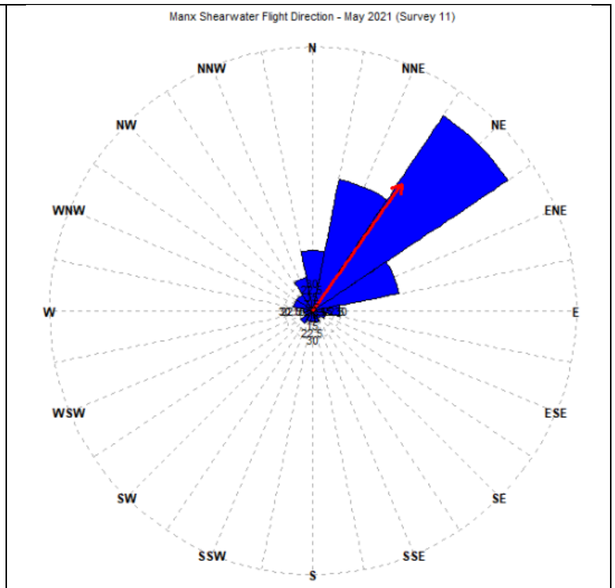


Number of Observations	188
Mean Vector (μ)	256.448
Length of Mean Vector (r)	0.329
Rayleigh Test (Z)	20.347
Rayleigh Test (p)	<0.001

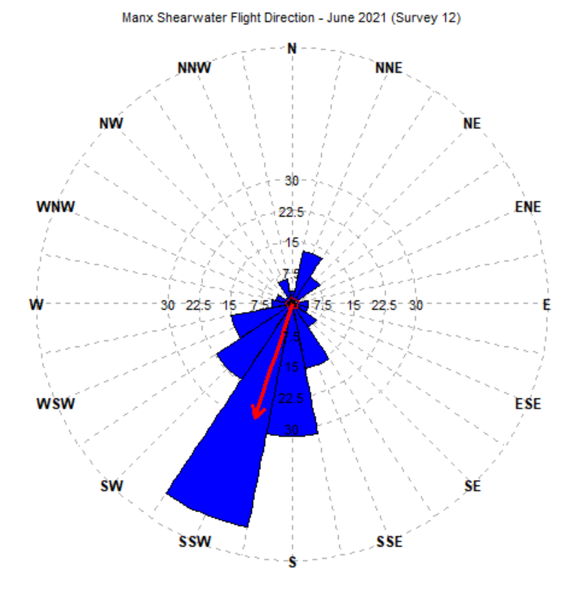
Figure 8.11b August 2020

	
Number of Observations 146	Number of Observations 1
Mean Vector (μ) 155.064	Mean Vector (μ) 137.231
Length of Mean Vector (r) 0.065	Length of Mean Vector (r) 1.000
Rayleigh Test (Z) 0.620	Rayleigh Test (Z) 1.000
Rayleigh Test (p) 0.538	Rayleigh Test (p) 0.512
Figure 8.11c September 2020	**Figure 8.11d March 2021**



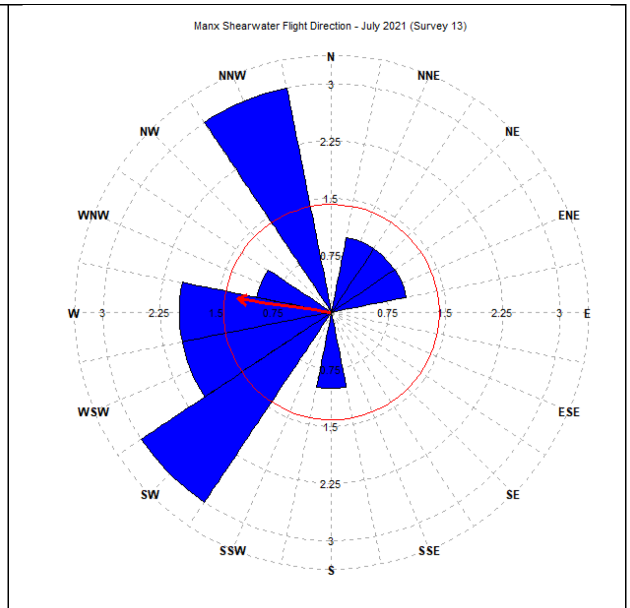


Number of Observations	68	Number of Observations	748
Mean Vector (µ)	78.224	Mean Vector (µ)	35.478
Length of Mean Vector (r)	0.381	Length of Mean Vector (r)	0.659
Rayleigh Test (Z)	9.891	Rayleigh Test (Z)	324.827
Rayleigh Test (p)	<0.001	Rayleigh Test (p)	<0.001
Figure 8.11e April 2021		**Figure 8.11f May 2021**	



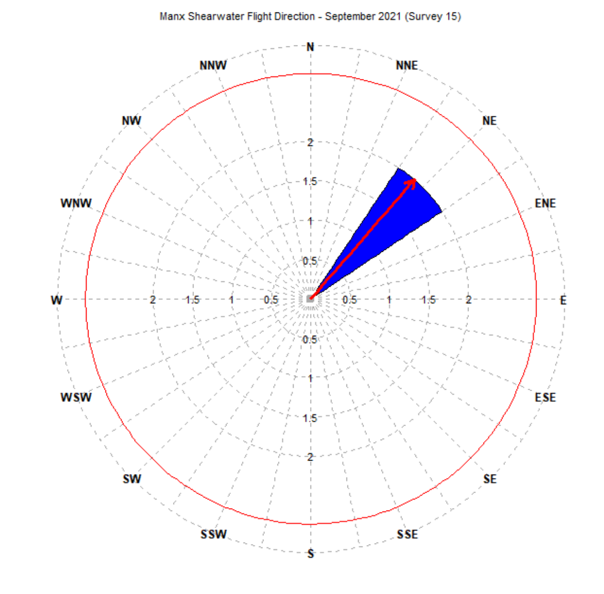
Number of Observations	196
Mean Vector (µ)	198.128
Length of Mean Vector (r)	0.525
Rayleigh Test (Z)	54.052
Rayleigh Test (p)	<0.001

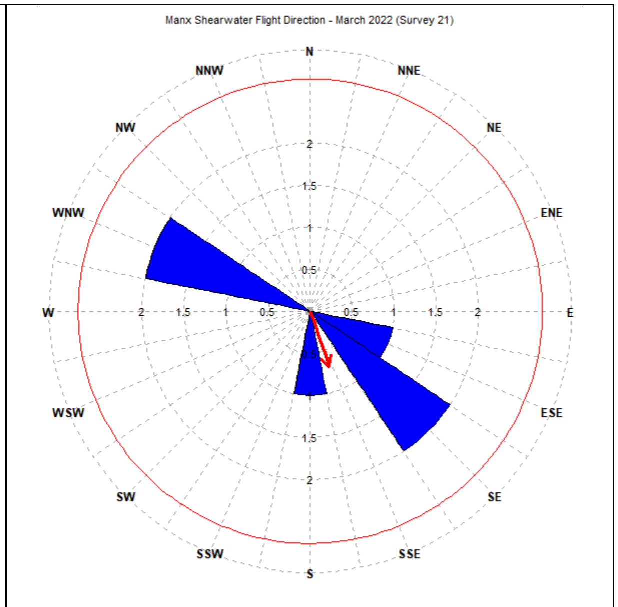
Figure 8.11g June 2021



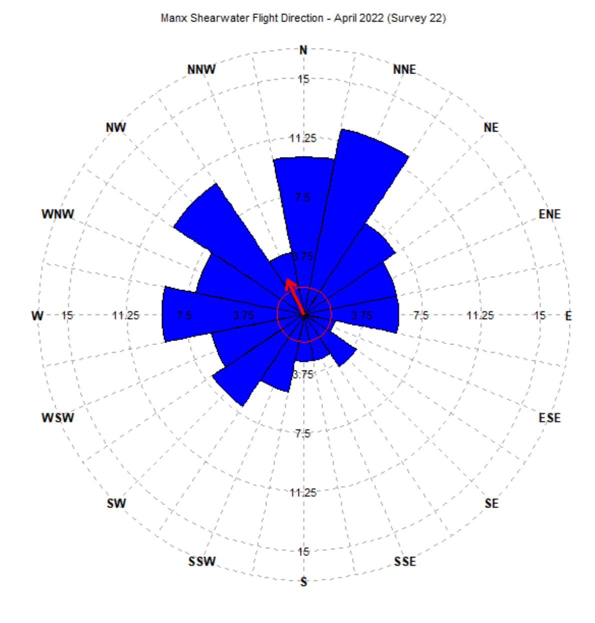
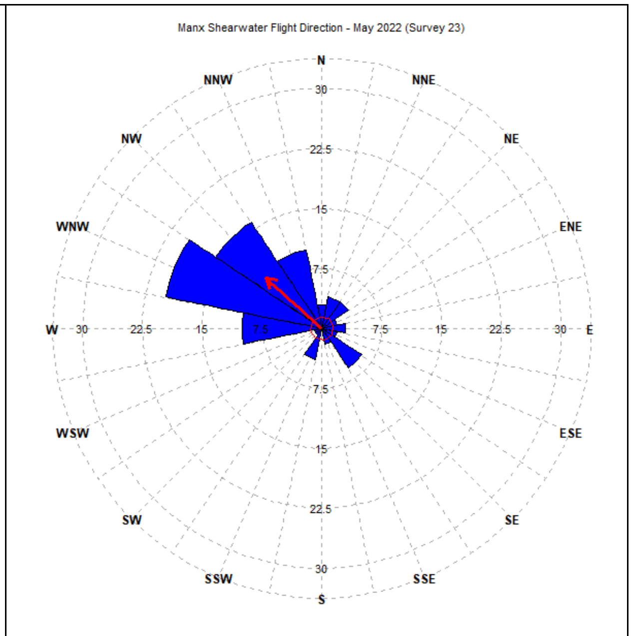
Number of Observations	15
Mean Vector (µ)	278.313
Length of Mean Vector (r)	0.416
Rayleigh Test (Z)	2.592
Rayleigh Test (p)	0.073

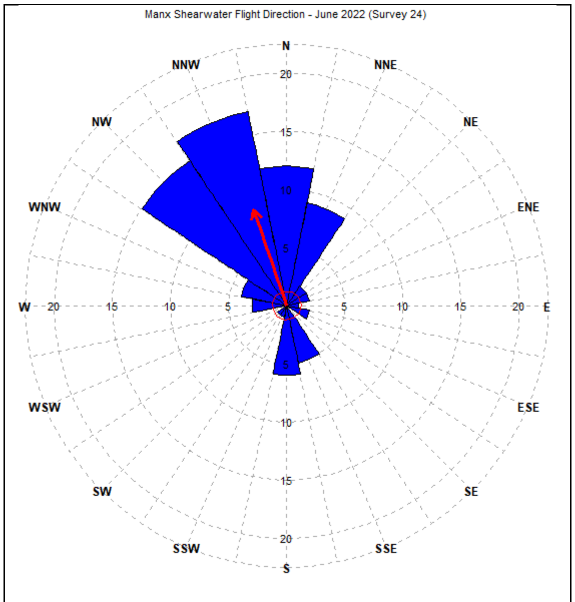
Figure 8.11h July 2021





Number of Observations	2	Number of Observations	6
Mean Vector (μ)	41.306	Mean Vector (μ)	161.783
Length of Mean Vector (r)	1.000	Length of Mean Vector (r)	0.345
Rayleigh Test (Z)	1.999	Rayleigh Test (Z)	0.715
Rayleigh Test (p)	0.137	Rayleigh Test (p)	0.509
Figure 8.11i September 2021		**Figure 8.11j March 2022**	

	
Number of Observations 101	Number of Observations 88
Mean Vector (µ) 334.543	Mean Vector (µ) 312.461
Length of Mean Vector (r) 0.204	Length of Mean Vector (r) 0.469
Rayleigh Test (Z) 4.204	Rayleigh Test (Z) 19.341
Rayleigh Test (p) 0.015	Rayleigh Test (p) <0.001
Figure 8.11k April 2022	**Figure 8.11l May 2022**



Number of Observations	80
Mean Vector (μ)	341.270
Length of Mean Vector (r)	0.512
Rayleigh Test (Z)	20.985
Rayleigh Test (p)	<0.001

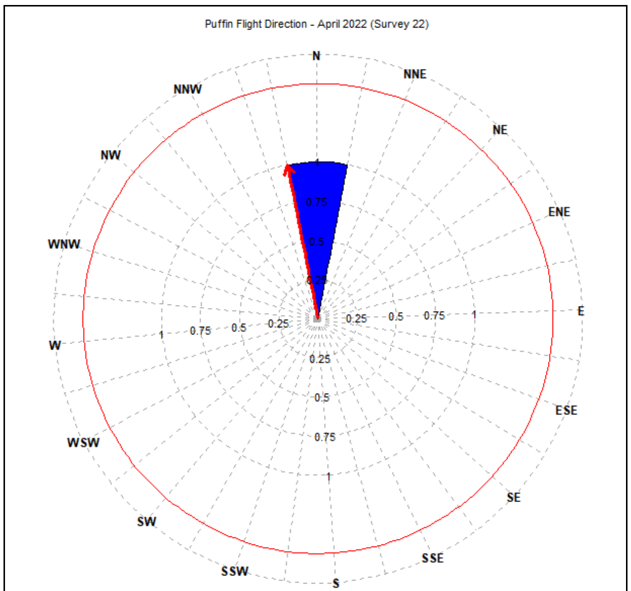
Figure 8.11m June 2022

Figure 8.11 Summary of flight direction of Manx shearwaters during survey period

8.1.2.12 Puffin

71. Puffin was recorded in seven of the 24 baseline surveys in the Windfarm Site + 4km buffer area, and of these was recorded within the Windfarm Site itself on only two baseline surveys. Both of these occurrences (July 2020, April 2022) were in the breeding season (April to August). Occurrences within the Windfarm Site + 4km buffer area were also concentrated in the breeding season (particularly April and May in which surveys captured consistently higher abundance than other breeding months in both survey years).

72. Across surveys where puffin was recorded, densities were variable within each season (breeding, non-breeding), and densities were not distinctively higher or lower in the breeding season than in the non-breeding season.



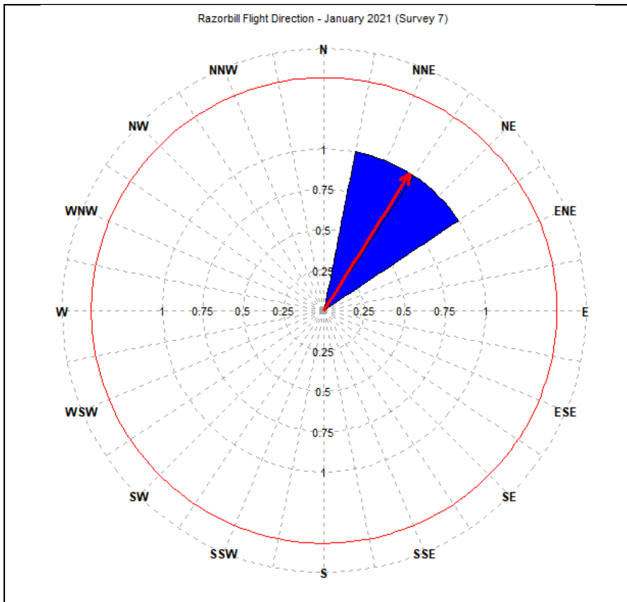
Number of Observations	1
Mean Vector (µ)	356.395
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

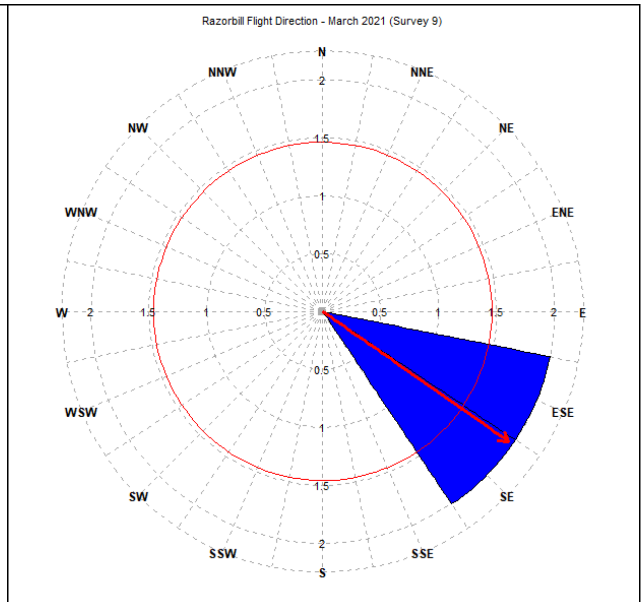
Figure 8.12 Summary of flight direction of puffins during survey period

8.1.2.13 Razorbill

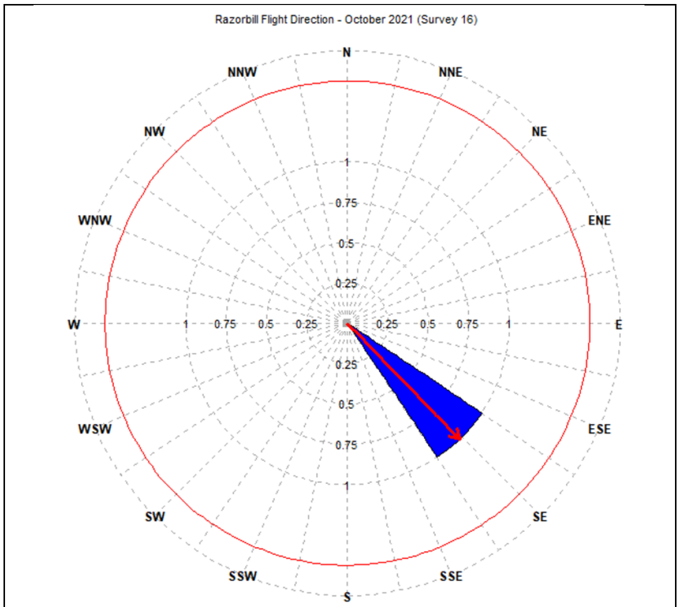
73. Razorbill was recorded within the Windfarm Site + 4km buffer area in 17 of the 24 baseline surveys, and in all four biological seasons considered appropriate for characterising the species in UK waters – spring migration (January to March), breeding season (April to July), autumn migration (August to October) and wintering season (November, December). The species was recorded in all of these seasons within the Windfarm Site also, where it was recorded in nine of the 24 surveys.

74. Across baseline surveys, densities exceeding 0.5 birds/km^2 in the Windfarm Site + 4km buffer area were recorded at least once in each of these seasons. However, the two highest recorded densities in this area by far (>3.5 birds/km^2) were in December 2020 and January 2021, i.e. in the winter season and spring migration season, respectively.





Number of Observations	2	Number of Observations	4
Mean Vector (μ)	32.722	Mean Vector (μ)	125.490
Length of Mean Vector (r)	0.993	Length of Mean Vector (r)	0.980
Rayleigh Test (Z)	1.971	Rayleigh Test (Z)	3.839
Rayleigh Test (p)	0.143	Rayleigh Test (p)	0.010
Figure 8.13a January 2021		**Figure 8.13b March 2021**	



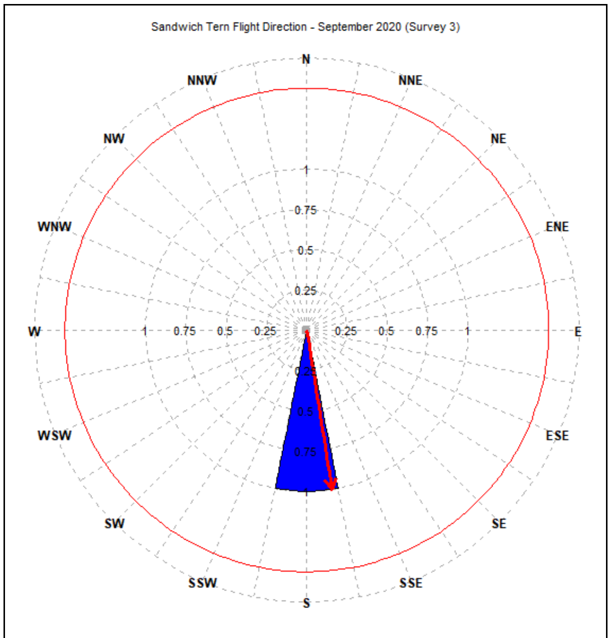
Number of Observations	1
Mean Vector (μ)	136.330
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

Figure 8.13c October 2021

Figure 8.13 Summary of flight direction of razorbills during survey period

8.1.2.14 Sandwich tern

75. Sandwich tern was recorded on a single occasion during the baseline surveys in September 2020 (i.e. the species was absent on 23 of 24 surveys). This falls within the autumn migration season for this species (July to September). On the single occasion it was recorded during a survey, it was present in very low densities (<0.1 bird/km^2) in the 4km buffer zone of the survey area only.



Number of Observations	1
Mean Vector (μ)	171.204
Length of Mean Vector (r)	1.000
Rayleigh Test (Z)	1.000
Rayleigh Test (p)	0.512

Figure 8.14 September 2020

Figure 8.14 Summary of flight direction of Sandwich terns during survey period

8.2 Ornithology Baseline – Offshore Export Cable Corridor

8.2.1 Background and approach

76. This section presents the baseline conditions in respect of offshore ornithology receptors for the Export Cable Corridor for the Offshore Project. In accordance with standard practice, specific surveys of the corridor have not been undertaken, with the exception of a small area where the 4km survey buffer around the Windfarm Site overlaps the Offshore Export Cable Corridor. The baseline has therefore been derived from this area of coverage form the survey and from desk-based sources:

- Information on designated sites (Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs)) notified for seabird populations, from JNCC, Natural England and Natural Resources Wales (NRW) websites
- Survey data from the Windfarm Site and 4km buffer recorded during 24 months aerial survey (July 2020-June 2022; refer also to **Section 4**)
- Published information on seabird distribution from Waggitt *et al.* (2019) and Bradbury *et al.* (2014)
- Relevant species-specific sources including Wakefield *et al* (2013) for gannet, Guilford *et al (2008*) for Manx shearwater, and Phillips *et al* (2021) for Balearic shearwater.

77. The baseline is focussed on seabird species that are considered potentially vulnerable to activity associated with cable installation; i.e. those species considered sensitive to disturbance / displacement from ship activity (e.g. based on Furness *et al* (2013) and Fleissbach *et al* (2019)). Manx shearwater and Balearic shearwater are also included (despite their low susceptibility to disturbance / displacement), given the particular importance of the Celtic Sea to these species. The following species are therefore considered in the baseline:

- Red-throated diver (wintering)
- Common Scoter (wintering)
- Guillemot (breeding and non-breeding)
- Razorbill (breeding and non-breeding)
- Puffin (breeding and non-breeding)
- Gannet (breeding and non-breeding)
- Manx shearwater (breeding and passage)
- Balearic shearwater (passage).

8.2.2 Designated sites

78. No SPAs or SSSIs designated for their seabird populations occur within or adjacent to the Offshore Export Cable Corridor.

79. Sites considered particularly relevant to the assessment (based on professional judgement and taking into account the breeding mean maximum foraging ranges (from Woodward *et al* (2019)) of relevant species) are as follows:

- Lundy SSSI (3.5km north of Offshore Export Cable Corridor; breeding puffin, Manx shearwater, razorbill and guillemot)
- Skomer, Skokholm and the Seas off Pembrokeshire SPA (37km north of Offshore Export Cable Corridor; breeding Manx shearwater, puffin and seabird assemblage (including guillemot and razorbill))
- Carmarthen Bay SPA (47km north of Offshore Export Cable Corridor; wintering common scoter)
- Grassholm SPA (63km north of SPA; breeding gannet).

8.2.3 Species accounts

8.2.3.1 Red-throated diver (wintering)

80. No divers were recorded during aerial surveys of the Windfarm Site and 4km buffer, and diver species are not included within Waggitt *et al.* (2019). Predicted red-throated diver densities for the English Celtic Sea and Severn approaches are included within Bradbury *et al* (2014), which indicates very low densities (0.002-0.006 birds/ km^2) across the majority of the Offshore Export Cable Corridor route, reducing to 0.001 birds/km^2 at its western end, adjoining the windfarm site. These densities are typical for the coast around the southwest peninsula and English Channel, and significantly below peak values for this species recorded off the East Anglian coast and Liverpool Bay, where densities of up to six birds/km^2 are predicted. Overall, therefore, it is considered that the presence of significant populations of red-throated diver along the Offshore Export Cable Corridor is very unlikely.

8.2.3.2 Common Scoter (wintering)

81. No common scoters were recorded during aerial surveys of the Windfarm Site and 4km buffer. No density estimates for this species are presented in Bradbury *et al.* (2014), and this species is not included within Waggitt *et al.* (2019). The Offshore Export Cable Corridor is located outside of areas known to be of importance for this species, which occurs primarily in shallow coastal waters during the winter period, and is too distant from the Carmarthen Bay SPA population for birds from this SPA to be present along the Offshore Export Cable Corridor. Overall, therefore, it is considered that the presence of

significant populations of common scoter along the Offshore Export Cable Corridor is very unlikely.

8.2.3.3 Guillemot (breeding and non-breeding)

82. Guillemot was recorded regularly during the aerial surveys of the Windfarm Site and 4km buffer (20 of 24 surveys). Mean peak densities were 22.40 birds/km^2 during the breeding season and 6.51 birds/ km^2 during the non-breeding season. Density maps presented within Waggitt *et al.* (2019) (which are presented at a 10km grid resolution) indicate typical peak abundance of this species within the Celtic Sea occurs in the period between December and March (i.e. during the non-breeding and first part of the breeding season), with values in the region of two birds/km^2. Densities reduce in open-sea areas during the breeding season, with concentrations around breeding sites; densities within open-sea areas (i.e. along the majority of the Offshore Export Cable Corridor) are below one bird/km^2. The Offshore Export Cable Corridor is located within mean maximum foraging range of guillemot (73km; Woodward *et al.*, 2019) for both Lundy Island SSSI and Skomer, Skokholm and the Seas off Pembrokeshire SPA. Birds from these sites may therefore occur in the vicinity of the Offshore Export Cable Corridor during the breeding season, together birds from other colonies within foraging range, and non-breeding and immature birds not directly associated with the designated sites. During the non-breeding season, it is likely that birds would originate from a range of breeding colonies within the UK Western Waters Biologically Defined Minimum Population Scales (BDMPS) area (Furness, 2015).

8.2.3.4 Razorbill (breeding and non-breeding)

83. Razorbill was recorded regularly during the aerial surveys of the Windfarm Site and 4km buffer (17 of 24 surveys). Mean peak densities were 0.32 birds/km^2 during the breeding season, 0.35 birds/ km^2 during autumn migration, 2.03 birds/km^2 during the winter, and 2.07 birds/ km^2 during spring migration. Density maps presented within Waggitt *et al.* (2019) indicate generally low densities of this species in the Celtic Sea, but highest during the spring-migration period (January-March), with typical densities in the order of 0.2 birds/km^2. During the breeding season densities in open-sea areas are typically less (i.e. <0.1 birds/km^2), with concentrations around breeding sites. The Offshore Export Cable Corridor is located within mean maximum foraging range of razorbill (89km; Woodward *et al.*, 2019) for both Lundy Island SSSI and Skomer, Skokholm and the Seas off Pembrokeshire SPA. Birds from these sites may therefore occur in the vicinity of the Offshore Export Cable Corridor during the breeding season, together birds from other colonies within foraging range, and non-breeding and immature birds not directly associated with the designated sites. During the non-breeding season,

it is likely that birds would originate from a range of breeding colonies within the UK Western Waters BDMPS area (Furness, 2015).

8.2.3.5 Puffin (breeding and non-breeding)

84. Puffin was recorded occasionally during the aerial surveys of the Windfarm Site and 4km buffer (7 of 24 surveys). Mean peak densities were 0.41 birds/km^2 during the breeding season and 0.18 birds/km^2 during the non-breeding season. Density maps presented within Waggitt *et al.* (2019) indicate very low densities of this species in the Celtic Sea, with typical densities in the order of below 0.1 birds/km^2 throughout the year. The Offshore Export Cable Corridor is located within mean maximum foraging range of puffin (137km; Woodward *et al.*, 2019) for both Lundy Island SSSI and Skomer, Skokholm and the Seas off Pembrokeshire SPA. Birds from these sites may therefore occur in the vicinity of the Offshore Export Cable Corridor during the breeding season, together birds from other colonies within foraging range, and non-breeding and immature birds not directly associated with the designated sites. During the non-breeding season, it is likely that birds would originate from a range of breeding colonies within the UK Western Waters BDMPS area (Furness, 2015).

8.2.3.6 Gannet (breeding and non-breeding)

85. Gannet was recorded regularly during the aerial surveys of the Windfarm Site and 4km buffer (23 of 24 surveys). Mean peak densities were 1.47 birds/km^2 during the breeding season, 0.77 birds/km^2 during autumn migration, and 0.50 birds/km^2 during spring migration. Density maps presented within Waggitt *et al.* (2019) indicate typical peak abundance of this species within the Celtic Sea occurs during the breeding season (March-September), with values in the region of 0.5 birds/km^2; lower densities (0.3-0.5 birds/km^2) are predicted outside of the breeding season. The Offshore Export Cable Corridor is located within mean maximum foraging range of gannet (315km; Woodward *et al.*, 2019) for Grassholm SPA. Modelled at-sea utilisation distributions of breeding adult birds during the breeding season have been published, based on global positioning system (GPS) tracking data (Wakefield *et al.*, 2013). These indicate that birds present during the breeding season in the area of the Celtic Sea within which the Offshore Export Cable Corridor would be located are most likely to originate from Grassholm SPA. It is expected that non-breeding and immature birds not directly associated with the SPA would also be present at this time. During the non-breeding season, it is likely that birds would originate from a range of breeding colonies within the UK Western Waters BDMPS area (Furness, 2015).

8.2.3.7 Manx shearwater (breeding and passage)

86. Manx shearwater was recorded frequently during the aerial surveys of the Windfarm Site and 4km buffer (13 of 24 surveys). Mean peak densities were 81.32 birds/km^2 during the breeding season, 0.57 birds/km^2 during autumn migration, and 0.18 birds/km^2 during spring migration. Manx shearwaters are absent from UK waters during the winter. Density maps presented within Waggitt *et al.* (2019) indicate typical peak abundance of this species within the Celtic Sea occurs during the late breeding season (July and August), with values in the region of one bird/km^2. The Offshore Export Cable Corridor is located within mean maximum foraging range of Manx shearwater (1,347km; Woodward *et al.*, 2019) for both Lundy Island SSSI and Skomer, Skokholm and the Seas off Pembrokeshire SPA. A tracking study of Manx shearwaters from the Skomer colony is documented in Guilford *et al.* (2008); this indicated that the majority of birds foraged in areas to the north and west of the colony (typically within 100km). However, a proportion of trips continued further north into the Irish Sea, including the Irish Sea Front SPA area, the west coast of Northern Ireland, and as far north as the west coast of southern Scotland adjoining the Rhins of Galloway. This suggests that birds present in the vicinity of the Offshore Export Cable Corridor during the breeding season may not be breeding birds from the Skomer, Skokholm and the Seas off Pembrokeshire SPA, and are therefore more likely to be birds from Lundy SSSI, together birds from other colonies within foraging range, and non-breeding and immature birds not directly associated with the designated sites. During the migration seasons, it is likely that birds would originate from a range of breeding colonies within the UK Western Waters plus Channel BDMPS (Furness, 2015).

8.2.3.8 Balearic shearwater (passage)

87. There were no confirmed records of Balearic shearwater during the aerial surveys of the Windfarm Site and 4km buffer. However, it is recognised that a small proportion of likely Manx shearwater records (84 out a total of 6,691, or 1.3%) could not be identified to species, and therefore could potentially include Balearic shearwaters. Modelled at-sea probability distribution maps (Phillips *et al.*, 2021) indicate that the Windfarm Site and western section of the Offshore Export Cable Corridor is situated in an area of marine habitat which overlaps with the potential post-breeding season range of Balearic shearwater. This species is thought to be present on UK waters between July and October, with estimates of abundance within the Celtic Sea of between 652 and 6,904 (2013-2017; Phillips *et al.*, 2021). It is therefore probable that small numbers of Balearic shearwaters will occur in the vicinity of the Offshore Export Cable Corridor during the late summer and early autumn period, but such presence is likely to be sporadic.

8.3 Collision risk modelling

88. Input flight density estimates, and estimated monthly and annual collisions by species calculated from the sCRM (Option 2) for the Offshore Project, are tabulated in **Annex 3**.

8.4 Displacement

89. **Table 8.2** to **Table 8.11** report abundance estimates from baseline surveys for the Windfarm Site + 2km buffer area, of bird species screened into displacement assessment, which were used to calculate seasonal peak mean abundance. Displacement matrices showing estimated displacement/mortality numbers, and estimated change in percentage mortality rate, due to project-alone displacement for each species, are tabulated in **Annex 2**.

8.4.1.1 Gannet

90. Monthly gannet abundance estimates for Windfarm Site + 2km buffer are shown in **Table 8.2**.

Table 8.2 Monthly gannet abundance estimates for Windfarm Site + 2km buffer. Biological seasons following Furness (2015) are shown through shading. UCI = upper 95% confidence interval. LCI = lower 95% confidence interval. Values in bold show seasonal peaks per year which were used to calculate mean peaks of mean, LCI and UCI.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
	Breeding			**Aut Mig**		**Spring Mig**			**Breeding**			
	2020>						**2021>**					
Mean	37	108	278	153	8	53	8	15	74	67	168	60
LCI	7	29	60	36	1	7	1	2	29	15	91	8
UCI	81	231	676	306	23	212	23	45	125	134	259	134
							2022>					
Mean	0	199	43	128	7	15	0	98	66	103	15	102
LCI	0	76	14	68	1	2	0	13	22	29	2	22
UCI	0	344	79	188	22	37	0	293	118	213	37	212

Table 8.3 Mean peak abundance by season in Windfarm Site + 2km buffer area

Metric	Autumn Mig	Breeding	Spring Mig
Mean Peak	141	239	57
95% LCI Peak	52	76	8
95% UCI Peak	247	510	169

8.4.1.2 Guillemot

91. Monthly guillemot abundance estimates for Windfarm Site + 2km buffer are shown in **Table 8.4**.

Table 8.4 Monthly guillemot abundance estimates for Windfarm Site + 2km buffer. Biological seasons following Furness 2015 are shown through shading. UCI = upper 95% confidence interval. LCI = lower 95% confidence interval. Values in bold show seasonal peaks per calendar year which were used to calculate mean peaks

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
		Non-breeding							**Breeding**			
	2020>						**2021>**					
Mean	193	0	672	0	45	602	430	1110	822	131	3481	41
LCI	116	0	294	0	8	288	214	745	573	54	2886	6
UCI	289	0	1119*	0	90	973	662	1593	1089	230	4132	97
							2022>					
Mean	174	0	0	289	783	832	729	1008	3127	1263	740	265
LCI	69	0	0	146	439	111	440	684	2289	968	493	154
UCI	301	0	0	467	1173	2052	1062	1397	4078	1590	985	398

* this value is the UCI for 'birds on the sea' as it exceeded the UCI for 'birds in flight and on the sea' and maximum values are of priority in derivation of displacement estimates

Table 8.5 Mean peak abundance by season in Windfarm Site + 2km buffer area

Metric	Breeding	Non-breeding
Mean Peak	3304	1059
95% LCI Peak	2588	714
95% UCI Peak	4105	1725

8.4.1.3 Manx shearwater

92. Monthly guillemot abundance estimates for Windfarm Site + 2km buffer are shown in **Table 8.6**.

Table 8.6 Monthly Manx shearwater abundance estimates for Windfarm Site + 2km buffer. Biological seasons following Furness (2015) are shown through shading. UCI = upper 95% confidence interval. LCI = lower 95% confidence interval. Values in bold show seasonal peaks per calendar year which were used to calculate mean peaks

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
	Breeding		**Autumn Mig**						**Spr Mi**	**Breeding**		
	2020						2021					
Mean	5646	994	30	0	0	0	0	0	29	861	18605	462

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LCI	3959	497	8	0	0	0	0	0	4	430	12945	238
UCI	7574	1629	60	0	0	0	0	0	74	1521	25884	753
							2022					
Mean	37	0	14	0	0	0	0	0	37	1527	645	503
LCI	5	0	2	0	0	0	0	0	7	492	274	153
UCI	74	0	36	0	0	0	0	0	81	2819	1186	1072

Table 8.7 Mean peak abundance by season in Windfarm Site + 2km buffer area

Metric	Breeding	Autumn mig	Spring mig
Mean Peak	12126	22	33
95% LCI Peak	8452	5	6
95% UCI Peak	16729	48	78

8.4.1.4 Puffin

93. Monthly puffin abundance estimates for Windfarm Site + 2km buffer are shown in **Table 8.8**.

Table 8.8 Monthly puffin abundance estimates for Windfarm Site + 2km buffer. Biological seasons following Furness 2015 are shown through shading. UCI = upper 95% confidence interval. LCI = lower 95% confidence interval. Values in bold show seasonal peaks per calendar year which were used to calculate mean peaks

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
			Non-breeding							**Breeding**		
	2020						2021					
Mean	8	0	0	0	62	0	0	0	0	19	16	0
LCI	1	0	0	0	8	0	0	0	0	3	2	0
UCI	25	0	0	0	159	0	0	0	0	57	48	0
							2022					
Mean	0	0	0	0	0	0	0	0	0	78	18	0
LCI	0	0	0	0	0	0	0	0	0	6	2	0
UCI	0	0	0	0	0	0	0	0	0	90	53	0

Table 8.9 Mean peak abundance by season in Windfarm Site + 2km buffer area

Metric	Breeding	Non-breeding
Mean Peak	49	31
95% LCI Peak	4	4
95% UCI Peak	74	80

8.4.1.5 Razorbill

94. Monthly razorbill abundance estimates for Windfarm Site + 2km buffer are shown in **Table 8.10**.

Table 8.10 Monthly razorbill abundance estimates for Windfarm Site + 2km buffer. Biological seasons following Furness 2015 are shown through shading. UCI = upper 95% confidence interval. LCI = lower 95% confidence interval. Values in bold show seasonal peaks per calendar year which were used to calculate mean peaks

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
		Autumn mig			Winter		Spring mig			Breeding		
	2020						2021					
Mean	0	0	80	0	74	722	602	0	94	0	9	0
LCI	0	0	17	0	9	423	284	0	18	0	1	0
UCI	0	0	175	0	213	1085	986*	0	206	0	27	0
							2022					
Mean	0	0	0	0	0	0	68	60	87	58	0	71
LCI	0	0	0	0	0	0	9	8	12	8	0	21
UCI	0	0	0	0	0	0	168	152	191	125	0	142*

* this value is the UCI for 'birds on the sea' as it exceeded the UCI for 'birds in flight and on the sea' and maximum values are of priority in derivation of displacement estimates

Table 8.11 Mean peak abundance by season in Windfarm Site + 2km buffer area

Metric	Breeding	Autumn mig	Winter	Spring mig
Mean Peak	40	40	361	345
95% LCI Peak	11	8	211	148
95% UCI Peak	85	87	542	589

9. References

Cleasby, I.R., Owen, E., Wilson, I., J., Bolton, M., (2018). RSPB research report 63

Cook, A.S.C.P., Humphries, E.M., Masden, E.A., and Burton, N.H.K. (2014). The avoidance rates of collision between birds and offshore turbines. *BTO research Report No. 656* to Marine Scotland Science

Coulson, J., 2011. The kittiwake. A&C Black.

Efron, B. & Tibshirani, R. J. (1993). An introduction to the bootstrap. *Monographs on statistics and applied probability*, *57*, 1-436.

Furness, R.W. (2015) Non-breeding season populations of seabirds in UK waters - Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164.

Horswill, C. & Robinson, R.A. (2015). Review of seabird demographic rates and density dependence, JNCC Report No: 552, JNCC, Peterborough, ISSN 0963-8901.

Johnston, A., Cook, A.S., Wright, L.J., Humphreys, E.M. and Burton, N.H. (2014). Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology* 51(1), 31-41

"Corrigendum" (2014) Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, N.H.K. (2014). Corrigendum. *Journal of Applied Ecology* doi: 10.1111/1365-2664.12260

McGregor, R.M., King, S., Donovan, C.R., Caneco, B., Webb, A (2018) A Stochastic Collision Risk Model for Seabirds in Flight. Marine Scotland.

Parker, J., Banks, A., Fawcett, A., Axelsson, M., Rowell, H., Allen, S., Ludgate, C., Humphrey, O., Baker, A. & Copley, V. (2022a). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications. Natural England. Version 1.1. 79 pp

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022b). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp.

SNH. (2018). Habitats Regulations Appraisal (HRA) on the Moray Firth - A guidance for developers and regulators. [Online]. Available at: https://www.nature.scot/sites/default/files/2019-07/Habitats%20Regulations%20Appraisal%20%28HRA%29%20on%20the%20Moray%20Firth%20-%20A%20guidance%20for%20developers%20and%20regulators_0.pdf [Accessed July 2022].

SNH (Scottish Natural Heritage) (2014) Breeding season dates for key breeding species in Scotland. SNH Inverness, May 2014. Available at: < https://www.nature.scot/sites/default/files/2017-07/A303080%20-%20Bird%20Breeding%20Season%20Dates%20in%20Scotland.pdf>

SNH (Scottish Natural Heritage) (2018). Interim Guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs.

UK SNCBs (2014) Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review.

Swann, B. 2016. East and North Caithness Cliff SPAs monitoring 2013: plot counts and breeding productivity. Scottish Natural Heritage Commissioned Report No. 622.

Svensson, L., Mullarney, K. and Zetterström, D., 2010. Collins bird guide 2nd edition.

Swann, B. 2018. Seabird counts at North Caithness Cliffs SPA in 2015 and 2016 for Marine Renewables Casework. Scottish Natural Heritage Research Report No. 965.

Wakefield, E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., Guilford, T., Mavor, R.A., Miller, P.I., Newell, M.A., Newton, S.F., Robertson, G.S., Shoji, A., Soanes, L.M., Votier, S.C., Wanless, S. and Bolton, M. (2017). Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species. Ecological Applications 27: 2074-91 regional distribution of four seabird species. Available online at https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1591.

Woodward, I, Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019). Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report No. 724. December 2019. The British Trust for Ornithology.

Annex 1 – Species Abundance and Density Estimates By Survey

Table A1- 1 Common gull design-based abundance estimates of birds in flight and on the sea (LCI= lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	7	1	22	16	2	39
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 2 Common gull design-based density estimates of birds in flight and on the sea (LCI= lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0.06	0.01	0.19	0.07	0.01	0.17
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 3 Common gull design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	7	1	22	16	2	39
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 4 Common gull design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0.06	0.01	0.19	0.07	0.01	0.17
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 5 Common gull design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 6 Common gull design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 7 Common tern design-based abundance estimates of birds in flight and on the sea (LCI= lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	70	8	190	65	9	180	68	9	189
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 8 Common tern design-based density estimates of birds in flight and on the sea (LCI= lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	1.42	0.16	3.85	0.51	0.07	1.41	0.30	0.04	0.83
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 9 Common tern design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	70	8	190	65	9	165	68	9	181
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 10 Common tern design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0.71	0.08	1.93	0.51	0.07	1.29	0.30	0.04	0.80
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 11 Common tern design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 12 Common tern design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 13 Fulmar design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	17	2	43	29	7	58	30	8	68
Sep-20	0	0	0	0	0	0	16	2	39
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	120	13	359	151	20	393	598	80	1459
Jan-21	0	0	0	8	1	23	8	1	32
Feb-21	9	1	27	7	1	22	63	8	165
Mar-21	0	0	0	0	0	0	39	5	101
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	7	1	29
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	9	1	28	15	2	38	16	2	40
Sep-21	0	0	0	7	1	21	8	1	23
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	8	1	23
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	113	15	225	149	55	282
Mar-22	9	1	27	7	1	22	8	1	23
Apr-22	0	0	0	7	1	22	8	1	23
May-22	9	1	27	15	2	37	15	2	39
Jun-22	9	1	26	15	2	36	15	2	38

Table A1- 14 Fulmar design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0.34	0.04	0.86	0.23	0.06	0.46	0.13	0.03	0.29
Sep-20	0	0	0	0	0	0	0.07	0.01	0.17
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	2.43	0.26	7.27	1.19	0.16	3.10	2.60	0.35	6.34
Jan-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.12
Feb-21	0.18	0.02	0.54	0.06	0.01	0.19	0.27	0.03	0.71
Mar-21	0	0	0	0	0	0	0.17	0.02	0.44
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.03	0.00	0.12
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.18	0.02	0.56	0.12	0.02	0.30	0.07	0.01	0.18
Sep-21	0	0	0	0.06	0.01	0.18	0.03	0.00	0.09
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0.03	0.00	0.09
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0.89	0.12	1.77	0.65	0.24	1.23
Mar-22	0.18	0.02	0.54	0.06	0.01	0.19	0.03	0.00	0.09
Apr-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
May-22	0.18	0.02	0.54	0.12	0.02	0.30	0.07	0.01	0.18
Jun-22	0.18	0.02	0.52	0.12	0.02	0.29	0.07	0.01	0.18

Table A1- 15 Fulmar design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	17	2	43	22	3	50	23	3	53
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	110	12	331	129	17	333	526	66	1276
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	8	1	24
Mar-21	0	0	0	0	0	0	16	2	47
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	8	1	23	8	1	24
Sep-21	0	0	0	7	1	21	8	1	23
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	98	15	203	117	31	227
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	7	1	22	8	1	23

Table A1- 16 Fulmar design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0.34	0.04	0.86	0.17	0.02	0.39	0.10	0.01	0.23
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	2.23	0.24	6.71	1.01	0.13	2.61	2.28	0.29	5.53
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0.03	0.00	0.09
Mar-21	0	0	0	0	0	0	0.07	0.01	0.21
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.09
Sep-21	0	0	0	0.06	0.01	0.18	0.03	0.00	0.09
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0.77	0.12	1.60	0.51	0.14	0.99
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09

Table A1- 17 Fulmar design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	7	1	22	8	1	23
Sep-20	0	0	0	0	0	0	16	2	39
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	9	1	28	23	3	53	72	9	175
Jan-21	0	0	0	8	1	23	8	1	24
Feb-21	9	1	27	7	1	22	55	7	141
Mar-21	0	0	0	0	0	0	23	3	70
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	9	1	28	8	1	23	8	1	24
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	8	1	23
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	15	2	38	31	8	70
Mar-22	9	1	27	7	1	30	8	1	31
Apr-22	0	0	0	7	1	22	8	1	23
May-22	9	1	27	15	2	37	15	2	46
Jun-22	9	1	35	7	1	22	8	1	23

Table A1- 18 Fulmar design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Sep-20	0	0	0	0	0	0	0.07	0.01	0.17
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0.18	0.02	0.56	0.18	0.02	0.41	0.31	0.04	0.75
Jan-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.09
Feb-21	0.18	0.02	0.54	0.06	0.01	0.19	0.24	0.03	0.62
Mar-21	0	0	0	0	0	0	0.10	0.01	0.30
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.18	0.02	0.56	0.06	0.01	0.17	0.03	0.00	0.09
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0.03	0.00	0.09
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0.12	0.02	0.30	0.13	0.03	0.29
Mar-22	0.18	0.02	0.54	0.06	0.01	0.26	0.03	0.00	0.12
Apr-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
May-22	0.18	0.02	0.54	0.12	0.02	0.30	0.07	0.01	0.21
Jun-22	0.18	0.02	0.70	0.06	0.01	0.19	0.03	0.00	0.09

Table A1- 19 Gannet design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	17	2	44	37	7	81	429	56	1125
Aug-20	9	1	26	108	29	231	166	68	309
Sep-20	18	2	45	278	60	676	417	157	898
Oct-20	26	3	70	153	36	306	206	76	381
Nov-20	9	1	27	8	1	23	8	1	24
Dec-20	0	0	0	53	7	212	120	15	295
Jan-21	9	1	37	8	1	23	16	2	39
Feb-21	0	0	0	15	2	45	39	5	94
Mar-21	36	9	71	74	29	125	140	70	210
Apr-21	18	2	45	67	15	134	117	47	203
May-21	34	8	68	168	91	259	220	132	316
Jun-21	9	1	27	60	8	134	103	32	190
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	64	18	129	199	76	344	248	120	423
Sep-21	9	1	26	43	14	79	128	30	280
Oct-21	82	37	137	128	68	188	149	86	220
Nov-21	0	0	0	7	1	22	8	1	23
Dec-21	0	0	0	15	2	37	23	3	55
Jan-22	0	0	0	0	0	0	8	1	24
Feb-22	0	0	0	98	13	293	110	14	313
Mar-22	45	9	100	66	22	118	124	62	186
Apr-22	9	1	27	103	29	213	410	147	812
May-22	9	1	27	15	2	37	23	3	54
Jun-22	53	6	131	102	22	212	130	46	236

Table A1- 20 Gannet design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0.34	0.04	0.88	0.29	0.05	0.63	1.86	0.24	4.88
Aug-20	0.18	0.02	0.52	0.85	0.23	1.82	0.72	0.29	1.34
Sep-20	0.36	0.04	0.90	2.18	0.47	5.30	1.81	0.68	3.90
Oct-20	0.53	0.06	1.43	1.20	0.28	2.40	0.89	0.33	1.65
Nov-20	0.18	0.02	0.54	0.06	0.01	0.17	0.03	0.00	0.09
Dec-20	0	0	0	0.42	0.06	1.68	0.52	0.07	1.28
Jan-21	0.18	0.02	0.74	0.06	0.01	0.17	0.07	0.01	0.17
Feb-21	0	0	0	0.12	0.02	0.36	0.17	0.02	0.41
Mar-21	0.73	0.18	1.44	0.58	0.23	0.98	0.61	0.31	0.92
Apr-21	0.36	0.04	0.90	0.53	0.12	1.06	0.51	0.20	0.88
May-21	0.69	0.16	1.38	1.32	0.72	2.04	0.96	0.58	1.38
Jun-21	0.18	0.02	0.54	0.47	0.06	1.05	0.45	0.14	0.83
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	1.30	0.37	2.62	1.56	0.60	2.70	1.08	0.52	1.84
Sep-21	0.18	0.02	0.52	0.34	0.11	0.62	0.56	0.13	1.23
Oct-21	1.66	0.75	2.77	1.01	0.54	1.48	0.65	0.38	0.96
Nov-21	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Dec-21	0	0	0	0.12	0.02	0.30	0.10	0.01	0.24
Jan-22	0	0	0	0	0	0	0.03	0.00	0.09
Feb-22	0	0	0	0.77	0.10	2.30	0.48	0.06	1.37
Mar-22	0.91	0.18	2.02	0.52	0.17	0.93	0.54	0.27	0.81
Apr-22	0.18	0.02	0.54	0.81	0.23	1.68	1.78	0.64	3.53
May-22	0.18	0.02	0.54	0.12	0.02	0.30	0.10	0.01	0.23
Jun-22	1.07	0.12	2.64	0.80	0.17	1.66	0.56	0.20	1.02

Table A1- 21 Gannet design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	17	2	44	29	7	66	92	46	145
Aug-20	9	1	26	79	11	187	128	45	249
Sep-20	9	1	27	240	32	624	339	94	756
Oct-20	9	1	26	109	22	219	122	30	251
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	24	3	48
Jan-21	0	0	0	0	0	0	8	1	24
Feb-21	0	0	0	0	0	0	24	3	63
Mar-21	27	3	53	44	15	81	78	31	124
Apr-21	9	1	27	45	7	104	86	31	164
May-21	8	1	25	56	21	98	81	37	125
Jun-21	9	1	27	60	8	134	103	32	190
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	37	9	74	115	31	222	160	64	288
Sep-21	9	1	26	29	7	57	98	15	242
Oct-21	73	27	128	90	45	143	110	55	173
Nov-21	0	0	0	7	1	22	8	1	23
Dec-21	0	0	0	15	2	37	16	2	39
Jan-22	0	0	0	0	0	0	8	1	24
Feb-22	0	0	0	30	4	83	39	5	102
Mar-22	9	1	27	37	7	74	93	46	147
Apr-22	9	1	35	88	29	184	248	85	449
May-22	9	1	27	7	1	22	15	2	39
Jun-22	9	1	26	58	8	146	84	23	183

Table A1- 22 Gannet design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0.34	0.04	0.88	0.23	0.06	0.52	0.40	0.20	0.63
Aug-20	0.18	0.02	0.52	0.62	0.09	1.47	0.56	0.20	1.09
Sep-20	0.18	0.02	0.54	1.89	0.25	4.91	1.47	0.41	3.28
Oct-20	0.18	0.02	0.52	0.86	0.17	1.73	0.53	0.13	1.09
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.10	0.01	0.20
Jan-21	0	0	0	0	0	0	0.03	0.00	0.09
Feb-21	0	0	0	0	0	0	0.10	0.01	0.26
Mar-21	0.55	0.06	1.08	0.35	0.12	0.64	0.34	0.14	0.54
Apr-21	0.18	0.02	0.54	0.35	0.05	0.81	0.37	0.13	0.71
May-21	0.16	0.02	0.50	0.44	0.17	0.77	0.35	0.16	0.54
Jun-21	0.18	0.02	0.54	0.47	0.06	1.05	0.45	0.14	0.83
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.75	0.18	1.50	0.90	0.24	1.74	0.69	0.28	1.24
Sep-21	0.18	0.02	0.52	0.23	0.06	0.45	0.43	0.07	1.06
Oct-21	1.48	0.55	2.60	0.71	0.36	1.13	0.48	0.24	0.75
Nov-21	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Dec-21	0	0	0	0.12	0.02	0.30	0.07	0.01	0.17
Jan-22	0	0	0	0	0	0	0.03	0.00	0.09
Feb-22	0	0	0	0.24	0.03	0.66	0.17	0.02	0.44
Mar-22	0.18	0.02	0.54	0.29	0.05	0.58	0.40	0.20	0.63
Apr-22	0.18	0.02	0.70	0.69	0.23	1.44	1.08	0.37	1.96
May-22	0.18	0.02	0.54	0.06	0.01	0.19	0.07	0.01	0.18
Jun-22	0.18	0.02	0.52	0.46	0.06	1.16	0.36	0.10	0.78

Table A1- 23 Gannet design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	7	1	22	337	44	1003
Aug-20	0	0	0	22	3	50	30	8	60
Sep-20	9	1	36	38	8	75	79	31	134
Oct-20	18	2	53	44	6	102	84	30	152
Nov-20	9	1	36	8	1	23	8	1	24
Dec-20	0	0	0	53	7	159	96	12	255
Jan-21	9	1	27	8	1	30	8	1	24
Feb-21	0	0	0	15	2	45	16	2	47
Mar-21	9	1	27	29	4	66	62	16	124
Apr-21	9	1	27	22	3	59	31	4	70
May-21	25	3	59	112	49	189	139	66	220
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	28	3	64	84	15	176	88	16	192
Sep-21	0	0	0	14	2	36	30	8	60
Oct-21	9	1	27	38	8	75	39	8	79
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	8	1	23
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	68	9	270	70	9	211
Mar-22	36	4	82	30	4	74	31	4	77
Apr-22	0	0	0	15	2	37	162	23	379
May-22	0	0	0	0	0	0	0	0	0
Jun-22	44	5	96	44	7	95	46	8	91

Table A1- 24 Gannet design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0.06	0.01	0.19	1.46	0.19	4.35
Aug-20	0	0	0	0.17	0.02	0.39	0.13	0.03	0.26
Sep-20	0.18	0.02	0.72	0.30	0.06	0.59	0.34	0.13	0.58
Oct-20	0.36	0.04	1.06	0.35	0.05	0.81	0.36	0.13	0.65
Nov-20	0.18	0.02	0.72	0.06	0.01	0.17	0.03	0.00	0.09
Dec-20	0	0	0	0.42	0.06	1.26	0.42	0.05	1.12
Jan-21	0.18	0.02	0.54	0.06	0.01	0.23	0.03	0.00	0.09
Feb-21	0	0	0	0.12	0.02	0.36	0.07	0.01	0.21
Mar-21	0.18	0.02	0.54	0.23	0.03	0.52	0.27	0.07	0.54
Apr-21	0.18	0.02	0.54	0.17	0.02	0.46	0.13	0.02	0.29
May-21	0.51	0.06	1.20	0.88	0.39	1.49	0.60	0.28	0.95
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.57	0.06	1.30	0.66	0.12	1.38	0.38	0.07	0.83
Sep-21	0	0	0	0.11	0.02	0.28	0.13	0.03	0.26
Oct-21	0.18	0.02	0.54	0.30	0.06	0.59	0.17	0.03	0.34
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0.03	0.00	0.09
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0.53	0.07	2.10	0.30	0.04	0.90
Mar-22	0.73	0.08	1.66	0.24	0.03	0.59	0.13	0.02	0.32
Apr-22	0	0	0	0.12	0.02	0.30	0.70	0.10	1.64
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.89	0.10	1.94	0.35	0.06	0.76	0.20	0.03	0.40

Table A1- 25 Great black-backed gull design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	7	1	22	23	3	69
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	8	1	24
Dec-20	0	0	0	8	1	23	136	17	399
Jan-21	0	0	0	8	1	23	8	1	24
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	18	2	44	15	2	37	16	2	39
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	8	1	24
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	240	32	901	258	33	752
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	9	1	26	7	1	22	15	2	38

Table A1- 26 Great black-backed gull design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0.06	0.01	0.19	0.1	0.01	0.3
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0.03	0.00	0.09
Dec-20	0	0	0	0.06	0.01	0.17	0.59	0.07	1.73
Jan-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.09
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0.36	0.04	0.88	0.12	0.02	0.30	0.07	0.01	0.17
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0.03	0.00	0.09
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	1.89	0.25	7.10	1.12	0.14	3.26
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.18	0.02	0.52	0.06	0.01	0.19	0.07	0.01	0.18

Table A1- 27 Great black-backed gull design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	7	1	22	15	2	46
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	8	1	31
Dec-20	0	0	0	8	1	23	24	3	72
Jan-21	0	0	0	8	1	23	8	1	24
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	9	1	27	7	1	22	8	1	23
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	8	1	24
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	9	1	26	7	1	22	15	2	38

Table A1- 28 Great black-backed gull design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0.06	0.01	0.19	0.07	0.01	0.21
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0.03	0.00	0.12
Dec-20	0	0	0	0.06	0.01	0.17	0.10	0.01	0.30
Jan-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.09
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0.18	0.02	0.54	0.06	0.01	0.19	0.03	0.00	0.09
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0.03	0.00	0.09
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.18	0.02	0.52	0.06	0.01	0.19	0.07	0.01	0.18

Table A1- 29 Great black-backed gull design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	8	1	23
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	112	14	335
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	9	1	27	7	1	22	8	1	31
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	240	32	721	258	33	767
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 30 Great black-backed gull design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0.03	0.00	0.09
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.49	0.06	1.47
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0.18	0.02	0.54	0.06	0.01	0.19	0.03	0.00	0.12
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	1.89	0.25	5.68	1.12	0.14	3.33
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 31 Great skua design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	8	1	30	8	1	24
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 32 Great skua design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0.06	0.01	0.23	0.03	0.00	0.09
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 33 Great skua design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 34 Great skua design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 35 Great skua design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	8	1	23	8	1	24
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 36 Great skua design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0.06	0.01	0.17	0.03	0.00	0.09
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 37 Guillemot design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	46	12	92	193	116	289	302	190	432
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	289	32	673	672	294	1085	1010	548	1501
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	45	8	90	73	25	138
Dec-20	167	27	334	602	288	973	672	375	972
Jan-21	34	4	102	430	214	662	671	379	1007
Feb-21	273	90	486	1110	745	1593	1673	1224	2218
Mar-21	293	165	442	822	573	1089	1259	977	1569
Apr-21	70	8	152	131	54	230	206	97	337
May-21	1444	982	1940	3481	2886	4132	6209	5418	7147
Jun-21	24	3	72	41	6	97	74	25	137
Jul-21	59	7	149	174	69	301	334	178	502
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	35	4	83	289	146	467	596	380	836

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Nov-21	189	21	416	783	439	1173	886	540	1207
Dec-21	0	0	0	832	111	2052	843	110	2016
Jan-22	171	33	342	729	440	1062	1038	720	1378
Feb-22	382	96	775	1008	684	1397	1308	974	1685
Mar-22	1367	705	2140	3127	2289	4078	4051	3270	4902
Apr-22	400	218	618	1263	968	1590	2174	1737	2631
May-22	138	38	262	740	493	985	1224	952	1558
Jun-22	86	37	148	265	154	398	475	292	713

Table A1- 38 Guillemot design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0.93	0.24	1.86	1.52	0.91	2.27	1.32	0.83	1.88
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	5.86	0.64	13.64	5.28	2.31	8.53	4.41	2.38	6.52
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0.35	0.06	0.70	0.32	0.11	0.60
Dec-20	3.38	0.55	6.77	4.73	2.26	7.65	2.94	1.63	4.22
Jan-21	0.69	0.08	2.07	3.38	1.68	5.20	2.93	1.65	4.38
Feb-21	5.53	1.82	9.85	8.72	5.85	12.52	7.30	5.31	9.63
Mar-21	5.94	3.34	8.95	6.46	4.50	8.56	5.50	4.24	6.82
Apr-21	1.42	0.16	3.09	1.03	0.43	1.80	0.9	0.42	1.46
May-21	29.26	19.89	39.30	27.36	22.69	32.47	27.11	23.53	31.04
Jun-21	0.49	0.05	1.46	0.32	0.04	0.76	0.32	0.11	0.59
Jul-21	1.20	0.13	3.02	1.37	0.54	2.37	1.46	0.77	2.18
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0.71	0.08	1.68	2.27	1.14	3.67	2.60	1.65	3.63
Nov-21	3.83	0.43	8.43	6.15	3.45	9.22	3.87	2.34	5.24
Dec-21	0	0	0	6.54	0.87	16.13	3.68	0.48	8.76
Jan-22	3.46	0.68	6.93	5.73	3.46	8.34	4.53	3.13	5.98

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Feb-22	7.74	1.94	15.70	7.92	5.37	10.98	5.71	4.23	7.32
Mar-22	27.70	14.28	43.35	24.58	17.99	32.05	17.69	14.20	21.29
Apr-22	8.11	4.41	12.52	9.93	7.61	12.49	9.49	7.55	11.43
May-22	2.80	0.76	5.31	5.82	3.88	7.74	5.34	4.14	6.77
Jun-22	1.74	0.74	3.00	2.08	1.21	3.13	2.07	1.27	3.10

Table A1- 39 Guillemot design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	45	8	90	63	16	118
Dec-20	18	2	55	45	6	102	55	11	121
Jan-21	0	0	0	102	14	274	160	20	393
Feb-21	46	5	100	255	103	454	485	259	769
Mar-21	9	1	27	36	9	73	85	25	153
Apr-21	9	1	27	15	2	37	23	3	55
May-21	17	2	42	21	3	56	22	3	59
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	23	3	53	24	3	55
Nov-21	0	0	0	0	0	0	8	1	23
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	9	1	27	37	7	74	46	8	93
Apr-22	10	1	30	31	4	72	40	10	80

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
May-22	0	0	0	0	0	0	8	1	23
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 40 Guillemot design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0.35	0.06	0.70	0.28	0.07	0.51
Dec-20	0.36	0.04	1.11	0.35	0.05	0.80	0.24	0.05	0.53
Jan-21	0	0	0	0.80	0.11	2.16	0.70	0.09	1.71
Feb-21	0.93	0.10	2.03	2.00	0.81	3.57	2.12	1.12	3.34
Mar-21	0.18	0.02	0.55	0.28	0.07	0.58	0.37	0.11	0.66
Apr-21	0.18	0.02	0.55	0.12	0.02	0.29	0.1	0.01	0.24
May-21	0.34	0.04	0.85	0.17	0.02	0.44	0.10	0.01	0.27
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0.18	0.02	0.42	0.10	0.01	0.23
Nov-21	0	0	0	0	0	0	0.03	0.00	0.09
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0.18	0.02	0.55	0.29	0.06	0.58	0.20	0.03	0.40
Apr-22	0.20	0.02	0.61	0.24	0.03	0.56	0.17	0.04	0.35
May-22	0	0	0	0	0	0	0.03	0.00	0.09
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 41 Guillemot design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	46	12	104	193	106	289	302	190	432
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	289	32	673	672	294	1119	1010	548	1501
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	10	1	30
Dec-20	149	36	298	557	229	915	617	310	955
Jan-21	34	4	102	328	165	512	511	294	758
Feb-21	227	57	460	855	559	1176	1188	885	1508
Mar-21	284	132	438	786	545	1030	1174	908	1488
Apr-21	61	7	151	116	34	221	183	81	307
May-21	1427	951	1947	3460	2874	4094	6187	5336	7106
Jun-21	24	3	72	41	6	97	74	25	137
Jul-21	59	7	134	174	69	290	334	178	502
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	35	4	83	266	125	443	572	350	832
Nov-21	189	38	416	783	465	1173	878	549	1272
Dec-21	0	0	0	832	111	2052	843	110	2016
Jan-22	171	33	309	729	401	1062	1038	720	1378
Feb-22	382	96	775	1008	649	1397	1308	974	1685
Mar-22	1358	712	2116	3090	2275	4043	4005	3156	4854
Apr-22	390	219	622	1232	927	1569	2134	1717	2614
May-22	138	38	262	740	514	1017	1216	923	1541
Jun-22	86	25	148	265	154	398	475	292	713

Table A1- 42 Guillemot design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0.93	0.24	2.10	1.52	0.84	2.27	1.32	0.83	1.88
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	5.86	0.64	13.64	5.28	2.31	8.80	4.41	2.38	6.52
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0.05	0.01	0.13
Dec-20	3.02	0.73	6.04	4.38	1.80	7.19	2.70	1.35	4.15
Jan-21	0.69	0.08	2.07	2.58	1.30	4.03	2.23	1.28	3.29
Feb-21	4.60	1.15	9.33	6.72	4.40	9.24	5.19	3.84	6.55
Mar-21	5.75	2.68	8.87	6.18	4.28	8.09	5.13	3.94	6.46
Apr-21	1.24	0.14	3.06	0.91	0.27	1.74	0.8	0.35	1.34
May-21	28.92	19.27	39.46	27.19	22.58	32.17	27.02	23.18	30.86
Jun-21	0.49	0.05	1.46	0.32	0.04	0.76	0.32	0.11	0.59
Jul-21	1.20	0.13	2.72	1.37	0.54	2.28	1.46	0.77	2.18
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0.71	0.08	1.68	2.09	0.98	3.48	2.50	1.52	3.61
Nov-21	3.83	0.77	8.43	6.15	3.66	9.22	3.84	2.38	5.52
Dec-21	0	0	0	6.54	0.87	16.13	3.68	0.48	8.76
Jan-22	3.46	0.68	6.25	5.73	3.15	8.34	4.53	3.13	5.98
Feb-22	7.74	1.94	15.70	7.92	5.10	10.98	5.71	4.23	7.32
Mar-22	27.52	14.43	42.87	24.28	17.88	31.78	17.49	13.71	21.08
Apr-22	7.90	4.44	12.59	9.68	7.28	12.33	9.32	7.46	11.35
May-22	2.80	0.76	5.31	5.82	4.04	7.99	5.31	4.01	6.69
Jun-22	1.74	0.51	3.00	2.08	1.21	3.13	2.07	1.27	3.10

Table A1- 43 Herring gull design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	175	22	518
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	8	1	23
May-21	0	0	0	0	0	0	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	7	1	22	23	3	54
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	9	1	27	15	2	37	31	8	62
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	878	117	2589	916	117	2748
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	7	1	22	8	1	23

Table A1- 44 Herring gull design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.76	0.10	2.25
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0.03	0.00	0.09
May-21	0	0	0	0	0	0	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0.06	0.01	0.19	0.10	0.01	0.23
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0.18	0.02	0.54	0.12	0.02	0.30	0.13	0.03	0.26
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	6.90	0.92	20.35	3.98	0.51	11.94
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09

Table A1- 45 Herring gull design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	88	11	263
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	8	1	23
May-21	0	0	0	0	0	0	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	7	1	22	23	3	47
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	9	1	27	15	2	37	31	8	62
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	45	6	135	47	6	141
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	7	1	22	8	1	23

Table A1- 46 Herring gull design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.38	0.05	1.14
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0.03	0.00	0.09
May-21	0	0	0	0	0	0	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0.06	0.01	0.19	0.10	0.01	0.20
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0.18	0.02	0.54	0.12	0.02	0.30	0.13	0.03	0.26
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0.35	0.05	1.05	0.20	0.03	0.60
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09

Table A1- 47 Herring gull design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	88	11	263
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	833	111	2454	869	111	2607
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 48 Herring gull design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.38	0.05	1.14
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	6.55	0.87	19.30	3.77	0.48	11.31
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 49 Kittiwake design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	27	3	82	68	9	150	71	9	150
Oct-20	26	3	70	277	38	802	297	39	1074
Nov-20	9	1	27	30	8	60	39	8	79
Dec-20	9	1	28	38	8	76	120	56	207
Jan-21	394	201	641	909	591	1302	1500	1058	1958
Feb-21	18	2	46	37	7	67	94	39	165
Mar-21	53	6	125	133	59	221	194	101	295
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	7	1	21	15	2	37
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	7	1	22	16	2	39
Aug-21	9	1	28	8	1	23	8	1	24
Sep-21	17	2	43	14	2	36	15	2	38
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	27	3	63	45	15	82	109	47	187
Dec-21	45	5	135	67	9	164	141	62	242
Jan-22	73	18	147	224	142	321	370	244	503
Feb-22	164	64	282	398	225	615	634	431	877
Mar-22	427	127	917	487	221	915	782	441	1231
Apr-22	0	0	0	15	2	37	15	2	39
May-22	0	0	0	0	0	0	0	0	0
Jun-22	18	2	53	124	29	270	183	61	366

Table A1- 50 Kittiwake design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0.55	0.06	1.67	0.53	0.07	1.17	0.31	0.04	0.65
Oct-20	0.53	0.06	1.43	2.18	0.30	6.31	1.29	0.17	4.66
Nov-20	0.18	0.02	0.54	0.24	0.06	0.48	0.17	0.03	0.34
Dec-20	0.18	0.02	0.56	0.30	0.06	0.60	0.52	0.24	0.90
Jan-21	7.98	4.07	12.98	7.14	4.64	10.23	6.52	4.60	8.51
Feb-21	0.36	0.04	0.92	0.29	0.05	0.53	0.41	0.17	0.72
Mar-21	1.07	0.12	2.52	1.05	0.47	1.74	0.84	0.44	1.28
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0.06	0.01	0.18	0.07	0.01	0.17
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0.06	0.01	0.19	0.07	0.01	0.17
Aug-21	0.18	0.02	0.56	0.06	0.01	0.17	0.03	0.00	0.09
Sep-21	0.34	0.04	0.86	0.11	0.02	0.28	0.07	0.01	0.18
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0.55	0.06	1.28	0.35	0.12	0.64	0.47	0.20	0.81
Dec-21	0.91	0.10	2.73	0.53	0.07	1.30	0.61	0.27	1.05
Jan-22	1.48	0.36	2.98	1.76	1.12	2.52	1.61	1.06	2.19
Feb-22	3.32	1.30	5.71	3.13	1.77	4.84	2.75	1.87	3.80
Mar-22	8.65	2.57	18.58	3.83	1.74	7.20	3.40	1.92	5.35
Apr-22	0	0	0	0.12	0.02	0.30	0.07	0.01	0.18
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.36	0.04	1.06	0.97	0.23	2.11	0.79	0.26	1.58

Table A1- 51 Kittiwake design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	23	3	68	24	3	71
Oct-20	9	1	26	248	34	736	267	35	777
Nov-20	9	1	27	30	8	60	39	8	79
Dec-20	9	1	28	38	8	76	104	40	183
Jan-21	384	192	622	727	439	1060	1279	884	1713
Feb-21	18	2	46	30	4	60	47	16	86
Mar-21	18	2	44	88	37	155	132	62	210
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	7	1	22	16	2	39
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	17	2	43	14	2	36	15	2	45
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	27	3	63	45	15	82	101	47	171
Dec-21	27	3	81	37	5	97	94	39	164
Jan-22	55	18	101	179	105	261	283	197	385
Feb-22	82	36	146	165	98	240	321	211	423
Mar-22	163	73	272	266	155	384	372	248	526
Apr-22	0	0	0	7	1	22	8	1	23
May-22	0	0	0	0	0	0	0	0	0
Jun-22	9	1	26	102	15	248	122	23	282

Table A1- 52 Kittiwake design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0.18	0.02	0.53	0.10	0.01	0.30
Oct-20	0.18	0.02	0.52	1.95	0.27	5.79	1.16	0.15	3.38
Nov-20	0.18	0.02	0.54	0.24	0.06	0.48	0.17	0.03	0.34
Dec-20	0.18	0.02	0.56	0.30	0.06	0.60	0.45	0.17	0.79
Jan-21	7.78	3.89	12.60	5.71	3.45	8.33	5.56	3.84	7.45
Feb-21	0.36	0.04	0.92	0.24	0.03	0.48	0.20	0.07	0.37
Mar-21	0.36	0.04	0.88	0.69	0.29	1.22	0.57	0.27	0.91
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0.06	0.01	0.19	0.07	0.01	0.17
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0.34	0.04	0.86	0.11	0.02	0.28	0.07	0.01	0.21
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0.55	0.06	1.28	0.35	0.12	0.64	0.44	0.20	0.74
Dec-21	0.55	0.06	1.65	0.29	0.04	0.76	0.41	0.17	0.72
Jan-22	1.11	0.36	2.04	1.41	0.83	2.06	1.23	0.86	1.67
Feb-22	1.66	0.73	2.96	1.30	0.77	1.89	1.39	0.91	1.83
Mar-22	3.30	1.48	5.51	2.09	1.22	3.02	1.62	1.08	2.29
Apr-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.18	0.02	0.52	0.80	0.12	1.95	0.53	0.10	1.23

Table A1- 53 Kittiwake design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	27	3	82	45	6	105	47	6	118
Oct-20	18	2	53	29	4	73	30	4	76
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	16	2	40
Jan-21	9	1	27	182	53	326	221	87	403
Feb-21	0	0	0	7	1	22	47	8	102
Mar-21	36	4	98	44	7	103	62	16	132
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	7	1	21	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	9	1	28	8	1	23	8	1	24
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	8	1	23
Dec-21	18	2	54	30	4	67	47	8	94
Jan-22	18	2	55	45	7	97	87	31	157
Feb-22	82	9	164	233	98	428	313	164	525
Mar-22	263	29	653	221	30	517	410	147	790
Apr-22	0	0	0	7	1	22	8	1	23
May-22	0	0	0	0	0	0	0	0	0
Jun-22	9	1	26	22	3	58	61	8	130

Table A1- 54 Kittiwake design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0.55	0.06	1.67	0.35	0.05	0.82	0.20	0.03	0.50
Oct-20	0.36	0.04	1.06	0.23	0.03	0.58	0.13	0.02	0.33
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.07	0.01	0.18
Jan-21	0.18	0.02	0.54	1.43	0.42	2.56	0.96	0.38	1.75
Feb-21	0	0	0	0.06	0.01	0.19	0.20	0.03	0.43
Mar-21	0.73	0.08	1.99	0.35	0.06	0.82	0.27	0.07	0.57
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0.00	0.00	0.00	0.06	0.01	0.18	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.18	0.02	0.56	0.06	0.01	0.17	0.03	0.00	0.09
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0.03	0.00	0.09
Dec-21	0.36	0.04	1.08	0.24	0.03	0.54	0.20	0.03	0.40
Jan-22	0.36	0.04	1.10	0.35	0.05	0.75	0.38	0.14	0.69
Feb-22	1.66	0.18	3.32	1.83	0.77	3.36	1.36	0.71	2.28
Mar-22	5.33	0.59	13.23	1.74	0.24	4.07	1.78	0.64	3.43
Apr-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0.18	0.02	0.52	0.17	0.02	0.45	0.26	0.03	0.55

Table A1- 55 Lesser black-backed gull design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	136	17	407
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	22	3	51
Jun-21	0	0	0	7	1	22	8	1	24
Jul-21	9	1	27	7	1	22	23	3	54
Aug-21	9	1	28	23	3	54	48	8	104
Sep-21	0	0	0	0	0	0	23	3	68
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	893	119	2679	932	119	2795
Mar-22	9	1	27	7	1	22	8	1	23
Apr-22	0	0	0	7	1	22	8	1	23
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	15	2	36	30	8	61

Table A1- 56 Lesser black-backed gull design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.59	0.07	1.77
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.10	0.01	0.23
Jun-21	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Jul-21	0.18	0.02	0.54	0.06	0.01	0.19	0.10	0.01	0.23
Aug-21	0.18	0.02	0.56	0.18	0.02	0.42	0.21	0.04	0.46
Sep-21	0	0	0	0	0	0	0.10	0.01	0.30
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	7.02	0.94	21.06	4.05	0.52	12.15
Mar-22	0.18	0.02	0.54	0.06	0.01	0.19	0.03	0.00	0.09
Apr-22	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0.12	0.02	0.29	0.13	0.03	0.26

Table A1- 57 Lesser black-backed gull design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	40	5	120
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	15	2	37
Jun-21	0	0	0	7	1	22	8	1	24
Jul-21	9	1	27	7	1	22	23	3	54
Aug-21	0	0	0	8	1	23	16	2	48
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	7	1	29	8	1	23
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	15	2	36	30	8	61

Table A1- 58 Lesser black-backed gull design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.17	0.02	0.51
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.07	0.01	0.17
Jun-21	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Jul-21	0.18	0.02	0.54	0.06	0.01	0.19	0.10	0.01	0.23
Aug-21	0	0	0	0.06	0.01	0.17	0.07	0.01	0.21
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0.06	0.01	0.25	0.03	0.00	0.09
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0.12	0.02	0.29	0.13	0.03	0.26

Table A1- 59 Lesser black-backed gull design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	96	12	287
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	7	1	22
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	9	1	28	15	2	38	32	4	80
Sep-21	0	0	0	0	0	0	23	3	68
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	893	119	2679	932	119	2795
Mar-22	9	1	27	7	1	22	8	1	23
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 60 Lesser black-backed gull design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0.42	0.05	1.26
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0.03	0.00	0.09
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0.18	0.02	0.56	0.12	0.02	0.30	0.14	0.02	0.35
Sep-21	0	0	0	0	0	0	0.10	0.01	0.30
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	7.02	0.94	21.06	4.05	0.52	12.15
Mar-22	0.18	0.02	0.54	0.06	0.01	0.19	0.03	0.00	0.09
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 61 Manx shearwater design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	1758	875	3009	5646	3959	7574	10143	7509	12738
Aug-20	225	69	416	994	497	1629	1834	1079	2672
Sep-20	9	1	27	30	8	60	260	33	866
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	29	4	74	31	4	78
Apr-21	250	107	438	861	430	1521	1489	920	2198
May-21	8544	3463	14641	18605	12945	25884	27301	19850	35127
Jun-21	109	36	191	462	238	753	2817	1306	5254
Jul-21	0	0	0	37	5	74	202	47	466
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	14	2	36	23	3	53
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	27	3	73	37	7	81	54	15	108
Apr-22	380	43	1008	1527	492	2819	2212	1168	3589
May-22	108	36	197	645	274	1186	990	503	1655
Jun-22	79	9	245	503	153	1072	2217	411	4702

Table A1- 62 Manx shearwater design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	35.62	17.73	60.97	44.37	31.11	59.52	44.05	32.61	55.32
Aug-20	4.56	1.40	8.43	7.81	3.91	12.80	7.97	4.69	11.61
Sep-20	0.18	0.02	0.54	0.24	0.06	0.48	1.13	0.14	3.76
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0.23	0.03	0.59	0.13	0.02	0.33
Apr-21	5.07	2.17	8.88	6.77	3.38	11.96	6.47	4.00	9.55
May-21	173.13	70.17	296.68	146.22	101.74	203.43	118.58	86.22	152.57
Jun-21	2.21	0.73	3.87	3.63	1.87	5.92	12.24	5.67	22.83
Jul-21	0	0	0	0.29	0.04	0.58	0.88	0.20	2.03
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0.11	0.02	0.28	0.10	0.01	0.23
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0.55	0.06	1.49	0.29	0.05	0.63	0.23	0.06	0.46
Apr-22	7.70	0.87	20.43	12.00	3.87	22.15	9.61	5.07	15.59
May-22	2.19	0.73	3.99	5.07	2.15	9.32	4.30	2.18	7.19
Jun-22	1.60	0.18	4.96	3.95	1.20	8.42	9.63	1.79	20.42

Table A1- 63 Manx shearwater design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	1015	315	1916	4055	2552	5851	7088	4960	9377
Aug-20	199	61	381	577	331	879	996	672	1343
Sep-20	9	1	27	30	8	60	47	16	94
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	7	1	22	8	1	23
Apr-21	36	9	81	111	67	163	249	164	359
May-21	601	254	1177	2384	1276	3934	3839	2467	5763
Jun-21	64	27	109	335	171	537	1092	641	1685
Jul-21	0	0	0	37	5	81	78	31	140
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	7	1	21	15	2	38
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	9	1	27	22	3	52	39	8	85
Apr-22	44	9	97	264	117	433	441	263	665
May-22	63	18	125	289	170	430	588	340	913
Jun-22	18	2	44	328	45	744	518	160	991

Table A1- 64 Manx shearwater design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	20.57	6.38	38.83	31.87	20.06	45.99	30.79	21.55	40.73
Aug-20	4.03	1.24	7.72	4.53	2.60	6.90	4.33	2.92	5.84
Sep-20	0.18	0.02	0.54	0.24	0.06	0.48	0.20	0.07	0.40
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0.06	0.01	0.19	0.03	0.00	0.09
Apr-21	0.73	0.18	1.64	0.87	0.53	1.28	1.08	0.71	1.56
May-21	12.18	5.15	23.85	18.74	10.03	30.92	16.67	10.71	25.02
Jun-21	1.30	0.55	2.21	2.63	1.34	4.22	4.74	2.78	7.31
Jul-21	0	0	0	0.29	0.04	0.63	0.34	0.14	0.61
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0.06	0.01	0.18	0.07	0.01	0.18
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0.18	0.02	0.54	0.17	0.02	0.40	0.17	0.03	0.37
Apr-22	0.89	0.18	1.96	2.07	0.92	3.40	1.92	1.15	2.90
May-22	1.28	0.37	2.54	2.27	1.34	3.38	2.55	1.47	3.96
Jun-22	0.36	0.04	0.88	2.58	0.35	5.85	2.25	0.69	4.30

Table A1- 65 Manx shearwater design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	744	324	1260	1591	1012	2244	3054	2082	4241
Aug-20	26	3	61	418	58	915	838	332	1524
Sep-20	0	0	0	0	0	0	213	27	638
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	22	3	59	23	3	62
Apr-21	215	63	403	749	304	1358	1240	678	2011
May-21	7943	2955	13963	16220	10449	23219	23462	16627	31111
Jun-21	45	9	100	127	37	268	1725	483	3751
Jul-21	0	0	0	0	0	0	124	16	342
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	7	1	21	8	1	23
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	18	2	54	15	2	44	15	2	46
Apr-22	336	38	928	1263	382	2386	1771	828	3078
May-22	45	5	108	356	48	897	402	62	1013
Jun-22	61	7	245	161	29	328	1684	221	4023

Table A1- 66 Manx shearwater design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	15.08	6.57	25.54	12.50	7.95	17.63	13.26	9.04	18.41
Aug-20	0.53	0.06	1.24	3.29	0.46	7.20	3.64	1.44	6.62
Sep-20	0	0	0	0	0	0	0.93	0.12	2.79
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0.17	0.02	0.46	0.10	0.01	0.27
Apr-21	4.36	1.28	8.17	5.89	2.39	10.68	5.39	2.95	8.74
May-21	160.95	59.88	282.93	127.47	82.12	182.47	101.90	72.21	135.12
Jun-21	0.91	0.18	2.02	1.00	0.29	2.11	7.49	2.10	16.29
Jul-21	0	0	0	0	0	0	0.54	0.07	1.49
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0.06	0.01	0.18	0.03	0.00	0.09
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0.36	0.04	1.08	0.12	0.02	0.35	0.07	0.01	0.21
Apr-22	6.81	0.77	18.81	9.93	3.00	18.76	7.69	3.60	13.37
May-22	0.91	0.10	2.18	2.80	0.38	7.06	1.75	0.27	4.41
Jun-22	1.24	0.14	4.98	1.27	0.23	2.59	7.31	0.96	17.46

Table A1- 67 Puffin design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	10	1	29	8	1	25	9	1	26
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	62	8	159	83	11	174
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	9	1	26
Apr-21	0	0	0	19	3	57	20	3	59
May-21	0	0	0	16	2	48	26	4	70
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	43	5	108	78	11	174	163	63	272
May-22	0	0	0	18	2	53	28	4	85
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 68 Puffin design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0.20	0.02	0.59	0.06	0.01	0.20	0.04	0.00	0.11
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0.49	0.06	1.25	0.36	0.05	0.76
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0.04	0.00	0.11
Apr-21	0	0	0	0.15	0.02	0.45	0.09	0.01	0.26
May-21	0	0	0	0.13	0.02	0.38	0.11	0.02	0.30
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0.87	0.10	2.19	0.61	0.08	1.37	0.71	0.28	1.18
May-22	0	0	0	0.14	0.02	0.41	0.12	0.02	0.37
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 69 Puffin design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	10	1	30	8	1	25	9	1	26
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 70 Puffin design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0.20	0.02	0.61	0.06	0.01	0.20	0.04	0.00	0.11
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 71 Puffin design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	10	1	29	8	1	25	9	1	26
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	62	8	150	83	11	174
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	9	1	26
Apr-21	0	0	0	19	3	57	20	3	59
May-21	0	0	0	16	2	48	26	4	70
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	33	4	87	71	10	168	155	54	275
May-22	0	0	0	18	2	53	28	4	85
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 72 Puffin design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0.20	0.02	0.59	0.06	0.01	0.20	0.04	0.00	0.11
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0.49	0.06	1.18	0.36	0.05	0.76
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0.04	0.00	0.11
Apr-21	0	0	0	0.15	0.02	0.45	0.09	0.01	0.26
May-21	0	0	0	0.13	0.02	0.38	0.11	0.02	0.30
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0.71	0.08	1.79	0.56	0.08	1.32	0.68	0.24	1.19
May-22	0	0	0	0.14	0.02	0.41	0.12	0.02	0.37
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 73 Razorbill design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	29	3	87	80	17	175	120	41	213
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	11	1	33	74	9	213	93	12	213
Dec-20	342	104	617	722	423	1085	918	597	1258
Jan-21	357	64	746	602	284	980	826	506	1163
Feb-21	0	0	0	0	0	0	10	1	30
Mar-21	18	2	54	94	18	206	134	59	237
Apr-21	0	0	0	0	0	0	10	1	29
May-21	10	1	31	9	1	27	27	4	63
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	10	1	29
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	38	5	115
Nov-21	0	0	0	0	0	0	10	1	29
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	31	3	127	68	9	168	79	10	181
Feb-22	0	0	0	60	8	152	118	15	264
Mar-22	42	5	105	87	12	191	116	17	249
Apr-22	56	6	135	58	8	125	98	19	197
May-22	0	0	0	0	0	0	28	4	85
Jun-22	0	0	0	71	21	132	120	50	200

Table A1- 74 Razorbill design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0.59	0.07	1.76	0.63	0.13	1.37	0.53	0.18	0.92
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0.22	0.02	0.67	0.58	0.07	1.67	0.41	0.05	0.93
Dec-20	6.93	2.11	12.50	5.67	3.32	8.53	4.01	2.59	5.46
Jan-21	7.23	1.29	15.11	4.73	2.23	7.70	3.61	2.20	5.05
Feb-21	0	0	0	0	0	0	0.04	0.01	0.13
Mar-21	0.36	0.04	1.09	0.74	0.14	1.62	0.58	0.26	1.03
Apr-21	0	0	0	0	0	0	0.04	0.01	0.12
May-21	0.20	0.03	0.63	0.07	0.01	0.21	0.12	0.02	0.27
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0.04	0.01	0.12
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0.16	0.02	0.50
Nov-21	0	0	0	0	0	0	0.04	0.01	0.12
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0.63	0.07	2.58	0.53	0.07	1.32	0.34	0.04	0.79
Feb-22	0	0	0	0.47	0.06	1.19	0.52	0.07	1.15
Mar-22	0.85	0.09	2.13	0.68	0.09	1.50	0.51	0.07	1.08
Apr-22	1.13	0.13	2.73	0.46	0.06	0.98	0.43	0.08	0.86
May-22	0	0	0	0	0	0	0.12	0.02	0.37
Jun-22	0	0	0	0.56	0.16	1.04	0.52	0.22	0.87

Table A1- 75 Razorbill design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	34	5	102	35	4	103
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 76 Razorbill design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0.27	0.04	0.80	0.15	0.02	0.45
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 77 Razorbill design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	29	3	87	80	17	175	120	41	213
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	11	1	44	74	9	213	93	12	213
Dec-20	342	104	684	722	391	1085	918	597	1258
Jan-21	357	64	746	568	245	986	791	456	1201
Feb-21	0	0	0	0	0	0	10	1	30
Mar-21	18	2	54	94	18	206	134	59	237
Apr-21	0	0	0	0	0	0	10	1	29
May-21	10	1	31	9	1	27	27	4	63
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	10	1	29
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	38	5	115
Nov-21	0	0	0	0	0	0	10	1	29
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	31	3	96	68	9	168	79	10	181
Feb-22	0	0	0	60	8	152	118	15	264
Mar-22	42	5	105	87	12	191	116	17	249
Apr-22	56	6	135	58	9	125	98	19	197
May-22	0	0	0	0	0	0	28	4	85
Jun-22	0	0	0	71	21	142	120	50	200

Table A1- 78 Razorbill design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0.59	0.07	1.76	0.63	0.13	1.37	0.53	0.18	0.92
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0.22	0.02	0.89	0.58	0.07	1.67	0.41	0.05	0.93
Dec-20	6.93	2.11	13.86	5.67	3.07	8.53	4.01	2.59	5.46
Jan-21	7.23	1.29	15.11	4.46	1.93	7.75	3.45	1.98	5.22
Feb-21	0	0	0	0	0	0	0.04	0.01	0.13
Mar-21	0.36	0.04	1.09	0.74	0.14	1.62	0.58	0.26	1.03
Apr-21	0	0	0	0	0	0	0.04	0.01	0.12
May-21	0.20	0.03	0.63	0.07	0.01	0.21	0.12	0.02	0.27
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.12
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0.16	0.02	0.50
Nov-21	0	0	0	0	0	0	0.04	0.01	0.12
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0.63	0.07	1.95	0.53	0.07	1.32	0.34	0.04	0.79
Feb-22	0	0	0	0.47	0.06	1.19	0.52	0.07	1.15
Mar-22	0.85	0.09	2.13	0.68	0.09	1.50	0.51	0.07	1.08
Apr-22	1.13	0.13	2.73	0.46	0.07	0.98	0.43	0.08	0.86
May-22	0	0	0	0	0	0	0.12	0.02	0.37
Jun-22	0	0	0	0.56	0.16	1.12	0.52	0.22	0.87

Table A1- 79 Sandwich tern design-based abundance estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	8	1	24
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 80 Sandwich tern design-based density estimates of birds in flight and on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0.03	0.00	0.09
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 81 Sandwich tern design-based abundance estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	8	1	24
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 82 Sandwich tern design-based density estimates of birds in flight (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0.03	0.00	0.09
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 83 Sandwich tern design-based abundance estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Abundance	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	Mean	LCI	UCI	Mean	LCI	UCI	Mean	LCI	UCI
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Table A1- 84 Sandwich tern design-based density estimates of birds on the sea (LCI = lower 95% confidence interval, UCI = Upper 95% confidence interval)

Density	Windfarm site			Windfarm site + 2km buffer			Windfarm site + 4km buffer		
Month	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**	**Mean**	**LCI**	**UCI**
Jul-20	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0
Feb-21	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0
Apr-21	0	0	0	0	0	0	0	0	0
May-21	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	0	0
Aug-21	0	0	0	0	0	0	0	0	0
Sep-21	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0
Nov-21	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0
Jan-22	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0
May-22	0	0	0	0	0	0	0	0	0
Jun-22	0	0	0	0	0	0	0	0	0

Annex 2 – EIA Displacement Matrices

1. Mean, LCI and UCI displacement matrices for **gannet** from the Windfarm Site in the **breeding season**. Estimated population based on Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0	0	1	1	1	2	5	7	12	19	24
	20%	0	1	1	2	2	5	10	14	24	38	48
	30%	1	1	2	3	4	7	14	21	36	57	72
	40%	1	2	3	4	5	10	19	29	48	76	95
	50%	1	2	4	5	6	12	24	36	60	95	119
	60%	1	3	4	6	7	14	29	43	72	114	143
	70%	2	3	5	7	8	17	33	50	83	134	167
	80%	2	4	6	8	10	19	38	57	95	153	191
	90%	2	4	6	9	11	21	43	64	107	172	215
	100%	2	5	7	10	12	24	48	72	119	191	239
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	1	2	2	4	6	8
	20%	0	0	0	1	1	2	3	5	8	12	15
	30%	0	0	1	1	1	2	5	7	11	18	23
	40%	0	1	1	1	2	3	6	9	15	24	30
	50%	0	1	1	2	2	4	8	11	19	30	38
	60%	0	1	1	2	2	5	9	14	23	36	45
	70%	1	1	2	2	3	5	11	16	26	42	53
	80%	1	1	2	2	3	6	12	18	30	48	60
	90%	1	1	2	3	3	7	14	20	34	54	68
	100%	1	2	2	3	4	8	15	23	38	60	76
UCI		Mortality										
Disp		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%

	10%	1	1	2	2	3	5	10	15	26	41	51
	20%	1	2	3	4	5	10	20	31	51	82	102
	30%	2	3	5	6	8	15	31	46	77	122	153
	40%	2	4	6	8	10	20	41	61	102	163	204
	50%	3	5	8	10	13	26	51	77	128	204	255
	60%	3	6	9	12	15	31	61	92	153	245	306
	70%	4	7	11	14	18	36	71	107	179	286	357
	80%	4	8	12	16	20	41	82	122	204	326	408
	90%	5	9	14	18	23	46	92	138	230	367	459
	100%	5	10	15	20	26	51	102	153	255	408	510

2. Mean, LCI and UCI displacement matrices showing change in mortality rate for **gannet** due to displacement from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.07%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	60%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.11%
	70%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.12%
	80%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
	90%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.13%	0.16%
	100%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.14%	0.18%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	30%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.11%
	40%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.12%	0.15%
	50%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.09%	0.15%	0.19%
	60%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.05%	0.07%	0.11%	0.18%	0.23%
	70%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.21%	0.26%
	80%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.15%	0.24%	0.30%
	90%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.07%	0.10%	0.17%	0.27%	0.34%
	100%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.11%	0.19%	0.30%	0.38%

3. Mean, LCI and UCI displacement matrices for **gannet** from the Windfarm Site in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	1	1	1	3	4	7	11	14
	20%	0	1	1	1	1	3	6	8	14	22	28
	30%	0	1	1	2	2	4	8	13	21	34	42
	40%	1	1	2	2	3	6	11	17	28	45	56
	50%	1	1	2	3	4	7	14	21	35	56	70
	60%	1	2	3	3	4	8	17	25	42	67	84
	70%	1	2	3	4	5	10	20	30	49	79	98
	80%	1	2	3	4	6	11	22	34	56	90	112
	90%	1	3	4	5	6	13	25	38	63	101	126
	100%	1	3	4	6	7	14	28	42	70	112	141

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	1	1	2	3	4	5
	20%	0	0	0	0	1	1	2	3	5	8	10
	30%	0	0	0	1	1	2	3	5	8	12	16
	40%	0	0	1	1	1	2	4	6	10	17	21
	50%	0	1	1	1	1	3	5	8	13	21	26
	60%	0	1	1	1	2	3	6	9	16	25	31
	70%	0	1	1	1	2	4	7	11	18	29	36
	80%	0	1	1	2	2	4	8	12	21	33	42
	90%	0	1	1	2	2	5	9	14	23	37	47
	100%	1	1	2	2	3	5	10	16	26	42	52

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	1	1	1	2	5	7	12	20	25

	20%	0	1	1	2	2	5	10	15	25	40	49
	30%	1	1	2	3	4	7	15	22	37	59	74
	40%	1	2	3	4	5	10	20	30	49	79	99
	50%	1	2	4	5	6	12	25	37	62	99	124
	60%	1	3	4	6	7	15	30	44	74	119	148
	70%	2	3	5	7	9	17	35	52	86	138	173
	80%	2	4	6	8	10	20	40	59	99	158	198
	90%	2	4	7	9	11	22	44	67	111	178	222
	100%	2	5	7	10	12	25	49	74	124	198	247

4. Mean, LCI and UCI displacement matrices showing change in mortality rate for **gannet** due to displacement in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Displacement and mortality ranges considered by the assessment shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.09%
	80%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.09%	0.11%
	90%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.12%
	100%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.13%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.07%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.09%
	50%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.09%	0.12%
	60%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
	70%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.13%	0.17%
	80%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.09%	0.15%	0.19%
	90%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.11%	0.17%	0.21%
	100%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.05%	0.07%	0.12%	0.19%	0.24%

5. Mean, LCI and UCI displacement matrices for **gannet** from the Windfarm Site in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	1	1	2	3	5	6
	20%	0	0	0	0	1	1	2	3	6	9	11
	30%	0	0	1	1	1	2	3	5	9	14	17
	40%	0	0	1	1	1	2	5	7	11	18	23
	50%	0	1	1	1	1	3	6	9	14	23	29
	60%	0	1	1	1	2	3	7	10	17	27	34
	70%	0	1	1	2	2	4	8	12	20	32	40
	80%	0	1	1	2	2	5	9	14	23	36	46
	90%	1	1	2	2	3	5	10	15	26	41	51
	100%	1	1	2	2	3	6	11	17	29	46	57

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	0	1	1
	20%	0	0	0	0	0	0	0	0	1	1	2
	30%	0	0	0	0	0	0	0	1	1	2	2
	40%	0	0	0	0	0	0	1	1	2	3	3
	50%	0	0	0	0	0	0	1	1	2	3	4
	60%	0	0	0	0	0	0	1	1	2	4	5
	70%	0	0	0	0	0	1	1	2	3	4	6
	80%	0	0	0	0	0	1	1	2	3	5	6
	90%	0	0	0	0	0	1	1	2	4	6	7
	100%	0	0	0	0	0	1	2	2	4	6	8

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	1	1	1	2	3	5	8	14	17

	20%	0	1	1	1	2	3	7	10	17	27	34
	30%	1	1	2	2	3	5	10	15	25	41	51
	40%	1	1	2	3	3	7	14	20	34	54	68
	50%	1	2	3	3	4	8	17	25	42	68	85
	60%	1	2	3	4	5	10	20	30	51	81	101
	70%	1	2	4	5	6	12	24	35	59	95	118
	80%	1	3	4	5	7	14	27	41	68	108	135
	90%	2	3	5	6	8	15	30	46	76	122	152
	100%	2	3	5	7	8	17	34	51	85	135	169

6. Mean, LCI and UCI displacement matrices showing change in mortality rate for **gannet** due to displacement in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. . See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.07%	0.08%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	80%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.09%	0.11%
	90%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.12%
	100%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%

7. Mean, LCI and UCI displacement matrices for **guillemot** from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	3	7	10	13	17	33	66	99	165	264	330
	20%	7	13	20	26	33	66	132	198	330	529	661
	30%	10	20	30	40	50	99	198	297	496	793	991
	40%	13	26	40	53	66	132	264	396	661	1057	1322
	50%	17	33	50	66	83	165	330	496	826	1322	1652
	60%	20	40	59	79	99	198	396	595	991	1586	1982
	70%	23	46	69	93	116	231	463	694	1156	1850	2313
	80%	26	53	79	106	132	264	529	793	1322	2115	2643
	90%	30	59	89	119	149	297	595	892	1487	2379	2974
	100%	33	66	99	132	165	330	661	991	1652	2643	3304
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	3	5	8	10	13	26	52	78	129	207	259
	20%	5	10	16	21	26	52	104	155	259	414	518
	30%	8	16	23	31	39	78	155	233	388	621	776
	40%	10	21	31	41	52	104	207	311	518	828	1035
	50%	13	26	39	52	65	129	259	388	647	1035	1294
	60%	16	31	47	62	78	155	311	466	776	1242	1553
	70%	18	36	54	72	91	181	362	543	906	1449	1812
	80%	21	41	62	83	104	207	414	621	1035	1656	2070
	90%	23	47	70	93	116	233	466	699	1165	1863	2329
	100%	26	52	78	104	129	259	518	776	1294	2070	2588
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	4	8	12	16	21	41	82	123	205	328	411

	20%	8	16	25	33	41	82	164	246	411	657	821
	30%	12	25	37	49	62	123	246	369	616	985	1232
	40%	16	33	49	66	82	164	328	493	821	1314	1642
	50%	21	41	62	82	103	205	411	616	1026	1642	2053
	60%	25	49	74	99	123	246	493	739	1232	1970	2463
	70%	29	57	86	115	144	287	575	862	1437	2299	2874
	80%	33	66	99	131	164	328	657	985	1642	2627	3284
	90%	37	74	111	148	185	369	739	1108	1847	2956	3695
	100%	41	82	123	164	205	411	821	1232	2053	3284	4105

8. Mean, LCI and UCI displacement matrices showing change in mortality rate for **guillemot** due to displacement from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. . See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.20%	0.25%
	20%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.10%	0.15%	0.25%	0.40%	0.50%
	30%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.15%	0.23%	0.38%	0.61%	0.76%
	40%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.20%	0.30%	0.50%	0.81%	1.01%
	50%	0.01%	0.03%	0.04%	0.05%	0.06%	0.13%	0.25%	0.38%	0.63%	1.01%	1.26%
	60%	0.02%	0.03%	0.05%	0.06%	0.08%	0.15%	0.30%	0.45%	0.76%	1.21%	1.51%
	70%	0.02%	0.04%	0.05%	0.07%	0.09%	0.18%	0.35%	0.53%	0.88%	1.41%	1.77%
	80%	0.02%	0.04%	0.06%	0.08%	0.10%	0.20%	0.40%	0.61%	1.01%	1.61%	2.02%
	90%	0.02%	0.05%	0.07%	0.09%	0.11%	0.23%	0.45%	0.68%	1.14%	1.82%	2.27%
	100%	0.03%	0.05%	0.08%	0.10%	0.13%	0.25%	0.50%	0.76%	1.26%	2.02%	2.52%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.20%
	20%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.32%	0.40%
	30%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.18%	0.30%	0.47%	0.59%
	40%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.16%	0.24%	0.40%	0.63%	0.79%
	50%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.20%	0.30%	0.49%	0.79%	0.99%
	60%	0.01%	0.02%	0.04%	0.05%	0.06%	0.12%	0.24%	0.36%	0.59%	0.95%	1.19%
	70%	0.01%	0.03%	0.04%	0.06%	0.07%	0.14%	0.28%	0.42%	0.69%	1.11%	1.38%
	80%	0.02%	0.03%	0.05%	0.06%	0.08%	0.16%	0.32%	0.47%	0.79%	1.26%	1.58%
	90%	0.02%	0.04%	0.05%	0.07%	0.09%	0.18%	0.36%	0.53%	0.89%	1.42%	1.78%
	100%	0.02%	0.04%	0.06%	0.08%	0.10%	0.20%	0.40%	0.59%	0.99%	1.58%	1.98%
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.16%	0.25%	0.31%

	20%	0.01%	0.01%	0.02%	0.03%	0.03%	0.06%	0.13%	0.19%	0.31%	0.50%	0.63%
	30%	0.01%	0.02%	0.03%	0.04%	0.05%	0.09%	0.19%	0.28%	0.47%	0.75%	0.94%
	40%	0.01%	0.03%	0.04%	0.05%	0.06%	0.13%	0.25%	0.38%	0.63%	1.00%	1.25%
	50%	0.02%	0.03%	0.05%	0.06%	0.08%	0.16%	0.31%	0.47%	0.78%	1.25%	1.57%
	60%	0.02%	0.04%	0.06%	0.08%	0.09%	0.19%	0.38%	0.56%	0.94%	1.50%	1.88%
	70%	0.02%	0.04%	0.07%	0.09%	0.11%	0.22%	0.44%	0.66%	1.10%	1.76%	2.19%
	80%	0.03%	0.05%	0.08%	0.10%	0.13%	0.25%	0.50%	0.75%	1.25%	2.01%	2.51%
	90%	0.03%	0.06%	0.08%	0.11%	0.14%	0.28%	0.56%	0.85%	1.41%	2.26%	2.82%
	100%	0.03%	0.06%	0.09%	0.13%	0.16%	0.31%	0.63%	0.94%	1.57%	2.51%	3.14%

9. Mean, LCI and UCI displacement matrices for **guillemot** from the Windfarm Site in the **non-breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	1	2	3	4	5	11	21	32	53	85	106
	20%	2	4	6	8	11	21	42	64	106	169	212
	30%	3	6	10	13	16	32	64	95	159	254	318
	40%	4	8	13	17	21	42	85	127	212	339	424
	50%	5	11	16	21	26	53	106	159	265	424	530
	60%	6	13	19	25	32	64	127	191	318	508	635
	70%	7	15	22	30	37	74	148	222	371	593	741
	80%	8	17	25	34	42	85	169	254	424	678	847
	90%	10	19	29	38	48	95	191	286	477	762	953
	100%	11	21	32	42	53	106	212	318	530	847	1059
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	1	1	2	3	4	7	14	21	36	57	71
	20%	1	3	4	6	7	14	29	43	71	114	143
	30%	2	4	6	9	11	21	43	64	107	171	214
	40%	3	6	9	11	14	29	57	86	143	229	286
	50%	4	7	11	14	18	36	71	107	179	286	357
	60%	4	9	13	17	21	43	86	129	214	343	428
	70%	5	10	15	20	25	50	100	150	250	400	500
	80%	6	11	17	23	29	57	114	171	286	457	571
	90%	6	13	19	26	32	64	129	193	321	514	643
	100%	7	14	21	29	36	71	143	214	357	571	714
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	2	3	5	7	9	17	34	52	86	138	172

	20%	3	7	10	14	17	34	69	103	172	276	345
	30%	5	10	16	21	26	52	103	155	259	414	517
	40%	7	14	21	28	34	69	138	207	345	552	690
	50%	9	17	26	34	43	86	172	259	431	690	862
	60%	10	21	31	41	52	103	207	310	517	828	1035
	70%	12	24	36	48	60	121	241	362	604	966	1207
	80%	14	28	41	55	69	138	276	414	690	1104	1380
	90%	16	31	47	62	78	155	310	466	776	1242	1552
	100%	17	34	52	69	86	172	345	517	862	1380	1725

10. Mean, LCI and UCI displacement matrices showing change in mortality rate for **guillemot** due to displacement from the Windfarm Site in the **non-breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	20%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.13%
	30%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.20%
	40%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.21%	0.27%
	50%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.07%	0.10%	0.17%	0.27%	0.33%
	60%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.32%	0.40%
	70%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.09%	0.14%	0.23%	0.37%	0.46%
	80%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.11%	0.16%	0.27%	0.42%	0.53%
	90%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.18%	0.30%	0.48%	0.60%
	100%	0.01%	0.01%	0.02%	0.03%	0.03%	0.07%	0.13%	0.20%	0.33%	0.53%	0.66%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	30%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.13%
	40%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.14%	0.18%
	50%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.22%
	60%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.21%	0.27%
	70%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.16%	0.25%	0.31%
	80%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.29%	0.36%
	90%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.32%	0.40%
	100%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.09%	0.13%	0.22%	0.36%	0.45%

UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.09%	0.11%

	20%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.11%	0.17%	0.22%
	30%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.10%	0.16%	0.26%	0.32%
	40%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.09%	0.13%	0.22%	0.35%	0.43%
	50%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.11%	0.16%	0.27%	0.43%	0.54%
	60%	0.01%	0.01%	0.02%	0.03%	0.03%	0.06%	0.13%	0.19%	0.32%	0.52%	0.65%
	70%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.15%	0.23%	0.38%	0.61%	0.76%
	80%	0.01%	0.02%	0.03%	0.03%	0.04%	0.09%	0.17%	0.26%	0.43%	0.69%	0.87%
	90%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.19%	0.29%	0.49%	0.78%	0.97%
	100%	0.01%	0.02%	0.03%	0.04%	0.05%	0.11%	0.22%	0.32%	0.54%	0.87%	1.08%

11. Mean, LCI and UCI displacement matrices for **Manx shearwater** from White Cross in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	12	24	36	49	61	121	243	364	606	970	1213
	20%	24	49	73	97	121	243	485	728	1213	1940	2425
	30%	36	73	109	146	182	364	728	1091	1819	2910	3638
	40%	49	97	146	194	243	485	970	1455	2425	3880	4850
	50%	61	121	182	243	303	606	1213	1819	3031	4850	6063
	60%	73	146	218	291	364	728	1455	2183	3638	5820	7275
	70%	85	170	255	340	424	849	1698	2546	4244	6790	8488
	80%	97	194	291	388	485	970	1940	2910	4850	7760	9700
	90%	109	218	327	437	546	1091	2183	3274	5456	8730	10913
	100%	121	243	364	485	606	1213	2425	3638	6063	9700	12126
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	8	17	25	34	42	85	169	254	423	676	845
	20%	17	34	51	68	85	169	338	507	845	1352	1690
	30%	25	51	76	101	127	254	507	761	1268	2028	2536
	40%	34	68	101	135	169	338	676	1014	1690	2705	3381
	50%	42	85	127	169	211	423	845	1268	2113	3381	4226
	60%	51	101	152	203	254	507	1014	1521	2536	4057	5071
	70%	59	118	177	237	296	592	1183	1775	2958	4733	5916
	80%	68	135	203	270	338	676	1352	2028	3381	5409	6762
	90%	76	152	228	304	380	761	1521	2282	3803	6085	7607
	100%	85	169	254	338	423	845	1690	2536	4226	6762	8452
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	17	33	50	67	84	167	335	502	836	1338	1673

	20%	33	67	100	134	167	335	669	1004	1673	2677	3346
	30%	50	100	151	201	251	502	1004	1506	2509	4015	5019
	40%	67	134	201	268	335	669	1338	2007	3346	5353	6692
	50%	84	167	251	335	418	836	1673	2509	4182	6692	8365
	60%	100	201	301	401	502	1004	2007	3011	5019	8030	10037
	70%	117	234	351	468	586	1171	2342	3513	5855	9368	11710
	80%	134	268	401	535	669	1338	2677	4015	6692	10707	13383
	90%	151	301	452	602	753	1506	3011	4517	7528	12045	15056
	100%	167	335	502	669	836	1673	3346	5019	8365	13383	16729

12. Mean, LCI and UCI displacement matrices showing change in mortality rate for **Manx shearwater** due to displacement from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean	Mortality										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
20%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.08%	0.14%	0.23%	0.28%
30%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.13%	0.21%	0.34%	0.42%
40%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.11%	0.17%	0.28%	0.45%	0.57%
50%	0.01%	0.01%	0.02%	0.03%	0.04%	0.07%	0.14%	0.21%	0.35%	0.57%	0.71%
60%	0.01%	0.02%	0.03%	0.03%	0.04%	0.08%	0.17%	0.25%	0.42%	0.68%	0.85%
70%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.20%	0.30%	0.49%	0.79%	0.99%
80%	0.01%	0.02%	0.03%	0.05%	0.06%	0.11%	0.23%	0.34%	0.57%	0.91%	1.13%
90%	0.01%	0.03%	0.04%	0.05%	0.06%	0.13%	0.25%	0.38%	0.64%	1.02%	1.27%
100%	0.01%	0.03%	0.04%	0.06%	0.07%	0.14%	0.28%	0.42%	0.71%	1.13%	1.41%

LCI	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
20%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.20%
30%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.09%	0.15%	0.24%	0.30%
40%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.32%	0.39%
50%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.10%	0.15%	0.25%	0.39%	0.49%
60%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.18%	0.30%	0.47%	0.59%
70%	0.01%	0.01%	0.02%	0.03%	0.03%	0.07%	0.14%	0.21%	0.34%	0.55%	0.69%
80%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.16%	0.24%	0.39%	0.63%	0.79%
90%	0.01%	0.02%	0.03%	0.04%	0.04%	0.09%	0.18%	0.27%	0.44%	0.71%	0.89%
100%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.20%	0.30%	0.49%	0.79%	0.99%

UCI	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.20%

	20%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.20%	0.31%	0.39%
	30%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.18%	0.29%	0.47%	0.59%
	40%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.16%	0.23%	0.39%	0.62%	0.78%
	50%	0.01%	0.02%	0.03%	0.04%	0.05%	0.10%	0.20%	0.29%	0.49%	0.78%	0.98%
	60%	0.01%	0.02%	0.04%	0.05%	0.06%	0.12%	0.23%	0.35%	0.59%	0.94%	1.17%
	70%	0.01%	0.03%	0.04%	0.05%	0.07%	0.14%	0.27%	0.41%	0.68%	1.09%	1.37%
	80%	0.02%	0.03%	0.05%	0.06%	0.08%	0.16%	0.31%	0.47%	0.78%	1.25%	1.56%
	90%	0.02%	0.04%	0.05%	0.07%	0.09%	0.18%	0.35%	0.53%	0.88%	1.40%	1.76%
	100%	0.02%	0.04%	0.06%	0.08%	0.10%	0.20%	0.39%	0.59%	0.98%	1.56%	1.95%

13. Mean, LCI and UCI displacement matrices for **Manx shearwater** from the Windfarm Site in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	1	1	2	2
	20%	0	0	0	0	0	0	1	1	2	4	4
	30%	0	0	0	0	0	1	1	2	3	5	7
	40%	0	0	0	0	0	1	2	3	4	7	9
	50%	0	0	0	0	1	1	2	3	6	9	11
	60%	0	0	0	1	1	1	3	4	7	11	13
	70%	0	0	0	1	1	2	3	5	8	12	15
	80%	0	0	1	1	1	2	4	5	9	14	18
	90%	0	0	1	1	1	2	4	6	10	16	20
	100%	0	0	1	1	1	2	4	7	11	18	22
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	0	0	1
	20%	0	0	0	0	0	0	0	0	1	1	1
	30%	0	0	0	0	0	0	0	0	1	1	2
	40%	0	0	0	0	0	0	0	1	1	2	2
	50%	0	0	0	0	0	0	1	1	1	2	3
	60%	0	0	0	0	0	0	1	1	2	2	3
	70%	0	0	0	0	0	0	1	1	2	3	4
	80%	0	0	0	0	0	0	1	1	2	3	4
	90%	0	0	0	0	0	0	1	1	2	4	5
	100%	0	0	0	0	0	1	1	2	3	4	5
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	1	1	2	4	5

	20%	0	0	0	0	0	1	2	3	5	8	10
	30%	0	0	0	1	1	1	3	4	7	12	14
	40%	0	0	1	1	1	2	4	6	10	15	19
	50%	0	0	1	1	1	2	5	7	12	19	24
	60%	0	1	1	1	1	3	6	9	14	23	29
	70%	0	1	1	1	2	3	7	10	17	27	34
	80%	0	1	1	2	2	4	8	12	19	31	38
	90%	0	1	1	2	2	4	9	13	22	35	43
	100%	0	1	1	2	2	5	10	14	24	38	48

14. Mean, LCI and UCI displacement matrices showing change in mortality rate for **Manx shearwater** due to displacement from the Windfarm Site in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

15. Mean, LCI and UCI displacement matrices for **Manx shearwater** from the Windfarm Site in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

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

	20%	0	0	0	1	1	2	3	5	8	12	16
	30%	0	0	1	1	1	2	5	7	12	19	23
	40%	0	1	1	1	2	3	6	9	16	25	31
	50%	0	1	1	2	2	4	8	12	19	31	39
	60%	0	1	1	2	2	5	9	14	23	37	47
	70%	1	1	2	2	3	5	11	16	27	43	54
	80%	1	1	2	2	3	6	12	19	31	50	62
	90%	1	1	2	3	3	7	14	21	35	56	70
	100%	1	2	2	3	4	8	16	23	39	62	78

16. Mean, LCI and UCI displacement matrices showing change in mortality rate for **Manx shearwater** due to displacement from the Windfarm Site in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells . See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

17. Mean, LCI and UCI displacement matrices for **puffin** from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	1	1	2	4	5
	20%	0	0	0	0	0	1	2	3	5	8	10
	30%	0	0	0	1	1	1	3	4	7	12	15
	40%	0	0	1	1	1	2	4	6	10	16	19
	50%	0	0	1	1	1	2	5	7	12	19	24
	60%	0	1	1	1	1	3	6	9	15	23	29
	70%	0	1	1	1	2	3	7	10	17	27	34
	80%	0	1	1	2	2	4	8	12	19	31	39
	90%	0	1	1	2	2	4	9	13	22	35	44
	100%	0	1	1	2	2	5	10	15	24	39	49
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	1	1
	30%	0	0	0	0	0	0	0	0	1	1	1
	40%	0	0	0	0	0	0	0	0	1	1	2
	50%	0	0	0	0	0	0	0	1	1	2	2
	60%	0	0	0	0	0	0	0	1	1	2	2
	70%	0	0	0	0	0	0	1	1	1	2	3
	80%	0	0	0	0	0	0	1	1	2	3	3
	90%	0	0	0	0	0	0	1	1	2	3	4
	100%	0	0	0	0	0	0	1	1	2	3	4
UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	1	1	2	4	6	7

	20%	0	0	0	1	1	1	3	4	7	12	15
	30%	0	0	1	1	1	2	4	7	11	18	22
	40%	0	1	1	1	1	3	6	9	15	24	29
	50%	0	1	1	1	2	4	7	11	18	29	37
	60%	0	1	1	2	2	4	9	13	22	35	44
	70%	1	1	2	2	3	5	10	15	26	41	52
	80%	1	1	2	2	3	6	12	18	29	47	59
	90%	1	1	2	3	3	7	13	20	33	53	66
	100%	1	1	2	3	4	7	15	22	37	59	74

18. Mean, LCI and UCI displacement matrices showing change in mortality rate for **puffin** due to displacement from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.07%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	70%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	80%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.12%
	90%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.13%
	100%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.12%	0.15%

19. Mean, LCI and UCI displacement matrices for **puffin** from the Windfarm Site in the **non-breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	1	1	2	2	3
	20%	0	0	0	0	0	1	1	2	3	5	6
	30%	0	0	0	0	0	1	2	3	5	7	9
	40%	0	0	0	0	1	1	2	4	6	10	12
	50%	0	0	0	1	1	2	3	5	8	12	16
	60%	0	0	1	1	1	2	4	6	9	15	19
	70%	0	0	1	1	1	2	4	7	11	17	22
	80%	0	0	1	1	1	2	5	7	12	20	25
	90%	0	1	1	1	1	3	6	8	14	22	28
	100%	0	1	1	1	2	3	6	9	16	25	31
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	1	1
	30%	0	0	0	0	0	0	0	0	1	1	1
	40%	0	0	0	0	0	0	0	0	1	1	2
	50%	0	0	0	0	0	0	0	1	1	2	2
	60%	0	0	0	0	0	0	0	1	1	2	2
	70%	0	0	0	0	0	0	1	1	1	2	3
	80%	0	0	0	0	0	0	1	1	2	3	3
	90%	0	0	0	0	0	0	1	1	2	3	4
	100%	0	0	0	0	0	0	1	1	2	3	4
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	1	2	2	4	6	8

	20%	0	0	0	1	1	2	3	5	8	13	16
	30%	0	0	1	1	1	2	5	7	12	19	24
	40%	0	1	1	1	2	3	6	10	16	26	32
	50%	0	1	1	2	2	4	8	12	20	32	40
	60%	0	1	1	2	2	5	10	14	24	38	48
	70%	1	1	2	2	3	6	11	17	28	45	56
	80%	1	1	2	3	3	6	13	19	32	51	64
	90%	1	1	2	3	4	7	14	22	36	58	72
	100%	1	2	2	3	4	8	16	24	40	64	80

20. Mean, LCI and UCI displacement matrices showing change in mortality rate for **puffin** due to displacement from the Windfarm Site in the non-**breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%	0.03%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	60%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.09%	0.12%
	70%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
	80%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.13%	0.16%
	90%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.14%	0.18%
	100%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.20%

21. Mean, LCI and UCI displacement matrices for **razorbill** from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	1	1	2	3	4
	20%	0	0	0	0	0	1	2	2	4	6	8
	30%	0	0	0	0	1	1	2	4	6	10	12
	40%	0	0	0	1	1	2	3	5	8	13	16
	50%	0	0	1	1	1	2	4	6	10	16	20
	60%	0	0	1	1	1	2	5	7	12	19	24
	70%	0	1	1	1	1	3	6	8	14	22	28
	80%	0	1	1	1	2	3	6	10	16	26	32
	90%	0	1	1	1	2	4	7	11	18	29	36
	100%	0	1	1	2	2	4	8	12	20	32	40
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	1	1	1
	20%	0	0	0	0	0	0	0	1	1	2	2
	30%	0	0	0	0	0	0	1	1	2	3	3
	40%	0	0	0	0	0	0	1	1	2	4	4
	50%	0	0	0	0	0	1	1	2	3	4	6
	60%	0	0	0	0	0	1	1	2	3	5	7
	70%	0	0	0	0	0	1	2	2	4	6	8
	80%	0	0	0	0	0	1	2	3	4	7	9
	90%	0	0	0	0	0	1	2	3	5	8	10
	100%	0	0	0	0	1	1	2	3	6	9	11
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0	0	0	0	0	1	2	3	4	7	8

	20%	0	0	1	1	1	2	3	5	8	14	17
	30%	0	1	1	1	1	3	5	8	13	20	25
	40%	0	1	1	1	2	3	7	10	17	27	34
	50%	0	1	1	2	2	4	8	13	21	34	42
	60%	1	1	2	2	3	5	10	15	25	41	51
	70%	1	1	2	2	3	6	12	18	30	47	59
	80%	1	1	2	3	3	7	14	20	34	54	68
	90%	1	2	2	3	4	8	15	23	38	61	76
	100%	1	2	3	3	4	8	17	25	42	68	85

22. Mean, LCI and UCI displacement matrices showing change in mortality rate for **razorbil**l due to displacement from the Windfarm Site in the **breeding season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.07%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.06%	0.08%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.09%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%

23. Mean, LCI and UCI displacement matrices for **razorbill** from the Windfarm Site in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	1	1	2	3	4
	20%	0	0	0	0	0	1	2	2	4	6	8
	30%	0	0	0	0	1	1	2	4	6	10	12
	40%	0	0	0	1	1	2	3	5	8	13	16
	50%	0	0	1	1	1	2	4	6	10	16	20
	60%	0	0	1	1	1	2	5	7	12	19	24
	70%	0	1	1	1	1	3	6	8	14	22	28
	80%	0	1	1	1	2	3	6	10	16	26	32
	90%	0	1	1	1	2	4	7	11	18	29	36
	100%	0	1	1	2	2	4	8	12	20	32	40

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	0	0	0	0	0	0	1	1
	20%	0	0	0	0	0	0	0	1	1	1	2
	30%	0	0	0	0	0	0	1	1	1	2	3
	40%	0	0	0	0	0	0	1	1	2	3	3
	50%	0	0	0	0	0	0	1	1	2	3	4
	60%	0	0	0	0	0	1	1	2	3	4	5
	70%	0	0	0	0	0	1	1	2	3	5	6
	80%	0	0	0	0	0	1	1	2	3	5	7
	90%	0	0	0	0	0	1	2	2	4	6	8
	100%	0	0	0	0	0	1	2	3	4	7	8

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displ acem ent	10%	0	0	0	0	0	1	2	3	4	7	9

	20%	0	0	1	1	1	2	3	5	9	14	17
	30%	0	1	1	1	1	3	5	8	13	21	26
	40%	0	1	1	1	2	3	7	10	17	28	35
	50%	0	1	1	2	2	4	9	13	22	35	44
	60%	1	1	2	2	3	5	10	16	26	42	52
	70%	1	1	2	2	3	6	12	18	31	49	61
	80%	1	1	2	3	3	7	14	21	35	56	70
	90%	1	2	2	3	4	8	16	24	39	63	79
	100%	1	2	3	3	4	9	17	26	44	70	87

24. Mean, LCI and UCI displacement matrices showing change in mortality rate for **razorbill** due to displacement from the Windfarm Site in the **autumn migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%	0.03%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.05%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%
	90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.07%
	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.02%	0.04%	0.07%	0.08%

25. Mean, LCI and UCI displacement matrices for **razorbill** from the Windfarm Site in the **winter season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0	1	1	1	2	4	7	11	18	29	36
	20%	1	1	2	3	4	7	14	22	36	58	72
	30%	1	2	3	4	5	11	22	32	54	87	108
	40%	1	3	4	6	7	14	29	43	72	116	144
	50%	2	4	5	7	9	18	36	54	90	144	181
	60%	2	4	6	9	11	22	43	65	108	173	217
	70%	3	5	8	10	13	25	51	76	126	202	253
	80%	3	6	9	12	14	29	58	87	144	231	289
	90%	3	6	10	13	16	32	65	97	162	260	325
	100%	4	7	11	14	18	36	72	108	181	289	361
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	1	1	1	2	4	6	11	17	21
	20%	0	1	1	2	2	4	8	13	21	34	42
	30%	1	1	2	3	3	6	13	19	32	51	63
	40%	1	2	3	3	4	8	17	25	42	68	85
	50%	1	2	3	4	5	11	21	32	53	85	106
	60%	1	3	4	5	6	13	25	38	63	101	127
	70%	1	3	4	6	7	15	30	44	74	118	148
	80%	2	3	5	7	8	17	34	51	85	135	169
	90%	2	4	6	8	10	19	38	57	95	152	190
	100%	2	4	6	8	11	21	42	63	106	169	211
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	1	1	2	2	3	5	11	16	27	43	54

	20%	1	2	3	4	5	11	22	33	54	87	108
	30%	2	3	5	7	8	16	33	49	81	130	163
	40%	2	4	7	9	11	22	43	65	108	174	217
	50%	3	5	8	11	14	27	54	81	136	217	271
	60%	3	7	10	13	16	33	65	98	163	260	325
	70%	4	8	11	15	19	38	76	114	190	304	380
	80%	4	9	13	17	22	43	87	130	217	347	434
	90%	5	10	15	20	24	49	98	146	244	391	488
	100%	5	11	16	22	27	54	108	163	271	434	542

26. Mean, LCI and UCI displacement matrices showing change in mortality rate for **razorbill** due to displacement from the Windfarm Site in the **winter season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		**Mortality**										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	20%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.12%
	30%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.15%	0.18%
	40%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.05%	0.07%	0.12%	0.19%	0.24%
	50%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.15%	0.24%	0.30%
	60%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.29%	0.36%
	70%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.13%	0.21%	0.34%	0.42%
	80%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.10%	0.15%	0.24%	0.39%	0.48%
	90%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.11%	0.16%	0.27%	0.44%	0.54%
	100%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.12%	0.18%	0.30%	0.48%	0.60%
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.06%	0.07%
	30%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.11%
	40%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%
	50%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.14%	0.18%
	60%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.11%	0.17%	0.21%
	70%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.05%	0.07%	0.12%	0.20%	0.25%
	80%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.08%	0.14%	0.23%	0.28%
	90%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.10%	0.16%	0.25%	0.32%
	100%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.28%	0.35%
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.07%	0.09%

20%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.05%	0.09%	0.15%	0.18%
30%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.14%	0.22%	0.27%
40%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.29%	0.36%
50%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.09%	0.14%	0.23%	0.36%	0.45%
60%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.11%	0.16%	0.27%	0.44%	0.54%
70%	0.01%	0.01%	0.02%	0.03%	0.03%	0.06%	0.13%	0.19%	0.32%	0.51%	0.64%
80%	0.01%	0.01%	0.02%	0.03%	0.04%	0.07%	0.15%	0.22%	0.36%	0.58%	0.73%
90%	0.01%	0.02%	0.02%	0.03%	0.04%	0.08%	0.16%	0.25%	0.41%	0.65%	0.82%
100%	0.01%	0.02%	0.03%	0.04%	0.05%	0.09%	0.18%	0.27%	0.45%	0.73%	0.91%

27. Mean, LCI and UCI displacement matrices for **razorbill** from the Windfarm Site in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	1	1	1	2	3	7	10	17	28	34
	20%	1	1	2	3	3	7	14	21	34	55	69
	30%	1	2	3	4	5	10	21	31	52	83	103
	40%	1	3	4	6	7	14	28	41	69	110	138
	50%	2	3	5	7	9	17	34	52	86	138	172
	60%	2	4	6	8	10	21	41	62	103	165	207
	70%	2	5	7	10	12	24	48	72	121	193	241
	80%	3	6	8	11	14	28	55	83	138	220	276
	90%	3	6	9	12	16	31	62	93	155	248	310
	100%	3	7	10	14	17	34	69	103	172	276	345
LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0	0	0	1	1	1	3	4	7	12	15
	20%	0	1	1	1	1	3	6	9	15	24	30
	30%	0	1	1	2	2	4	9	13	22	35	44
	40%	1	1	2	2	3	6	12	18	30	47	59
	50%	1	1	2	3	4	7	15	22	37	59	74
	60%	1	2	3	4	4	9	18	27	44	71	89
	70%	1	2	3	4	5	10	21	31	52	83	103
	80%	1	2	4	5	6	12	24	35	59	94	118
	90%	1	3	4	5	7	13	27	40	66	106	133
	100%	1	3	4	6	7	15	30	44	74	118	148
UCI		Mortality										
Displacement		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
	10%	1	1	2	2	3	6	12	18	29	47	59

	20%	1	2	4	5	6	12	24	35	59	94	118
	30%	2	4	5	7	9	18	35	53	88	141	177
	40%	2	5	7	9	12	24	47	71	118	188	235
	50%	3	6	9	12	15	29	59	88	147	235	294
	60%	4	7	11	14	18	35	71	106	177	283	353
	70%	4	8	12	16	21	41	82	124	206	330	412
	80%	5	9	14	19	24	47	94	141	235	377	471
	90%	5	11	16	21	26	53	106	159	265	424	530
	100%	6	12	18	24	29	59	118	177	294	471	589

28. Mean, LCI and UCI displacement matrices showing change in mortality rate for **razorbill** due to displacement from the Windfarm Site in the **spring migration season**. Estimated population based on the Windfarm Site + 2km buffer area. Ranges of displacement and mortality considered by the assessment are shown in grey cells. See below.

Mean		Mortality										
		1%	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.06%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	40%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.06%	0.10%	0.13%
	50%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.13%	0.16%
	60%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.16%	0.19%
	70%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.05%	0.07%	0.11%	0.18%	0.23%
	80%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.08%	0.13%	0.21%	0.26%
	90%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.09%	0.15%	0.23%	0.29%
	100%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.06%	0.10%	0.16%	0.26%	0.32%

LCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
	20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%
	30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%
	40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%
	50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.07%
	60%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.07%	0.08%
	70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.08%	0.10%
	80%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.11%
	90%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.06%	0.10%	0.13%
	100%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.04%	0.07%	0.11%	0.14%

UCI		Mortality										
		1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
Displacement	10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%

20%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.09%	0.11%
30%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.13%	0.17%
40%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.04%	0.07%	0.11%	0.18%	0.22%
50%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.06%	0.08%	0.14%	0.22%	0.28%
60%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.07%	0.10%	0.17%	0.27%	0.33%
70%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.08%	0.12%	0.19%	0.31%	0.39%
80%	0.00%	0.01%	0.01%	0.02%	0.02%	0.04%	0.09%	0.13%	0.22%	0.35%	0.44%
90%	0.00%	0.01%	0.01%	0.02%	0.02%	0.05%	0.10%	0.15%	0.25%	0.40%	0.50%
100%	0.01%	0.01%	0.02%	0.02%	0.03%	0.06%	0.11%	0.17%	0.28%	0.44%	0.55%

Annex 3 – Collision Risk Modelling Inputs and Additional Species Outputs

1. Monthly means of flight density estimates (mean, lower 95% confidence interval (LCI) and upper 95% confidence interval (UCI)) of bird species within the the Windfarm Site area. Mean and SD values were used in the stochastic Collision Risk Modelling (sCRM) model.

Species		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gannet	Mean birds/km^2	0	0	0.365	0.180	0.170	0.180	0.170	0.465	0.180	0.830	0	0
	LCI	0	0	0.040	0.020	0.020	0.020	0.020	0.100	0.020	0.285	0	0
	UCI	0	0	0.810	0.620	0.520	0.530	0.440	1.010	0.530	1.560	0	0
	SD	0	0	0.1923	0.15	0.125	0.1275	0.105	0.2272	0.1275	0.3185	0	0
Great black-backed gull	Mean birds/km^2	0	0	0.090	0	0	0.090	0	0	0	0	0	0
	LCI	0	0	0.010	0	0	0.010	0	0	0	0	0	0
	UCI	0	0	0.270	0	0	0.260	0	0	0	0	0	0
	SD	0	0	0.065	0	0	0.0625	0	0	0	0	0	0
Herring gull	Mean birds/km^2	0	0	0	0	0	0	0	0	0	0	0	0.090
	LCI	0	0	0	0	0	0	0	0	0	0	0	0.010
	UCI	0	0	0	0	0	0	0	0	0	0	0	0.270
	SD	0	0	0	0	0	0	0	0	0	0	0	0.0650
Kittiwake	Mean birds/km^2	4.445	1.010	1.830	0	0	0.090	0	0	0.170	0.090	0.365	0.365
	LCI	2.125	0.385	0.760	0	0	0.010	0	0	0.020	0.010	0.040	0.040
	UCI	7.320	1.940	3.195	0	0	0.260	0	0	0.430	0.260	0.910	1.105
	SD	1.2984	0.3884	0.6086	0	0	0.0625	0	0	0.1025	0.0625	0.2178	0.2661
Lesser black-	Mean birds/km^2	0	0	0	0	0	0	0.0900	0	0	0	0	0

Species		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
backed gull	LCI	0	0	0	0	0	0	0.0100	0	0	0	0	0
	UCI	0	0	0	0	0	0	0.2700	0	0	0	0	0
	SD	0	0	0	0	0	0	0.065	0	0	0	0	0

OUTPUTS – predicted collisions per month and annual total estimates under 15MW and 18MW turbine scenarios.

9.1.1.1 Gannet

9.1.1.1.1 Nocturnal Activity 10%

9.1.1.1.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.591	0.356	0.374	0.388	0.35	0.854	0.323	1.222	0	0
SD	0	0	0.277	0.214	0.207	0.208	0.186	0.394	0.179	0.471	0	0
CV	NaN	NaN	0.468	0.602	0.553	0.536	0.533	0.461	0.555	0.385	NaN	NaN
Median	0	0	0.593	0.339	0.353	0.377	0.336	0.839	0.307	1.197	0	0
2.5%	0	0	0.088	0.03	0.042	0.043	0.032	0.164	0.03	0.349	0	0
25%	0	0	0.392	0.19	0.219	0.235	0.218	0.569	0.181	0.909	0	0
75%	0	0	0.776	0.487	0.515	0.513	0.469	1.095	0.438	1.531	0	0
97.5%	0	0	1.153	0.841	0.791	0.834	0.754	1.72	0.699	2.242	0	0

9.1.1.1.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.812	0.484	0.507	0.525	0.489	1.167	0.442	1.693	0	0
SD	0	0	0.387	0.288	0.282	0.287	0.259	0.539	0.236	0.677	0	0
CV	NaN	NaN	0.476	0.595	0.556	0.546	0.53	0.462	0.535	0.4	NaN	NaN
Median	0	0	0.799	0.457	0.483	0.503	0.476	1.152	0.428	1.656	0	0
2.5%	0	0	0.138	0.041	0.046	0.067	0.046	0.169	0.046	0.412	0	0
25%	0	0	0.535	0.252	0.297	0.308	0.296	0.767	0.262	1.234	0	0
75%	0	0	1.075	0.672	0.682	0.713	0.657	1.511	0.601	2.144	0	0
97.5%	0	0	1.6	1.092	1.11	1.134	1.068	2.307	0.942	3.093	0	0

9.1.1.2 Nocturnal Activity 20%

9.1.1.2.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.651	0.38	0.381	0.388	0.365	0.894	0.34	1.355	0	0
SD	0	0	0.303	0.226	0.213	0.222	0.193	0.414	0.191	0.517	0	0
CV	NaN	NaN	0.466	0.595	0.559	0.573	0.529	0.463	0.56	0.382	NaN	NaN
Median	0	0	0.65	0.357	0.371	0.362	0.349	0.886	0.32	1.333	0	0
2.5%	0	0	0.105	0.028	0.031	0.034	0.044	0.098	0.03	0.447	0	0
25%	0	0	0.435	0.211	0.218	0.216	0.221	0.616	0.2	0.973	0	0
75%	0	0	0.839	0.518	0.523	0.541	0.491	1.162	0.46	1.71	0	0
97.5%	0	0	1.267	0.903	0.813	0.852	0.772	1.701	0.782	2.437	0	0

9.1.1.2.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.909	0.529	0.53	0.551	0.511	1.229	0.459	1.829	0	0
SD	0	0	0.438	0.316	0.305	0.308	0.281	0.583	0.254	0.73	0	0
CV	NaN	NaN	0.482	0.597	0.576	0.559	0.55	0.475	0.553	0.399	NaN	NaN
Median	0	0	0.88	0.486	0.496	0.538	0.484	1.199	0.45	1.768	0	0
2.5%	0	0	0.139	0.048	0.039	0.041	0.056	0.166	0.041	0.494	0	0
25%	0	0	0.573	0.29	0.292	0.317	0.293	0.8	0.269	1.328	0	0
75%	0	0	1.202	0.735	0.728	0.768	0.692	1.614	0.613	2.309	0	0
97.5%	0	0	1.823	1.201	1.202	1.185	1.145	2.408	1.03	3.376	0	0

9.1.1.3 Great black-backed gull

9.1.1.3.1 25% Nocturnal Activity

9.1.1.3.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.2	0	0	0.226	0	0	0	0	0	0
SD	0	0	0.118	0	0	0.125	0	0	0	0	0	0
CV	NaN	NaN	0.591	NaN	NaN	0.554	NaN	NaN	NaN	NaN	NaN	NaN
Median	0	0	0.189	0	0	0.215	0	0	0	0	0	0
2.5%	0	0	0.014	0	0	0.022	0	0	0	0	0	0
25%	0	0	0.11	0	0	0.13	0	0	0	0	0	0
75%	0	0	0.281	0	0	0.308	0	0	0	0	0	0
97.5%	0	0	0.455	0	0	0.492	0	0	0	0	0	0

9.1.1.3.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.29	0	0	0.32	0	0	0	0	0	0
SD	0	0	0.173	0	0	0.177	0	0	0	0	0	0
CV	NaN	NaN	0.595	NaN	NaN	0.554	NaN	NaN	NaN	NaN	NaN	NaN
Median	0	0	0.263	0	0	0.306	0	0	0	0	0	0
2.5%	0	0	0.032	0	0	0.031	0	0	0	0	0	0
25%	0	0	0.16	0	0	0.191	0	0	0	0	0	0
75%	0	0	0.403	0	0	0.421	0	0	0	0	0	0
97.5%	0	0	0.69	0	0	0.723	0	0	0	0	0	0

9.1.1.3.2 50% Nocturnal Activity

9.1.1.3.2.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.248	0	0	0.255	0	0	0	0	0	0
SD	0	0	0.141	0	0	0.147	0	0	0	0	0	0
CV	NaN	NaN	0.567	NaN	NaN	0.575	NaN	NaN	NaN	NaN	NaN	NaN
Median	0	0	0.235	0	0	0.244	0	0	0	0	0	0
2.5%	0	0	0.026	0	0	0.022	0	0	0	0	0	0
25%	0	0	0.142	0	0	0.148	0	0	0	0	0	0
75%	0	0	0.34	0	0	0.351	0	0	0	0	0	0
97.5%	0	0	0.55	0	0	0.58	0	0	0	0	0	0

9.1.1.3.2.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0.342	0	0	0.357	0	0	0	0	0	0
SD	0	0	0.189	0	0	0.201	0	0	0	0	0	0
CV	NaN	NaN	0.554	NaN	NaN	0.562	NaN	NaN	NaN	NaN	NaN	NaN
Median	0	0	0.332	0	0	0.343	0	0	0	0	0	0
2.5%	0	0	0.03	0	0	0.025	0	0	0	0	0	0
25%	0	0	0.198	0	0	0.212	0	0	0	0	0	0
75%	0	0	0.465	0	0	0.485	0	0	0	0	0	0
97.5%	0	0	0.743	0	0	0.79	0	0	0	0	0	0

9.1.1.4 Herring gull

9.1.1.4.1 25% Nocturnal Activity

9.1.1.4.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0	0	0	0	0	0.147
SD	0	0	0	0	0	0	0	0	0	0	0	0.083
CV	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.566
Median	0	0	0	0	0	0	0	0	0	0	0	0.14
2.5%	0	0	0	0	0	0	0	0	0	0	0	0.014
25%	0	0	0	0	0	0	0	0	0	0	0	0.088
75%	0	0	0	0	0	0	0	0	0	0	0	0.204
97.5%	0	0	0	0	0	0	0	0	0	0	0	0.324

9.1.1.4.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0	0	0	0	0	0.212
SD	0	0	0	0	0	0	0	0	0	0	0	0.122
CV	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.577
Median	0	0	0	0	0	0	0	0	0	0	0	0.201
2.5%	0	0	0	0	0	0	0	0	0	0	0	0.018
25%	0	0	0	0	0	0	0	0	0	0	0	0.117
75%	0	0	0	0	0	0	0	0	0	0	0	0.292
97.5%	0	0	0	0	0	0	0	0	0	0	0	0.483

50% Nocturnal Activity

9.1.1.4.1.3 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0	0	0	0	0	0.191
SD	0	0	0	0	0	0	0	0	0	0	0	0.113
CV	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.592
Median	0	0	0	0	0	0	0	0	0	0	0	0.18
2.5%	0	0	0	0	0	0	0	0	0	0	0	0.016
25%	0	0	0	0	0	0	0	0	0	0	0	0.102
75%	0	0	0	0	0	0	0	0	0	0	0	0.263
97.5%	0	0	0	0	0	0	0	0	0	0	0	0.436

9.1.1.4.1.4 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0	0	0	0	0	0.279
SD	0	0	0	0	0	0	0	0	0	0	0	0.164
CV	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.588
Median	0	0	0	0	0	0	0	0	0	0	0	0.261
2.5%	0	0	0	0	0	0	0	0	0	0	0	0.024
25%	0	0	0	0	0	0	0	0	0	0	0	0.151
75%	0	0	0	0	0	0	0	0	0	0	0	0.386
97.5%	0	0	0	0	0	0	0	0	0	0	0	0.625

9.1.1.5 Kittiwake

25% nocturnal activity

9.1.1.5.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	5.543	1.237	2.717	0	0	0.165	0	0	0.269	0.139	0.487	0.497
SD	1.718	0.487	0.943	0	0	0.091	0	0	0.142	0.077	0.244	0.284
CV	0.31	0.393	0.347	NaN	NaN	0.551	NaN	NaN	0.527	0.554	0.501	0.571
Median	5.592	1.248	2.679	0	0	0.158	0	0	0.258	0.135	0.482	0.47
2.5%	2.277	0.271	0.983	0	0	0.016	0	0	0.026	0.012	0.059	0.051
25%	4.32	0.877	2.094	0	0	0.098	0	0	0.17	0.081	0.299	0.278
75%	6.592	1.581	3.338	0	0	0.222	0	0	0.354	0.19	0.65	0.68
97.5%	9.281	2.194	4.647	0	0	0.365	0	0	0.589	0.306	1	1.154

9.1.1.5.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	8.673	1.903	4.165	0	0	0.261	0	0	0.411	0.215	0.733	0.781
SD	2.638	0.751	1.509	0	0	0.148	0	0	0.213	0.12	0.373	0.435
CV	0.304	0.395	0.362	NaN	NaN	0.566	NaN	NaN	0.519	0.56	0.509	0.557
Median	8.63	1.869	4.145	0	0	0.25	0	0	0.393	0.206	0.707	0.752
2.5%	3.513	0.483	1.393	0	0	0.025	0	0	0.048	0.014	0.07	0.07
25%	6.985	1.408	3.166	0	0	0.148	0	0	0.258	0.127	0.457	0.441
75%	10.298	2.367	5.111	0	0	0.355	0	0	0.559	0.292	0.972	1.078
97.5%	14.03	3.493	7.295	0	0	0.583	0	0	0.866	0.472	1.488	1.692

50% nocturnal activity

9.1.1.5.1.3 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	7.395	1.574	3.355	0	0	0.191	0	0	0.309	0.174	0.632	0.672
SD	2.283	0.614	1.105	0	0	0.105	0	0	0.163	0.097	0.332	0.375
CV	0.309	0.39	0.329	NaN	NaN	0.55	NaN	NaN	0.527	0.558	0.525	0.558
Median	7.363	1.573	3.368	0	0	0.184	0	0	0.296	0.163	0.61	0.636
2.5%	3.13	0.381	1.338	0	0	0.016	0	0	0.036	0.019	0.069	0.054
25%	5.783	1.159	2.575	0	0	0.113	0	0	0.193	0.103	0.392	0.399
75%	8.959	1.997	4.098	0	0	0.256	0	0	0.412	0.233	0.83	0.923
97.5%	11.932	2.752	5.552	0	0	0.406	0	0	0.641	0.383	1.344	1.432

9.1.1.5.1.4 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	11.088	2.387	4.959	0	0	0.282	0	0	0.483	0.266	0.94	1.056
SD	3.348	0.938	1.75	0	0	0.16	0	0	0.257	0.146	0.48	0.608
CV	0.302	0.393	0.353	NaN	NaN	0.567	NaN	NaN	0.531	0.548	0.51	0.575
Median	11.005	2.35	4.918	0	0	0.265	0	0	0.463	0.258	0.916	1.006
2.5%	4.756	0.531	1.758	0	0	0.024	0	0	0.061	0.026	0.13	0.083
25%	8.794	1.743	3.71	0	0	0.157	0	0	0.284	0.153	0.581	0.569
75%	13.333	3.024	6.096	0	0	0.389	0	0	0.655	0.368	1.262	1.46
97.5%	18.07	4.189	8.559	0	0	0.617	0	0	1.013	0.573	1.942	2.366

9.1.1.6 Lesser black-backed gull

Nocturnal Activity 25%

9.1.1.6.1.1 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0.18	0	0	0	0	0
SD	0	0	0	0	0	0	0.108	0	0	0	0	0
CV	NaN	NaN	NaN	NaN	NaN	NaN	0.6	NaN	NaN	NaN	NaN	NaN
Median	0	0	0	0	0	0	0.165	0	0	0	0	0
2.5%	0	0	0	0	0	0	0.014	0	0	0	0	0
25%	0	0	0	0	0	0	0.1	0	0	0	0	0
75%	0	0	0	0	0	0	0.252	0	0	0	0	0
97.5%	0	0	0	0	0	0	0.424	0	0	0	0	0

9.1.1.6.1.2 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0.253	0	0	0	0	0
SD	0	0	0	0	0	0	0.157	0	0	0	0	0
CV	NaN	NaN	NaN	NaN	NaN	NaN	0.62	NaN	NaN	NaN	NaN	NaN
Median	0	0	0	0	0	0	0.238	0	0	0	0	0
2.5%	0	0	0	0	0	0	0.017	0	0	0	0	0
25%	0	0	0	0	0	0	0.135	0	0	0	0	0
75%	0	0	0	0	0	0	0.344	0	0	0	0	0
97.5%	0	0	0	0	0	0	0.63	0	0	0	0	0

Nocturnal Activity 50%

9.1.1.6.1.3 15MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0.204	0	0	0	0	0
SD	0	0	0	0	0	0	0.123	0	0	0	0	0
CV	NaN	NaN	NaN	NaN	NaN	NaN	0.606	NaN	NaN	NaN	NaN	NaN
Median	0	0	0	0	0	0	0.191	0	0	0	0	0
2.5%	0	0	0	0	0	0	0.008	0	0	0	0	0
25%	0	0	0	0	0	0	0.116	0	0	0	0	0
75%	0	0	0	0	0	0	0.276	0	0	0	0	0
97.5%	0	0	0	0	0	0	0.487	0	0	0	0	0

9.1.1.6.1.4 18MW

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0	0	0	0	0	0	0.297	0	0	0	0	0
SD	0	0	0	0	0	0	0.175	0	0	0	0	0
CV	NaN	NaN	NaN	NaN	NaN	NaN	0.587	NaN	NaN	NaN	NaN	NaN
Median	0	0	0	0	0	0	0.28	0	0	0	0	0
2.5%	0	0	0	0	0	0	0.022	0	0	0	0	0
25%	0	0	0	0	0	0	0.163	0	0	0	0	0
75%	0	0	0	0	0	0	0.409	0	0	0	0	0
97.5%	0	0	0	0	0	0	0.675	0	0	0	0	0

Annex 4 – SNH (2018) Apportionment Results

1. Manx shearwater apportionment (mean max plus one SD) results following the SNH apportionment guidance (SNH, 2018)

2.

Colony Name	Count of adult birds at colony (individuals)	Distance to Project Site (km)	Distance^2	Area of foraging range as sea (km^2)	Proportion of Foraging Range as Sea	1/P(Sea)	Weight	Proportion
Sark	10	5	144,704	8,402,793	0	2.092	0.00	0.00
Jethou	10	5	143,111	8,508,268	0	2.066	0.00	0.00
St Helen's	248	124	21,199	10,828,704	1	1.623	0.00	0.00
Gugh	160	80	23,685	10,846,283	1	1.621	0.00	0.00
St Agnes	130	65	24,056	10,811,125	1	1.626	0.00	0.00
Round Island	156	78	20,996	10,793,546	1	1.629	0.00	0.00
Tresco	92	46	21,815	10,828,704	1	1.623	0.00	0.00
Annet	458	229	24,211	10,863,862	1	1.618	0.00	0.00
St Martin's	52	26	21,083	10,740,809	1	1.637	0.00	0.00
Bryher	78	39	22,023	10,828,704	1	1.623	0.00	0.00
Great Ganilly	2	1	21,170	10,758,388	1	1.634	0.00	0.00
Lundy	11,008	5,504	2,237	10,002,488	1	1.757	1.08	0.03
Skomer	910,312	349,663	4,719	10,635,334	1	1.653	39.91	0.96
Middleholm		16,548						
Skokholm		88,945						
Ramsey Island RSPB	9,592	4,796	6,872	10,600,176	1	1.658	0.29	0.01
Bardsey Island	32,366	16,183	36,062	10,565,018	1	1.664	0.19	0.00
Calf of Man	848	424	108,175	10,740,809	1	1.637	0.00	0.00
Little Saltee	200	100	20,221	11,391,234	1	1.543	0.00	0.00
Great Saltee	300	150	20,107	11,408,813	1	1.541	0.00	0.00
Deenish	702	351	134,762	13,430,406	1	1.309	0.00	0.00

Colony Name	Count of adult birds at colony (individuals)	Distance to Project Site (km)	Distance^2	Area of foraging range as sea (km^2)	Proportion of Foraging Range as Sea	1/P(Sea)	Weight	Proportion
Scariff	3,920	1,960	134,469	13,412,827	1	1.311	0.00	0.00
Great Skellig Whole Island	1,476	738	146,689	13,658,934	1	1.287	0.00	0.00
Puffin Island Whole	12,658	6,329	146,919	13,535,880	1	1.299	0.01	0.00
Inishvickillane	1,286	643	168,100	13,694,092	1	1.284	0.00	0.00
Inishnabro	11,222	5,611	166,872	13,764,408	1	1.277	0.01	0.00
Great Blasket	7,168	3,584	171,230	13,623,776	1	1.290	0.01	0.00
Inishtooskert	19,392	9,696	174,390	13,746,829	1	1.279	0.02	0.00
Cruagh	6,572	3,286	350,819	13,940,199	1	1.261	0.00	0.00
High Island	1,636	818	350,464	13,905,041	1	1.264	0.00	0.00
Inishshark	102	51	362,524	13,905,041	1	1.264	0.00	0.00
Lighthouse Island	9,700	3,444	157,530	11,892,238	1	1.478	0.01	0.00
Big Copeland Island		1,406						
Ailsa Craig	40	20	211,968	11,531,867	1	1.524	0.00	0.00
Sanda Islands	600	300	215,296	12,006,502	1	1.464	0.00	0.00
Inchmarnock (West)	2	1	275,310	11,830,711	1	1.486	0.00	0.00

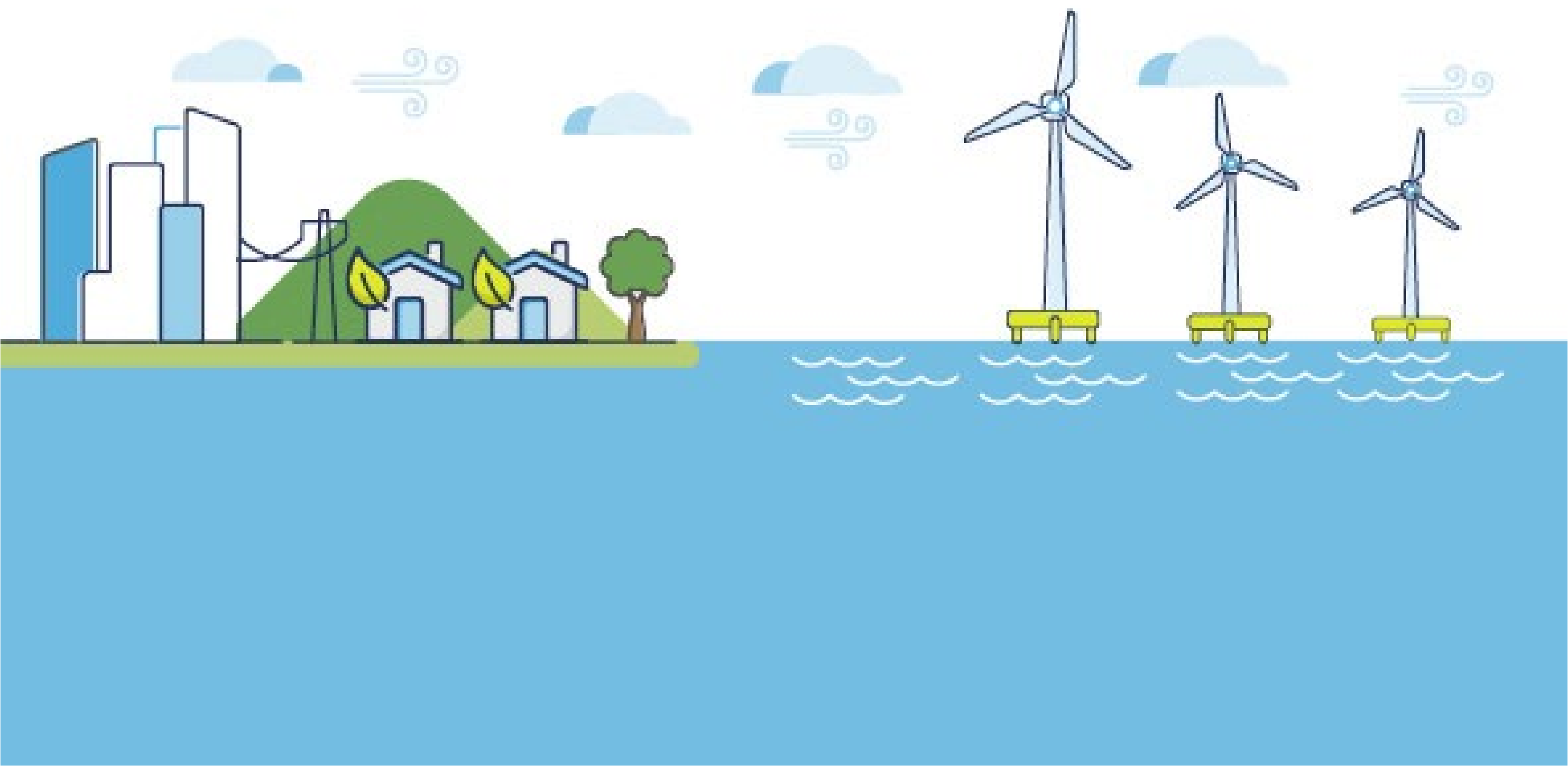
Colony Name	Count of adult birds at colony (individuals)	Distance to Project Site (km)	Distance^2	Area of foraging range as sea (km^2)	Proportion of Foraging Range as Sea	1/P(Sea)	Weight	Proportion
Soa	2	1	366,025	12,463,557	1	1.410	0.00	0.00
Lunga and Sgeir a' Chaisteil	3,984	1,992	393,756	12,463,557	1	1.410	0.00	0.00
Eigg	500	250	453,602	12,393,241	1	1.418	0.00	0.00
Rum	240,000	120,000	449,436	12,410,820	1	1.416	0.09	0.00
Canna and Sanday	4	2	462,264	12,463,557	1	1.410	0.00	0.00
Dun	7,330	222	646,577	13,694,092	1	1.284	0.00	0.00
Hirta		3,443						
Lamb Hoga	14	7	1,746,891	10,670,493	1	1.647	0.00	0.00
Isle of May	2	1	1,791,582	73,128,911	0	2.404	0.00	0.00
TOTALS	**1,294,334**		**10,163,926**			**62.724**	**41.66**	**1**

Foraging range and foraging area	
Mean-max + one SD Foraging Range (km)	2,365.5
Potential Foraging Range (km^2)	17,579,065

Appendix 13.B: Migratory Birds Report

White Cross Offshore Windfarm Environmental Statement

Appendix 13.B: Migratory Birds Report



Document Code:	FLO-WHI-REP-0002-13	
Contractor Document Number:	PC2978-RHD-ZZ-XX-RP-Z-0387	
Version Number:	0	
Date:	*07/06/2023*	
Prepared by:	M Costagliola-Ray, T Phelps, A Wheeldon	*Electronic Signature*
Checked by:	M Boa, S Sweeney	*Electronic Signature*
Owned by:	PT	*Electronic Signature*
Approved by Client:	MJ	*Electronic Signature*

Version Number	Reason for Issue / Major Changes	Date of Change
0	For approval	17/08/2023

Table of Contents

Table of Figures

Table of Tables

Appendices

Glossary of Acronyms

Acronym	Definition
AfL	Agreement for Lease
BEIS	Department for Business, Energy and Industrial Strategy
CEA	Cumulative Effect Assessment
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
FLOW	Floating Offshore Windfarm
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
JNCC	Joint Nature Conservancy Council
km	Kilometre
Km^2	Square kilometre
m	Metre
MMO	Marine Management Organisation
MW	Megawatts
NE	Natural England
NPS	National Policy Statement
OWL	Offshore Wind Ltd
RIAA	Report to Inform an Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
USSR	Union of Soviet Socialist Republics (USSR)
WTG	Wind Turbine Generator

Glossary of Terminology

Defined Term	Description
Agreement for Lease	An Agreement for Lease (AfL) is a non-binding agreement between a landlord and prospective tenant to grant and/or to accept a lease in the future. The AfL only gives the option to investigate a site for potential development. There is no obligation on the developer to execute a lease if they do not wish to.
Applicant	Offshore Wind Limited.
Cumulative effects	The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative Effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.
In-combination effects	In-combination effects are those effects that may arise from the development proposed in combination with other plans and projects proposed/consented but not yet built and operational.
Offshore Development Area	The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the project that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009.
Offshore Infrastructure	All of the offshore infrastructure including wind turbine generators, substructures, mooring lines, seabed anchors, Offshore Substation Platform and all cable types (export and inter-array). This encompasses the infrastructure that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009.
the Offshore Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required).
Offshore Wind Limited	Offshore Wind Ltd (OWL) is a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd.
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities associated with the Project.

Defined Term	Description
Project Design Envelope	A description of the range of possible elements that make up the Project design options under consideration. The Project Design Envelope, or 'Rochdale Envelope' is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact parameters are not yet known but a bounded range of parameters are known for each key project aspect.
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure.
Wind Turbine Generators (WTG)	The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, nacelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application.
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present.

1. Introduction

1.1 Project Background

1. Offshore Wind Ltd (hearafter "the Applicant") is proposing to develop the White Cross Offshore Windfarm Project (hereafter referred to as 'the Offshore Project'); a demonstration scale Floating Offshore Windfarm (FLOW). The Windfarm Site is located in the Celtic Sea, approximately 52km off the North Cornwall and North Devon coast (west-north-west of Hartland Point). The Windfarm Site covers approximately 50km^2. Details of the location of the Offshore Project and the offshore elements (including the Wind Turbine Generators' (WTG) operational footprint, Windfarm Site layout, inter-array cables and associated protection, and the spatial footprints of the construction or decommissioning works) are set out within **Chapter 5: Project Description** of the White Cross Offshore Windfarm ES.

2. APEM Ltd (hereafter APEM) was commissioned by the Applicant to undertake a study of offshore and intertidal ornithology characteristics of the area that may be influenced by the Offshore Project. A separate report (**Appendix 13.A: Offshore Ornithology Technical Report**) provides the findings from offshore ornithology data to determine the receptors that characterise the baseline and which are of relevance to the assessment of potential impacts from the Offshore Project. This technical annex has been produced to support **Chapter 13: Offshore Ornithology** of the White Cross Offshore Windfarm Environmental Statement (ES) and considered the potential risk to migratory birds that are not typically recorded in monthly surveys, which may interact with the Offshore Project.

1.2 Potential collision risk to migratory birds

3. APEM has conducted site specific surveys of the Offshore Project and surrounding area via high resolution digital aerial surveys. While the results of these surveys provide information on the likely abundance and distribution of key seabird species for each biological period, they also have limitations. In particular, neither these surveys, nor any other existing generally applied survey methods are guaranteed to provide reliable estimates of migrant bird numbers whilst on migration, particularly non-seabirds. This is due to the snapshot nature of baseline surveys which has the potential to miss some species moving through in short pulses, in poor weather or at night (when no surveys take place), or at high altitudes, which makes recording their numbers extremely complex using standard methods.

4. One solution is to model migratory bird movements. APEM has developed the bespoke software model 'Migropath' to provide estimates of such movements. This

builds on the work carried out by the British Trust for Ornithology (BTO) for the SOSS-05 project (Wright *et al*. 2012). Migropath can be used to estimate the proportion of a given population passing through a site's footprint, assuming point-to-point migration (for example from the coastline of continental Europe to designated SPAs within the UK).

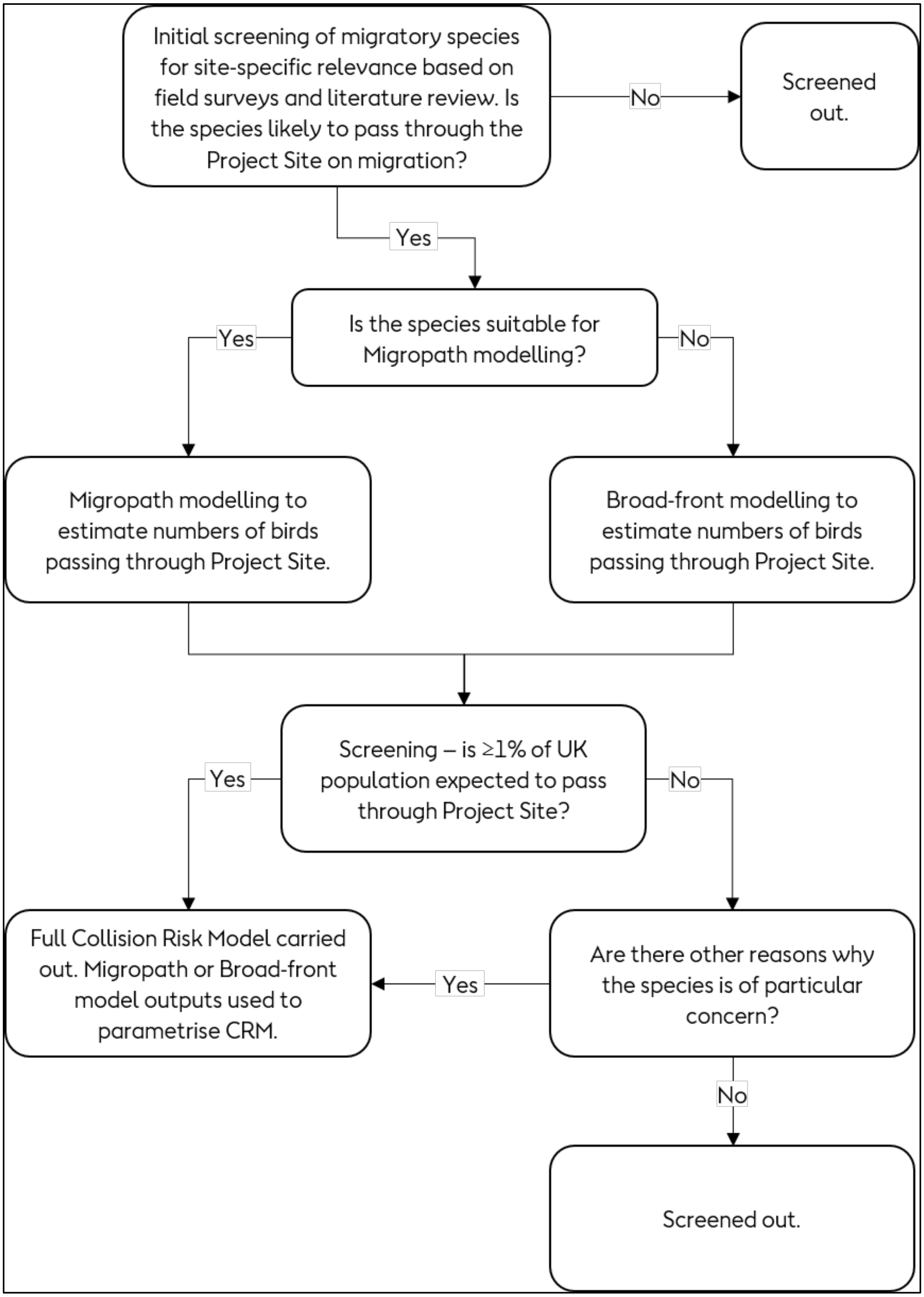
5. The use of Migropath is not suitable for all species, in particular species which do not follow a point-to-point migration pattern (Alerstam, 1990). Many seabirds fall into this category (Wernham *et al*. 2002), with some seabirds known to take longer routes, for example following the coastline in preference to a more direct route over land. For such species, a 'broad front' pathway might better describe the movements that these birds are making within western waters. Consequently, the risks to which the population is exposed relates to the proportion of the 'broad front' pathway crossing, in this instance, the location of the Offshore Project Windfarm Site. Within that 'broad front', birds might be distributed evenly, or they might have distribution that is skewed, such as a bias towards the coast.

2. Species selection/Screening process

2.1 Screening methodology

6. A combination of data sources – field surveys, literature review, Migropath modelling, and migratory apportionment – have been used to screen migratory species for more detailed impact assessments for collision risk. Where species have been screened in, the results also quantify inputs for use in Collision Risk Modelling (CRM), in particular the timing and numbers of birds migrating through the area of interest. The standard threshold for migratory birds used is that the species will be screened in if at least 1% of the UK population is expected to pass through the site footprint each year, in this case the Windfarm Site. Migratory species may also be screened in if there is species-specific evidence of an elevated risk of a significant impact from collisions. Note that the focus of this report is to assess potential interaction of migratory species passing through the Windfarm Site and not for species present in the project area for longer periods (for example, breeding birds which may fly through the project on regular foraging trips), which are considered separately in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES. This is summarised in the flowchart below (**Figure 1**).

Figure 1 Flowchart showing approach to screening and collision risk modelling for migratory species



2.1.1 Screening results

7. An initial screening exercise was completed to identify any migratory species that may pass through or nearby to the Windfarm Site. A review of site specific digital aerial survey data for the Offshore Project, migration surveys, local bird reports and other ornithological literature helped identify the birds to take on to the next stage of modelling. The species screened in are presented in **Table 1**, and the full approach to assessment is detailed in the screening matrix presented in **Appendix 1**.

8. For the purposes of initial screening, the above information sources were considered using expert judgement based on experience of undertaking previous assessments of migratory birds for the purpose of assessing potential risk from collision with WTGs, including work near to the development area. The objective of this exercise is to review and screen in species which have potential connectivity with the Windfarm Site in meaningful numbers on migration and / or known to be highly sensitive to collision risk.

Table 1 Migratory Birds Screened in for the Offshore Project and modelling approach

Migropath modelling		
Shelduck	Hen harrier	Snipe
Wigeon	Oystercatcher	Black-tailed godwit (Icelandic)
Gadwall	Ringed plover	Bar-tailed godwit
Teal	Golden plover	Whimbrel
Mallard	Grey plover	Curlew
Shoveler	Lapwing	Greenshank
Tufted duck	Knot	Redshank
Cormorant	Sanderling	Turnstone
Little egret	Dunlin	
'Broad front' modelling		
Arctic skua	Little tern	Roseate tern
Great skua	Sandwich tern	Arctic tern
Common gull	Common tern	

3. Migropath modelling methodology (migratory non-seabirds)

3.1 Migropath modelling approach

9. The non-breeding waterbird populations of UK SPAs (UK National Site Network) are regularly surveyed annually by the Wetland Bird Survey (Frost *et al*. 2020). Occasional surveys of non-breeding SPA features have been carried out, for example the inshore 2000/01 and 2001/02 Joint Nature Conservation Committee (JNCC) Winter Seaduck Survey (Dean *et al*. 2003). Each SPA has its original designation figures. There is therefore information on the numbers of birds over-wintering or breeding on these sites. From ringing / tagging data, as well as other literature, there is also information on the likely origin of some or all of these populations, including transboundary migrations (Wernham *et al*. 2002). A general migration route or zone can therefore be defined for a given population of birds. Furthermore, data from continental sites (e.g. staging posts, observatories) can be used to further refine the likely fronts, as well as provide information on temporal components of migration (for example, daily passage rate and duration of migration events).

10. It is therefore possible to estimate the numbers of birds associated with one SPA, with a defined group of SPAs, or with a regional suite of SPAs that will encounter one or more wind farms by defining appropriate migratory corridors.

11. The approach is a relatively uncomplicated method to answer a pressing set of questions. In order to develop more complex models simulating bird movement, additional environmental variables such as weather and photoperiod, and biological factors such as flight speed, energy budget, flocking behaviour and manoeuvrability would need to be considered. APEM has been involved in similar simulations for fish passage at tidal barrage locations (Willis and Teague 2014), using hydrodynamic and behavioural modelling, but at present, no such models exist for UK birds.

3.2 Migropath modelling assumption

12. Migropath has been developed alongside BTO's SOSS-05 project (Wright *et al*. 2012) and therefore is limited to the species considered in that project, specifically species that are either designated features of UK SPAs ('SPA species'), or other rare or vulnerable species listed in Annex 1 of the EU Birds Directive ('Annex 1 species') that regularly migrate across UK waters. Annex 1 species that only occasionally migrate across UK waters are excluded.

13. Migropath inevitably makes several assumptions. Chief amongst these is the assumption that migration is in a straight line between the SPA of interest and a given point (or defined area) outside the UK. Birds migrating between

breeding/wintering grounds outside the UK and UK SPAs that do not pass through the Windfarm Site are not considered to be at collision risk from the Offshore Project, based on the assumption of straight-line migration. Such no-risk (no risk from the Offshore Project) movements can be factored in to estimated proportions of birds arriving on / departing from SPAs but not encountering the Windfarm Site.

14. Another key assumption is that all migration of a particular species to a particular suite of SPAs can be defined within a set corridor. This corridor should aim to realistically represent the area across which birds must move.

15. Migropath does not take into account any macro-avoidance behaviour of birds (i.e. birds may alter their route to avoid the Windfarm Site). It therefore represents the number of birds expected to pass through the Windfarm Site in the absence of any turbines. This ensures avoidance is not double-counted, as the CRM model includes an avoidance factor. The potential for macro-avoidance to impact migratory birds by increasing the length of their migration and energy expenditure (barrier effect) is considered in **Chapter 13: Offshore Ornithology** of the White Cross Offshore Windfarm ES.

16. Migropath does not consider flight height, and as a precautionary assumption where the migratory route intersects the Windfarm Site, it is assumed that this leads to a potential for collisions to occur. The proportion of birds at potential collision height is included as an input into the CRM model.

3.3 Migropath modelling technical methodology

17. The centroid of each SPA was calculated using the geometry function within QGIS 3.10. The coastlines of continental Europe and Iceland were split into 1 km segments, and each segment labelled with a unique ID. Using the ET Geowizard or MMQGIS Hub Lines tool, each segment along the European or Icelandic coast was joined to the centre of each SPA, with each line classified as either passing within or out from the Windfarm Site. Flight pathways connecting the UK to Iceland are referred to as the North route, while flight pathways to continental Europe are referred to as the South route (notwithstanding that continental Europe includes Scandinavia and therefore some flight pathways on the South route have a northerly bearing).

18. A list of SPAs that each of the species is associated with was collated (Stroud *et al.* 2001). This information, along with the migratory pathways, was then fed into the statistical software 'R' (R Core Team 2021).

19. Shapefiles produced as part of the SOSS_05 project (Wright *et al*. 2012) were used to determine which parts of the European or Icelandic coastline migrants of each species are expected to use. Where species have known staging sites in Europe, the locations of these were also extracted from the shapefiles.

20. Within R, all possible flight paths for each species determined in the previous step were then considered – i.e. all flight paths within the portion of the European or Icelandic coast migratory routes identified for each species and SPAs associated with each species. The proportion of birds following each individual flight path was allocated randomly across those flight paths. For species which are known to stage or moult in known staging sites, an extra step was carried out to ensure that the proportion of birds departing from the staging area equalled the proportion of the population known to use the staging area. For birds staging in the Wadden sea, this proportion was extracted from Laursen *et al*. (2010).

21. Note that the model is not directional and can be run separately for autumn and spring migrations, allowing these to be parameterised differently if appropriate. For example, the proportion of birds using staging areas may differ between migration periods.

22. For some species, distinct races, sub-species, or populations were modelled separately, where there is evidence that migratory patterns differ between them.

23. The proportion of birds modelled to pass through the Windfarm Site in one year was then calculated. The model re-runs the random allocation of flight paths 200 times in order to estimate the confidence surrounding this result.

4. 'Broad Front' modelling (migratory seabirds)

4.1 Approach

24. This method is based on a basic calculation utilising species-specific information on population estimates and migration behaviour derived from desk-based study, with the results presented in **Section 6.2**. The method used to calculate 'broad front' migration follows a stepwise methodology outlined below:

- Identify the population of birds undertaking the 'broad front' migration.
- Identify the width of the 'broad front' based on the migratory pathway or corridor that is being used.
- Calculate the proportion of the 'broad front' occupied by the Windfarm Site perpendicular to the direction of flight.
- Where possible, identify if there is any skewed distribution of birds within the 'broad front' such as a preference to fly along the coast.
- Calculate the numbers of birds flying across the Windfarm Site based on the proportion of the 'broad front' occupied by the Windfarm Site factoring in any skewed migratory distribution.

25. Typically, to ensure the estimates are precautionary, the maximum 'broad front' corridor is assumed to extend from the UK coast to the Irish coast based on the Windfarm Site location. However, considering the geographical location of the site, a different approach was required to account for expected seabird behaviour within the region. Most seabirds tend to follow the coastline on migration but may take extended open sea crossing between prominent coastal headlands or peninsulas. There is evidence to suggest some seabirds migrating on the west coast of the UK take a migration route that cuts offshore between the west coast of Pembrokeshire to Cornwall. Given the location of the Windfarm Site in the outer Bristol channel there is the potential for seabirds to pass through the Windfarm Site when following a migration route between these two prominent peninsulas. In order to consider this in the 'broad front' modelling approach a migratory funnel was designed to consider the maximum corridor of birds migrating through the outer Bristol channel. This corridor represents the width intersecting the Windfarm Site perpendicular to birds migrating in a North/South flight pattern and was measured as being 173km at its widest (this was the migration corridor for common gull). The width of the Windfarm Site within that corridor is calculated to be 5.5km. This is the widest point across the Windfarm Site and when presuming an even distribution of birds migrating within the 'broad front' represents the worst-case scenario for collision risk, ensuring a precautionary approach to assessment is taken.

5. Results of Migropath modelling (migratory non-seabirds)

26. The total number of bird species determined to be screened in for Migropath modelling was 26 species (**Table 1**). Other than hen harrier and cormorant, these were all waterfowl and waders. The majority were included due to the importance of the populations which migrate to the UK for the non-breeding seasons; however, for species which also breed in the UK, the migratory breeding population was also included in the model.

27. The mean proportion of the UK population expected to pass through the Windfarm Site and the number of birds this equates to is presented in **Table 2**. The upper and lower confidence limits are presented in **Appendix 2**.

28. Where different populations or seasons were modelled separately in Migropath, all results were included in the CRM to give an annual total across all populations for each species.

29. As presented within **Table 2**, for all species screened in for Migropath modelling significantly less than 1% of the UK population is expected to pass through the Windfarm Site. It can therefore be concluded at this stage for all species modelled that there is no potential for a significant adverse effect from collision risk whilst on migration, due to the limited levels of connectivity predicted. Therefore, no non-seabird species were taken through for CRM.

Table 2 Results from Migropath modelling to estimate the number of birds of each species passing through the Offshore Project Windfarm Site on migration (and the proportion of the migratory population it represents)

Species/Population	UK Population	Migration route	Migration Season	Number of birds passing through the Windfarm Site each migration (mean; see Appendix A for details)	Percentage of migratory population passing through the Windfarm Site each migration (mean; see Appendix A for details)	Percentage of the UK population passing through the Windfarm Site annually (mean)
Shelduck	43,150	South	Spring	0	0.00%	0.00%
	51,000		Autumn	0	0.00%	
	7,850		Moult	0	0.00%	
Wigeon	450,000	South	Spring/Autumn	69	<0.01%	<0.01%
Gadwall	31,000	South	Spring/Autumn	0	0.00%	0.00%
Teal	435,000	South	Spring/Autumn	0	0.00%	0.00%
Mallard	675,000	South	Spring/Autumn	0	0.00%	0.00%
Shoveler	19,500	South	Spring/Autumn	0	0.00%	0.00%
Tufted duck	140,000	South	Spring/Autumn	75	<0.01%	<0.01%
	70,000	North	Spring/Autumn	0	0.00%	0.00%
Cormorant	64,500	South	Spring/Autumn	33	<0.01%	<0.01%
Little egret	11,500	South	Spring/Autumn	0	0.00%	0.00%
Hen harrier	750	South	Spring/Autumn	0	0.00%	0.00%
Oystercatcher	305,000	South	Spring/Autumn	0	0.00%	0.00%
Ringed plover	42,500	South	Spring/Autumn	12	<0.01%	<0.01%
Golden plover	410,000	South	Spring/Autumn	0	0.00%	0.00%
Grey plover	33,500	South	Spring/Autumn	0	0.00%	0.00%

Species/Population	UK Population	Migration route	Migration Season	Number of birds passing through the Windfarm Site each migration (mean; see Appendix A for details)	Percentage of migratory population passing through the Windfarm Site each migration (mean; see Appendix A for details)	Percentage of the UK population passing through the Windfarm Site annually (mean)
Lapwing	635,000	South	Spring/Autumn	99	<0.01%	<0.01%
Knot	450,000	South	Spring/Autumn	26	<0.01%	<0.01%
Sanderling	20,500	South	Spring/Autumn	5	<0.01%	<0.01%
Dunlin	350,000	South	Spring/Autumn	0	0.00%	0.00%
Snipe	1,100,000	South	Spring/Autumn	0	0.00%	0.00%
Black-tailed godwit (Icelandic)	41,000	South	Spring/Autumn	0	0.00%	0.00%
Bar-tailed godwit	53,500	South	Spring/Autumn	0	0.00%	0.00%
Whimbrel	41	South	Spring/Autumn	0	0.00%	0.00%
Curlew	125,000	South	Spring/Autumn	0	0.00%	0.00%
Greenshank	920	South	Spring/Autumn	0	0.00%	0.00%
Redshank	100,000	South	Spring/Autumn	11	<0.01%	<0.01%
Turnstone	43,000	South	Spring/Autumn	13	<0.01%	<0.01%

6. Results of 'Broad Front' modelling (migratory seabirds)

6.1 Species screened in

30. The total number of bird species determined to be required to be screened in for 'broad front' modelling was eight seabirds (**Table 1**). These were: Arctic skua, great skua, common gull, little tern, Sandwich tern, common tern, Roseate tern and Arctic tern. To determine the number of migratory seabirds that are considered within the 'broad front' modelling process, a full literature review was undertaken for each species. A summary of these literature reviews that form the basis of the evidence for each species and how these populations are apportioned for CRM are presented in the following sections.

6.1.1 Arctic skua

31. Arctic skua breed at high latitudes around the northern hemisphere including northern Scotland, Norway, Faroe Islands Iceland, Greenland, Svalbard, Russia, Canada, and Alaska. Birds from northern Europe spend the winter in Atlantic waters off western and southern Africa and some cross the Atlantic to South American wintering grounds (Wernham *et al*. 2002). The Biologically Defined Minimum Population Scales (BDMPS) for Arctic skua is defined by Furness (2015) for the autumn migration (August to October) as being an estimated population of 5,287 passing through UK Western waters, and for the spring migration (April to May) with an estimated population of 5,111 passing through UK Western waters. The number of birds on passage through UK waters has been estimated from sources such as seawatching data and the European Seabirds at Sea (ESAS) data as specified in Furness (2015), although these numbers are relatively uncertain, with year on year variation.

32. Arctic skua occur in two plumage phases: dark and light. In Scotland, dark birds predominate, in southern Scandinavia up to 95% of birds may be dark-phase, but at high latitudes nearly all birds are light-phase. The migrations of these birds differ in timing and so the proportions of light and dark birds on coasts change through the migration seasons (Arcos 1997). Most birds seen at sea in the North Sea in autumn were classified as dark-phase (Tasker *et al*. 1987), suggesting that few Arctic breeders pass through the North Sea in autumn. Birds from North Sea colonies (Orkney and Shetland) disperse in autumn through both the North Sea and Western waters. Birds from colonies on the west UK coast probably disperse through Western waters mainly south or south-westwards (Furness 2015). Autumn migration (mainly in August and September) tends to be more leisurely with individuals often lingering for some time around areas where terns and small gulls aggregate, such as in

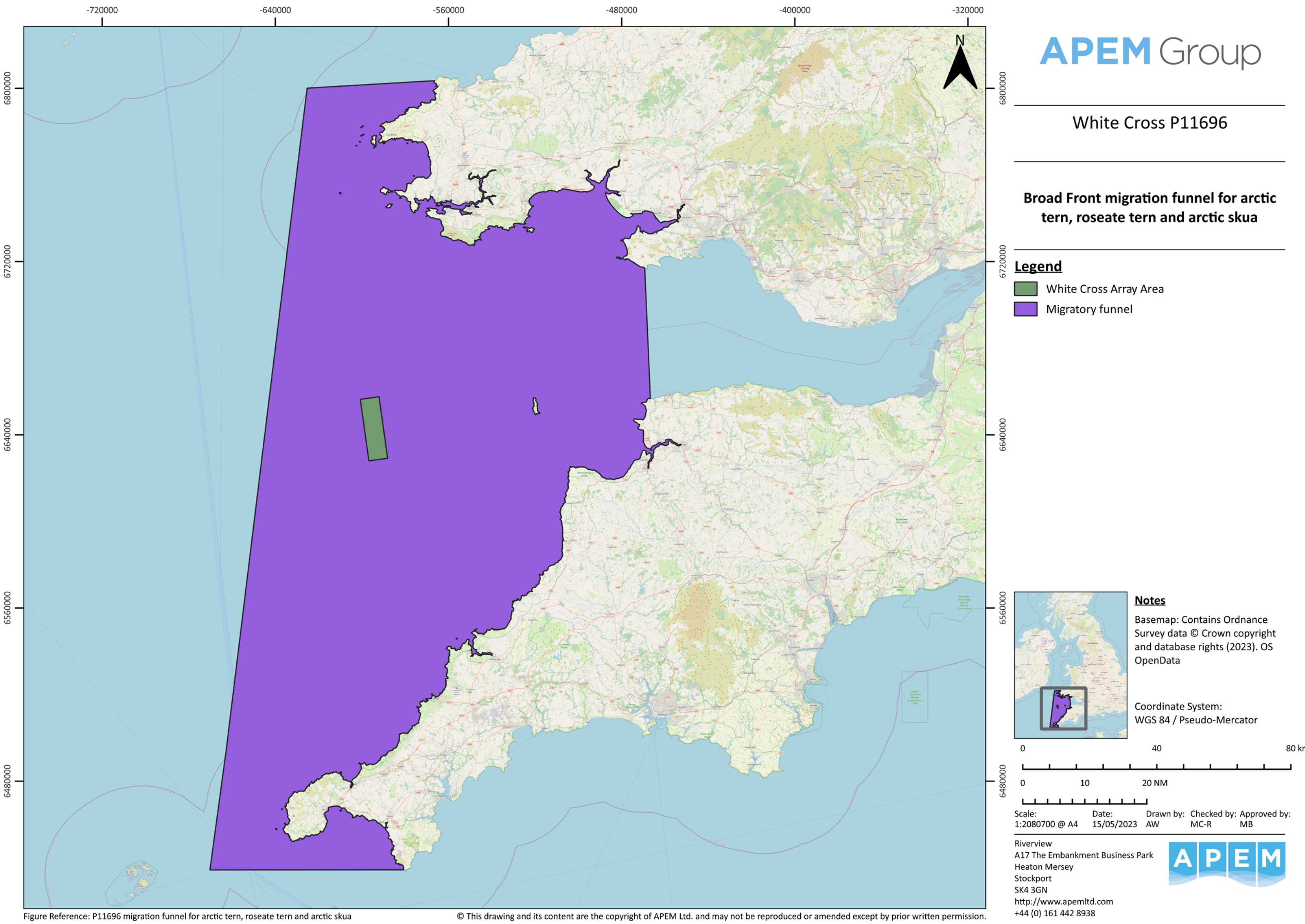
estuaries. (Taylor 1979). However, return migration in spring tends to be more rapid with most birds taking a route through Western waters, even for birds returning to colonies within the North Sea (Forrester *et al*. 2007). The proportion of light phase birds usually increases through spring as birds that breed at more southerly colonies (predominately dark phase birds) tend to arrive first, with birds migrating to the Arctic (where pale phase predominate) passing through later (Newham 1984).

33. Scottish adult Arctic skua return to colonies during late April, but birds breeding in the Arctic may not occupy breeding grounds until June, and some of these may occur along both British and Irish coasts in May.

34. The birds that migrate along the coasts of the UK and Ireland comprise both UK-breeding birds and those that breed in the north of Europe (Furness, 1987). Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For Arctic skua, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the majority migrate within 20km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022). Therefore, to consider this the migratory corridor was designed to extend 20 km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel skua species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For Arctic skua the 'broad front' corridor presented in **Figure 2** was used.

35. During the 24 months of digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES). No Arctic skuas were recorded within the Windfarm Site plus 4km buffer.

Figure 2 Broad Front migration funnel for arctic tern, roseate tern and arctic skua



6.1.2 Great skua

36. Great skua breed in northern Scotland, Iceland, Faroe Islands, Norway, Svalbard, Jan–Mayen and Russia, with the majority (98%) of the population breeding in Scotland and Iceland (del Hoyo *et al*. 1992-2013). This species spends the winter in the North Atlantic with different breeding colonies using different wintering areas - birds from Scotland winter in the waters to the south and west of Europe and off western Africa whilst birds from Iceland winter off eastern Canada and birds from Norway use both the east and west sides of the Atlantic (Furness *et al*. 2006; Magnusdottir *et al*. 2012). Great skua using breeding colonies on the west coast of Scotland are considered to migrate north-south along the Atlantic coast of Europe (Wright *et al*. 2012). Birds using colonies on the Scottish Northern Isles are considered to use a migratory route that differs between spring and autumn (Wernham *et al*. 2002; BirdGuides 2011). The rapid return migration in spring sees most birds moving northwards to the west of the British Isles with very few passing through the North Sea in spring. Whereas southbound migration in autumn is more dispersed with much larger numbers travelling through the North Sea (Tasker *et al.* 1987; Forrester *et al*. 2007). While all UK breeding great skuas are thought to migrate through European waters to winter off southern Europe and West Africa, about half of the birds breeding in Iceland and Bear Island (Norway) winter off the coast of eastern Canada (Magnusdottir *et al*. 2012). These birds apparently migrate direct from Iceland and Norway to North America and do not pass through UK waters (Magnusdottir *et al*. 2012). Given the UK breeding population is twice those in Iceland and populations in Norway, Faroes and Russia are comparatively small, it is estimated that at least 80% of birds present in UK waters during migration periods are from UK colonies (Furness *et al*. 2015).

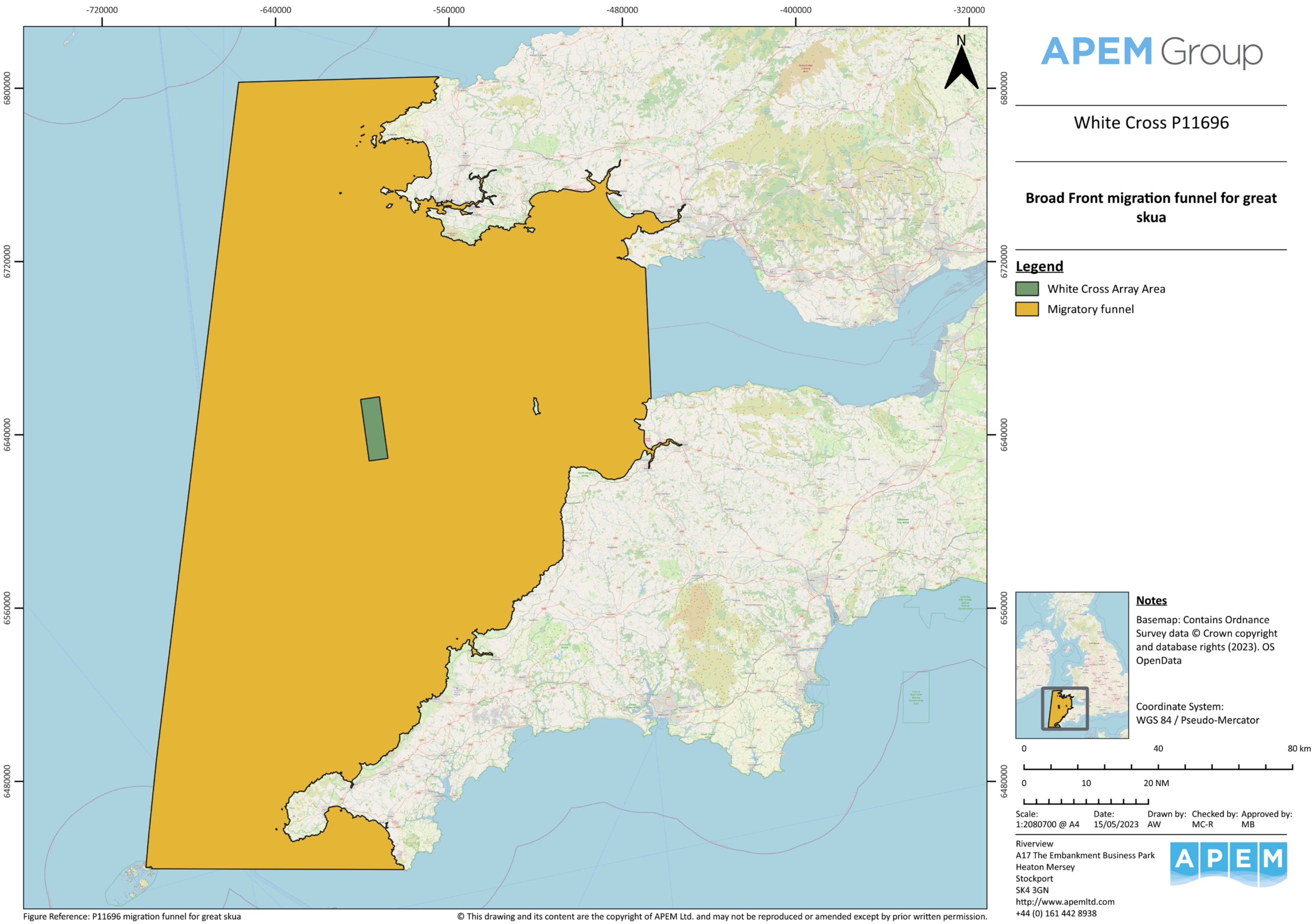
37. Overall, great skua are considered to avoid coasts except during periods of bad weather, but the extent of that avoidance has been described differently by different authors. Wright *et al*. (2012) describe great skuas on migration as tending to avoid the coast, Wernham *et al*. (2002) suggests they remains at least 2-5km from the shore, whilst Stienen *et al*. (2007) states that they are an offshore species that is rarely observed within 20km from the shoreline. Whilst avoiding the coast, great skua are considered to travel rarely into pelagic waters, tending to remain over the shallow seas of the continental shelf (Wernham *et al*. 2002). Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For great skua, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the

majority migrate within 40km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022). Therefore, to consider this the migratory corridor was designed to extend 40km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel skua species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For great skua the 'broad front' corridor presented in **Figure 3** was used.

38. The BDMPS for great skua is defined by Furness (2015) for the autumn migration (August to October) as being an estimated population of 16,336 individuals passing through UK Western waters, and for the spring migration (March to April) as an estimated population of 25,090 individuals passing through UK Western waters. There is greater uncertainty around numbers on passage during spring due to movements occurring over a shorter time period and because movements tend to occur in Western waters which have fewer consistently watched migration sites.

39. During the 24 months of site-specific digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES), no great skuas were recorded within the Windfarm Site. However, great skua was recorded in the surrounding 4km buffer during one survey: October 2021 with a raw count of one and an estimated abundance of eight individuals.

Figure 3 Broad Front migration funnel for great skua



6.1.3 Common gull

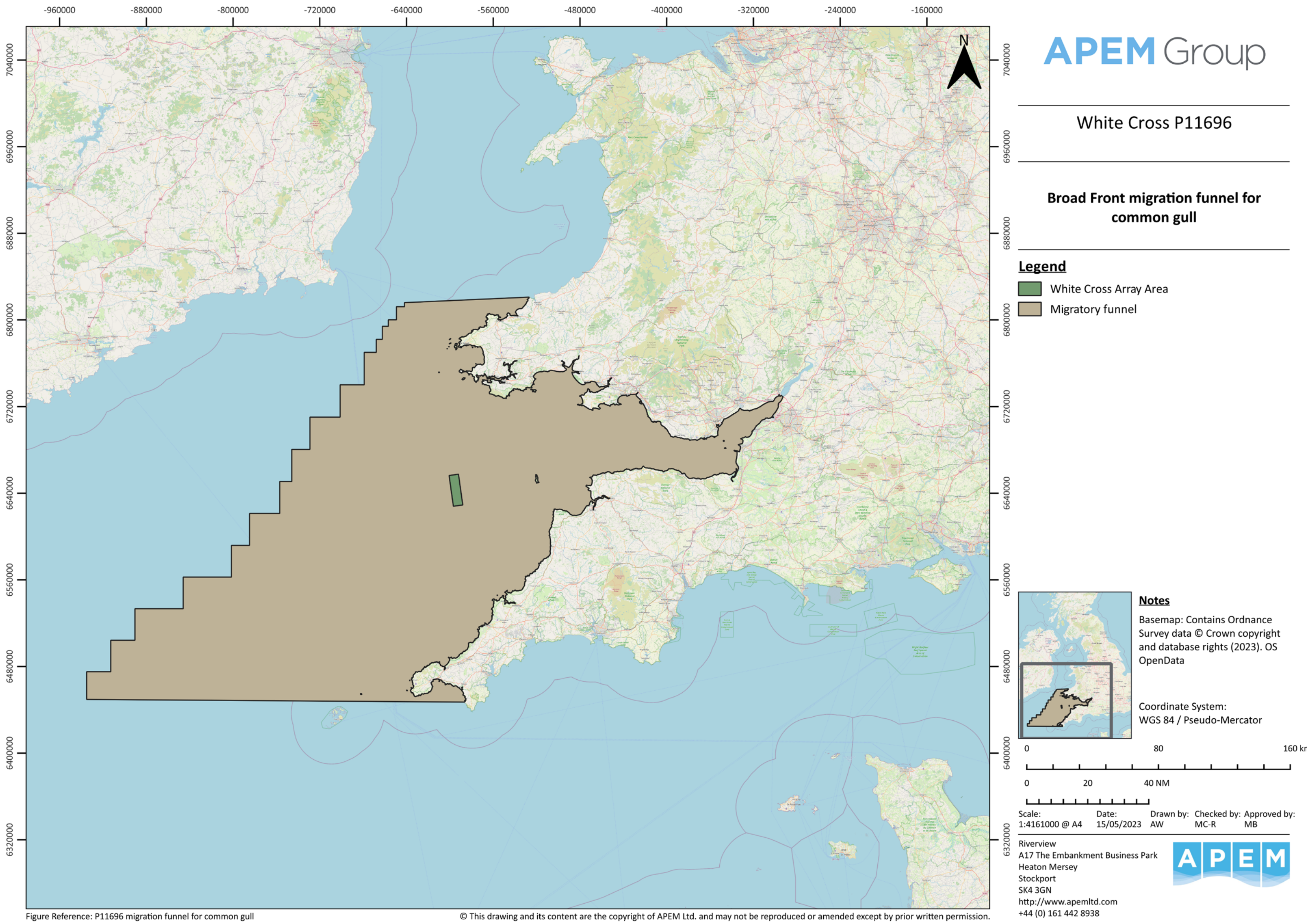
40. The common gull has a circumpolar distribution and can be found breeding in most of Europe, Asia and North America except from the extreme north and south, with an estimated population of the nominate race *canus* at 1,200,000-2,250,000 individuals (Wright *et al*. 2012). The British and Irish breeding distribution is largely confined to Scotland and northwest Ireland and it is only when numbers are boosted by continental migrants in the winter period, that common gull is encountered more widely in the British Isles (Wernham *et al*. 2002).

41. Common gulls breeding in Britain and Ireland are partial migrants, with some being sedentary while others move in a south-westerly direction from breeding sites, but predominantly remaining within the British Isles (Wernham *et al*. 2002). In comparison, common gulls breeding on the continent are more migratory and generally move in a westerly direction post breeding. Norwegian breeding common gulls migrate in a south-westerly direction, crossing the North Sea in large numbers to join resident Scottish birds for the winter. Ringing recoveries show that common gulls wintering in Britain and Ireland originate mainly from Norway, Sweden, Denmark and Finland (Wernham *et al*. 2002).

42. Migration of common gulls into Britain begins in August and September, as seen by birds arriving on the east coast of Britain and continues into winter. Potentially there are two routes into Britain. Across the North Sea into east Scotland and northeast England, and across the southern North Sea and the Channel, taken by birds travelling westward along the northwest European coast (Wernham *et al*. 2002). There is some tendency for more northerly breeding common gulls to winter further north in Britain, but this is not a clear trend, and it is likely that birds which have crossed the North Sea in Britain move further south as the winter progresses (Wernham *et al*. 2002). Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. Common gull was found to migrate more widely across the Bristol Channel than terns and skuas and, therefore the migratory corridor for this species encompasses the entire Bristol Channel out to the UK Exclusive Economic Zone (EEZ) boundary. For common gull the 'broad front' corridor presented in **Figure 4** was used.

43. Common gull return migration to continental breeding areas occurs over a short period, mostly in March and April (Wernham *et al*. 2002). Large flocks have been recorded leaving northeast Scotland in April (Bourne & Patterson 1962).

Figure 4 Broad Front migration funnel for common gull



44. Significant declines in the large breeding populations of Norway, Denmark and Estonia have been noted in Tucker & Heath (1994). The drivers of these reported declines are uncertain but are most likely related to the breeding grounds rather than in the passage and wintering range of these populations (Wernham *et al*. 2002).

45. The understanding of partial migratory movements of British and Irish breeding common gulls is relatively poor, especially with regards to the movements of birds once they reach adulthood (Wernham *et al*. 2002).

46. During the 24 months of site-specific digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES) no common gulls were recorded within the Windfarm Site. However, common gull were recorded in the surrounding 4km buffer during one survey: November 2021 with a raw count of two and an estimated abundance of 16 individuals.

6.1.4 Little tern

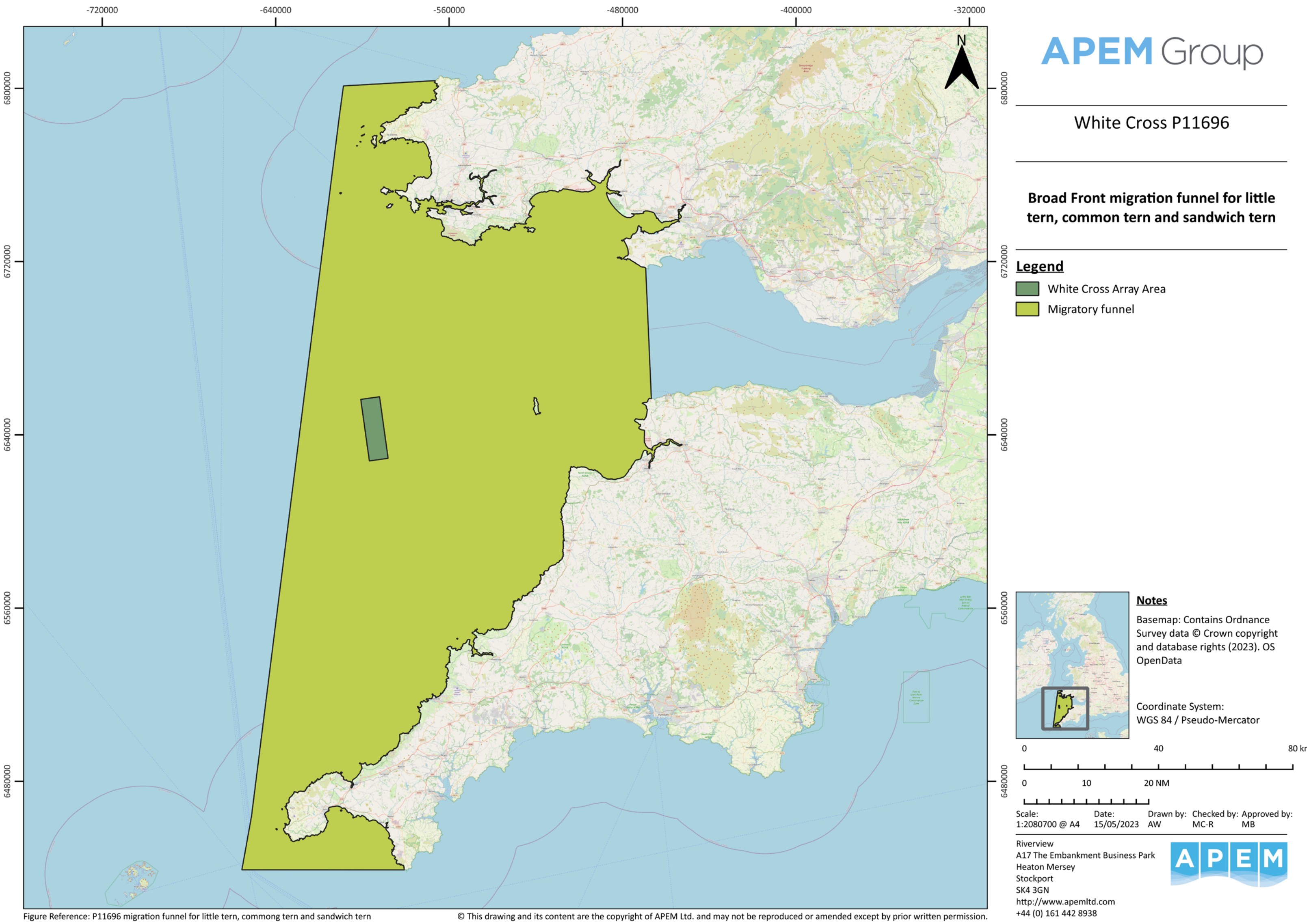
47. Little tern has a wide breeding range that includes the Palearctic, Afrotropic and Australasian regions. Nominate *Sternula albifrons* breeds in Britain and Ireland and eastward across most of Europe (largest numbers in southern countries), central Asia, northern India and North Africa. Further races occur in central Africa, Australia and East Asia (Wernham *et al*. 2002). Across its range, little tern breeds on the coast and at inland waterways. However, in Britain and Ireland the species is strictly coastal. Its total population size is between 70,000-100,000 pairs with around 17,000-22,000 pairs breeding in Europe (Wernham *et al*. 2002; Mitchell *et al*. 2004). Little terns are highly migratory across their northern range with most western European breeding birds migrating to winter in near-shore areas off the west coast of Africa (Furness 2015; Wernham *et al*. 2002).

48. Post-breeding migration can be rather rapid, with ring recoveries from southern Europe as early as August (Wernham *et al*. 2002). Gatherings of little terns in the Netherlands in August suggests birds from a wide geographical area may stage here during autumn migration (Wernham *et al*. 2002). Birds ringed at Scottish colonies have been recovered in Denmark, in comparison to English birds which have mostly been recovered in the Netherlands, suggesting Scottish little terns may cross the North Sea eastward from Scotland rather than moving south (Wernham *et al*. 2002; Furness 2015). Spring migration begins in March in southern Europe with the first little terns arriving in the UK in April. The majority of birds are back at breeding locations by May (Furness 2015).

49. It is not well known if birds breeding elsewhere pass through UK waters on migration. Presumably at least Irish breeding little terns (210 pairs in Seabird 2000; Mitchell *et al*. 2004) must pass through UK waters during migration between Ireland and West Africa (Furness 2015). Moreover, while large numbers are known to breed in Fennoscandia, the Baltic states, Germany and the Netherlands (Mitchell *et al*. 2004) there is no evidence of these populations crossing the North Sea into UK waters. In contrast, ring recovery data suggests these populations migrate through continental Europe (Furness 2015; Wernham *et al*. 2002). Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For little tern, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the majority migrate within 10 km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022).

50. Therefore, to consider this the migratory corridor was designed to extend 10 km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel tern species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For little tern the 'broad front' corridor presented in **Figure 5** was used. During the 24 months of site-specific digital aerial video surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES), no little terns were recorded to species level within the Windfarm Site plus 4km buffer. However, unidentified tern species were recorded in the surrounding 4km buffer during one survey: May 2021 with a raw count of one and an estimated abundance of seven individuals.

Figure 5 Broad Front migration funnel for little tern, common tern and Sandwich tern



6.1.5 Sandwich tern

51. The Sandwich tern has a circumpolar distribution and can be found breeding in most of Europe, Asia and North America except to the extreme north and south, with a total population at least 100,000 pairs, consisting of approximately 40,000 pairs in Europe and 45,000 pairs in North America, an estimated 40,000 pairs in the Caspian Sea (based on counts in 1995) and between 75,000 and 80,000 pairs in the former Union of Soviet Socialist Republics (USSR) (del Hoyo *et al*. 1992-2013).

52. Sandwich terns are a strictly coastal and a mainly warm-water species (del Hoyo *et al*. 1992-2013). After the breeding season, birds move north and south to favourable feeding grounds, dispersing around the coasts of Britain and Ireland and across the North Sea to the Netherlands and Denmark in late-June, July and August before southward migration begins in mid-September to wintering grounds (Wernham *et al*. 2002; del Hoyo *et al*. 1992-2013).

53. Return migration occurs between March and May and is more direct than in autumn, it is believed that birds from the west of the UK and Ireland do not enter the English Channel on southward migration due to lack of recoveries (Wernham *et al*. 2002).

54. In the UK and Ireland, Sandwich terns are primarily concentrated in three main areas: Northeast Scotland, Northumberland, and Norfolk, these main areas alone make up over 60% of the UK and Ireland breeding population (Wernham *et al*. 2002). On the west coast of the UK and Ireland the main colonies of Sandwich terns are located in Northern Ireland (Carlingford, Larne and Strangford Lough), Northern England (Morecombe Bay and Duddon Esturary) and Isle of Anglesey (Cemlyn Bay) (Furness 2015). The UK Western waters BDMPS for Sandwich terns is defined by Furness (2015) as 10,761 individuals for both migration seasons (July to September and March to May). Understanding of Sandwich tern movements is relatively poor, due to limited ring recoveries in the UK and no studies conducted using geolocators.

55. Sandwich tern is listed in Stienen *et al*. (2007) as an inshore species that is most abundant within 20km from the shoreline. Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For Sandwich tern, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the majority migrate within 10 km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022).

56. Therefore, to consider this the migratory corridor was designed to extend 10 km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel tern species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For Sandwich tern the 'broad front' corridor presented in **Figure 5** was used.

57. During the 24 months of site-specific digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES) no Sandwich terns were recorded in the Windfarm Site. However, Sandwich tern was recorded within the surrounding 4km buffer during one survey: September 2020 with a raw count of one and an estimated abundance of eight individuals.

6.1.6 Common tern

58. The common tern has a circumpolar distribution and can be found breeding in most of Europe, Asia and North America except the extreme north and south with a total population at least 250,000 pairs, possibly 500,000 pairs, consisting of 140,000 pairs in Europe, ~35,000 pairs in North America and several 100,000's pairs in the former USSR (del Hoyo *et al*. 1992-2013). Although they are mainly coastal, common terns also nest widely inland. Birds that breed in the British Isles, Netherlands, Belgium, France, Spain, Switzerland, Austria, and western Germany winter principally along the West African coast (BirdGuides 2011) and those from eastern Europe along the east and southern African coast. Birds from eastern Europe take an easterly route through northeast Africa and then along the coast or overland through the Rift Valley to their wintering grounds (del Hoyo *et al*. 1992-2013).

59. Post-fledging dispersal of juveniles occurs between July and October, with adults migrating mainly between August and October. Much of the movement of these coastal birds within Britain may be overland. There is known to be a significant movement from North Sea estuaries over to western waters in autumn (Ward 2000; Furness 2015; Wernham *et al*. 2002). During September, and especially October, there is a strong southward movement of common terns along the coast of

southwest Europe and away from Britain and Ireland, migration follows the coasts (Wernham *et al*. 2002). Many UK breeding birds are back at their breeding areas by April. The lack of records at west coast observatories implies that there is little movement through the Irish Sea to the Scottish colonies, and the frequency of inland sightings suggests that much of the spring passage takes place directly overland to the breeding sites. In fact, the only British observatories to record substantial numbers in spring are Dungeness and Portland Bill. At both sites, spring passage peaks in late April and early May and is mainly eastward, suggesting that these birds are most likely to be on their way to breeding areas elsewhere in northern Europe (Wernham *et al*. 2002).

60. Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For common tern, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the majority migrate within 10km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022). Therefore, to consider this the migratory corridor was designed to extend 10 km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel tern species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For common tern the 'broad front' corridor presented in **Figure 5** was used. The BDMPS for common terns is defined by Furness (2015) as 64,659 individuals for both the spring and autumn migration seasons in Western waters (April to May and late July to early September). Understanding of common tern movements is relatively poor, especially with regards to overseas populations due to limited ring recoveries in the UK and no studies conducted using geolocators.

61. During the 24 months of site-specific digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES), common tern was recorded to

species level within the Windfarm Site on one occasion: August 2020 with a raw count of eight and an estimated abundance of 70 individuals. Additionally, common and / or Arctic terns were recorded within Windfarm Site plus 4km buffer in one survey: September 2020 with a raw count of five and an estimated abundance of 39 individuals.

6.1.7 Roseate tern

62. Roseate terns are among the most marine of terns, with inland records extremely rare. In Northwest Europe, the species is predominantly found in the Irish Sea, although breeding colonies also occur along the East coast of the UK in Northumberland and Lothian (Wernham *et al*. 2002). Breeding occurs on offshore islands or islets in coastal lagoons within foraging range of sandeels and sprats which they feed upon during the breeding season. Juveniles fledge in July and pre-migratory dispersal occurs in August. Migration south to wintering grounds occurs between August to October, a rapid migration to the wintering grounds with no discrete staging areas en-route is suggested by the decline and broadly dispersed ring recoveries along the western Iberian and West African coastlines (Wernham *et al*. 2002). All roseate terns from UK and Ireland share the same migration route and wintering grounds (Wernham *et al*. 2002). Adults begin the return migration back to Britain and Ireland during summer, with birds arriving at the earliest in April and in Europe return in late June and July. Although there are less ring recoveries during spring migration, the available evidence suggests they follow a similar route to that in autumn (Wernham *et al*. 2002).

63. The BDMPS for roseate terns off the East coast and Channel is defined by Furness (2015) as 251 individuals for both the spring and autumn migration seasons (late April to May and August to September). Roseate terns although scarce, are monitored intensively in the UK and Ireland which gives high confidence in the BDMPS estimate, coupled with the unlikely exchange between Irish and North Sea populations, due to little evidence of roseate terns migrating overland in the way that common terns often do (Furness 2015). Based on this notion that Irish breeding roseate terns are unlikely to travel through UK waters on migration, roseate tern was screened out of migratory CRM at this stage.

64. During the 24 months of site-specific digital aerial surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES) no roseate terns were recorded to species level within the Windfarm Site or surrounding 4km buffer. However, unidentified tern species were recorded in the surrounding 4km buffer during one

survey: May 2021 with a raw count of one and an estimated abundance of seven unidentified terns.

6.1.8 Arctic tern

65. Britain is at the southern edge of the breeding range of the Arctic tern, and colonies are concentrated in the north of England and Scotland with its stronghold in Orkney and Shetland (Wright *et al*. 2012; Wernham *et al*. 2002). At the end of the breeding season, the main post-breeding movement of adult birds is southwards. Movements through Britain and Ireland are thought to occur further offshore than other British tern species (Furness 2015; Wernham *et al*. 2002). The migration continues southwards along the coast of western and southern Africa to wintering sites around the Antarctic (Wright *et al*. 2012). The return passage begins in March, with birds heading for European colonies heading northwards through the eastern Atlantic, with a similar route to that undertaken in autumn taken in spring (Wernham *et al*. 2002). In Britain, overland northward movements of Arctic terns are indicated by observations of hundreds or even thousands of birds during some spring months at reservoirs in central England. These observations may be the result of poor flying conditions at sea or at high altitudes over land (Kramer 1995).

66. 59. Given the geography surrounding the White Cross Offshore Site and the potential for seabirds to migrate directly across the outer Bristol Channel a migratory corridor was designed for the broad front species. For Arctic tern, the most recent assessment of migration by Wildfowl and Wetland Trust (WWT) and MacArthur Green (2013) concluded that the majority migrate within 20km from the UK coastline. This assumption has been widely applied and agreed upon with UK SNCBs in migratory assessments for multiple recent OWFs impact assessments (e.g., APEM, 2020 and 2022). Therefore, to consider this the migratory corridor was designed to extend 20km out west from the most prominent headlands in Pembrokeshire and Cornwall. To determine the width of the corridor (east) into the Bristol Channel migratory data from numerous sources (including Trektellen.org and eBird, 2021) were used to identify distributions of seabirds during the migration periods. Using data from the above sources and expert judgment two prominent headlands were selected: Port Eynon on the Gower and Bull Point near Ilfracombe in Devon. These were selected as appropriate locations for the eastern boundary of the migratory corridor for seabirds migrating through the outer Bristol Channel from the evidence reviewed for the desk study. Further east into the Bristol Channel tern species observations from coastal watchpoints decrease notably, suggesting few birds migrate across the inner Bristol Channel. For common tern the 'broad front' corridor presented in **Figure 2** was used. The BDMPS for Arctic terns is defined by Furness

(2015) as 71,398 individuals for both the spring and autumn migration seasons in Western waters (late April to May and July to early September). Arctic terns in most UK SPA colonies are monitored frequently. There has been a considerable decline in numbers from UK SPAs; if the same decline is apparent in non-SPA colonies, then the estimated number quoted could be smaller. Understanding of Arctic tern movements is relatively poor, due to limited ring recoveries in the UK and no studies conducted using geolocators with birds connected to UK waters.

67. During the 24 months of site-specific digital aerial video surveys conducted for the Offshore Project (detailed in **Appendix 13.A: Offshore Ornithology Technical Report** of the White Cross Offshore Windfarm ES), no Arctic terns were recorded to species level within the Windfarm Site or surrounding 4km buffer. However, Arctic and / or common tern were recorded in within Windfarm Site plus 4km buffer in one survey: September 2020 with a raw count of five and an estimated abundance of 39 individuals.

6.2 Summary of 'Broad Front' modelling assumptions

68. The Windfarm Site is located approximately 52km offshore at its nearest point, this is considerably further offshore than any of the migration corridors summarised above. As detailed in the species accounts in **Section 6.1**, given the location of the Windfarm Site in the outer Bristol channel there is the potential for seabirds to pass through the offshore site when following a migration route between these two prominent peninsulas. In order to consider this in the 'broad front' modelling approach a migratory funnel as described in **Section 6.1** for each species was designed to consider the maximum potential migratory corridor of through the outer Bristol Channel.

69. Due to the migratory routes of terns and skua described in **Section 6.1**, the population estimates with potential connectivity with the Offshore Project on migration were identified as the total UK western non-SPA colonies and the Northern England and Scotland SPA populations located to the north of the Offshore Project, with population estimates derived from Appendix A of Furness (2015). Any Irish colonies or southern England SPA colonies were not included within the population estimates presented in **Table 3**, due to no connectivity identified based on their migration routes.

70. Roseate tern, like other tern species, are more likely to migrate within waters close to the coast. The Western Waters BDMPS (Furness, 2015) for roseate tern during migration seasons does not include any breeding birds from Scotland, England or Wales, as this species does not breed anywhere on the western coastline of Great

Britain. It is also considered that Irish breeding terns migrate through Irish coastal waters and then fly towards France rather than flying through southern Welsh or southwest English waters, evidenced from a lack of records during migratory periods in these regions of each country. Considering this, any Irish colonies of roseate terns were not included within the population estimates run through the 'broad front' modelling and, therefore, based on these assumptions roseate tern was not included in the broad front modelling.

71. For common gull, populations with potential migration connectivity with the Offshore Project included all populations along the Scottish west coast obtained from Mitchell *et al*. (2004). Numbers in Mitchell *et al*. (2004) are presented as apparently occupied nests therefore the population size presented has been multiplied by 2.5 to give number of individuals, including juveniles. Half of the Orkney population was also included based on expert judgement, this is due to limited data on the migration routes of the Orkney population so on a precautionary basis, it is assumed half the population migrates through the Irish Sea and the other half through the North Sea. Based on migration routes of common gull no Irish populations were identified to have connectivity with the Offshore Project and were not included in the population estimate presented in **Table 3**.

Table 3 Estimated number of migratory seabirds predicted to pass through the Offshore Project Windfarm Site in spring and autumn

Species	Spring Migration	Autumn Migration
Arctic skua	54	46
Great skua	599	386
Common gull	1,095	1,095
Little tern	62	62
Sandwich tern	248	248
Common tern	384	384
Arctic tern	2,260	2,260

7. Collision risk modelling for migratory birds

7.1 Collision risk modelling methodology

72. There is potential risk to migratory birds from Offshore Wind Farms (OWFs) through collision with WTGs and associated infrastructure. The risk to migratory birds can occur when passing through the area on seasonal migrations. The potential collision risk can be estimated using CRM.

73. CRM was carried out using the Band (2012) model. The Band (2012) model is still the only model fully tested and publicly available that can be used to estimate collision risk for migratory species, where the density of birds cannot be reliably estimated from site-specific surveys.

7.2 CRM input parameters

74. The CRM input parameters for each species run through the Band (2012) model are presented in **Table 4**. Species biometrics for all species were obtained from Robinson (2005). However, Natural England's best practice guidance (Parker *et al*. 2022) and Natural England's interim guidance (Natural England, 2023) were also used where appropriate to ensure that most recent guidance was followed (detailed in **Table 4**).

75. Flight speeds for species were derived from Alterstam *et al*. (2007), where possible (except for Sandwich tern; which relied upon values presented within Natural England's interim guidance (2023)). Flight speeds given in Alterstam *et al*. (2007) are generally regarded as suitable for this purpose. For species not included in Alterstam *et al*. (2007), alternative published species-specific flight speeds were used if available, detailed in **Table 4**. If no species-specific flight speeds were available, flight speeds for the most similar co-generic species included in Alterstam *et al*. (2007) were substituted, as detailed in **Table 4**. Nocturnal activity scores were obtained from Garthe and Hüppop (2004) as outlined in Natural England's interim guidance (Natural England, 2023).

76. The "width of migration corridor" value used within the Band model for calculating migrant flux density was calculated as the width of the Windfarm Site perpendicular to the direction of migration, which was measured as 5.5km.

Table 4 Species biometrics used in the migratory collision risk modelling of the proposed Offshore Project for all species selected

Species	Body Length (m)	Wingspan (m)	Flight Speed (ms^{-1})	Nocturnal Activity	Flight Type
Arctic skua	0.44	1.18	13.8	1	Flapping
Great skua	0.56	1.33	14.9	1	Flapping
Common gull	0.41	1.20	13.4	1	Flapping
Little tern	0.23	0.52	10.0	1	Flapping
Sandwich tern	0.38	1.00	10.3[1]	1	Flapping
Common tern	0.33	0.88	10.0	1	Flapping
Arctic tern	0.34	0.80	10.9	1	Flapping

7.2.1 Avoidance rates

77. A bird's ability to avoid colliding with a WTGs rotating blades is a critical factor in predicting mortality rates. This ability will vary between species and is a measure of how sensitive each species is to those turbines and the wind farm in its entirety.

78. CRM following the standard Band model (Band 2012) was carried out using the following range of avoidance rates, 95%, 98%, 99%, and 99.5% for all species. For Sandwich tern and species where no specific avoidance rate has been calculated (i.e. Other marine species), Natural England's interim guidance (Natural England, 2023) recommends using an avoidance rate of 99% for evaluation of collision risk. For common gull an avoidance rate of 99.5% was used as suggested within Natural England's interim guidance (Natural England, 2023).

7.2.2 Proportion at Potential Collision Height

79. Band Option 1 (BO1) and / or Band Option 2 (BO2) have been used to carry out all of the CRM. BO1 uses a fixed proportion at Potential Collision Height (PCH). For all species considered in this report, the proportions of birds at PCH from literature sources have been used as the sample sizes from site-specific survey data were too low these species (**Table 5**). For BO1, for common tern, Arctic tern and Sandwich tern, proportion at PCH values were taken from Cook *et al.* (2012), which assessed

[1] Used value advised within Natural England's best practice guidance (Parker et al., 2022).

the flight height data from 32 OWFs. For the remaining species, the generic species group values put forward by Wright *et al*. (2012) were selected in the absence of any species-specific proportion at PCH data. BO2 uses flight height distribution data and turbine parameters (air gap and rotor radius) to calculate the proportion of birds at PCH. BO2 is therefore reliant on availability of flight height distribution data. For common tern, Arctic tern, Sandwich tern and Cormorant BO2 CRM was run using the maximum likelihood values in the Johnson *et al*. (2014) flight height spreadsheets, which supplemented the SOSS-02 project (Cook *et al*. 2012).

Table 5 Proportion at Potential Collision Height (PCH) for all migratory species used for BO2 CRM

Species	Proportion at PCH (%)
Wigeon	15.0
Tufted duck	15.0
Cormorant	19.0
Ringed plover	25.0
Lapwing	25.0
Knot	25.0
Sanderling	25.0
Redshank	25.0
Turnstone	25.0
Arctic skua	3.8
Great skua	4.3
Common gull	22.9
Little tern	7.0
Sandwich tern	3.6
Common tern	12.7
Arctic tern	2.8

7.2.3 WTG parameters

80. As presented within **Chapter 13: Offshore Ornithology** of the White Cross Offshore Windfarm ES and accompanying **Appendix 13.C: Revised Collision Risk Modelling** of the White Cross Offshore Windfarm ES, the Applicant modelled a range of WTG scenarios for Collision Risk Modelling (CRM) considered within the Rochdale Envelope, with potential impacts assessed against the Worst-Case Scenario (WCS) design in relation to potential impacts on ornithological features.

81. Therefore, within this report CRM was undertaken to assess the potential impacts of the WCS (identified within **Appendix 13.C: Revised Collision Risk Modelling**).

82. Input parameters relating to these WTG scenarios modelled are presented within **Table 6**. The estimated percentage of time that the WTGs are predicted to be operational per month (average across all turbines) is presented in **Table 7**, for clarity operational proportions remain the same as previously modelled within **Appendix 13.C: Revised Collision Risk Modelling** of the White Cross Offshore Windfarm ES.

Table 6 WTG and array parameters used to inform Collision Risk Models

Input Parameter	Application WCS 18 MW
Number of WTGs	7
Number of blades	3
Rotor radius (m)	131
Rotation speed (rpm)	7
Pitch (degrees)	3
Maximum blade width (m)	12
Minimum air gap (m)	22
Tidal offset (m)	0
Maximum footprint width (km)	5.5
Latitude (degrees)	51.1
Large array correction	No

Table 7 Theoretical WTG operational time per month

Month	Operational Time (%)	Mean downtime (%)	SD downtime
January	97.3	3	0
February	96.7	3	0
March	96.1	3	0
April	93.7	3	0
May	93.6	3	0
June	91.5	3	0
July	92.2	3	0

Month	Operational Time (%)	Mean downtime (%)	SD downtime
August	91.6	3	0
September	93.7	3	0
October	96.2	3	0
November	96.5	3	0
December	97.4	3	0

7.3 CRM results

83. Species for which less than 1% of the UK population are expected to pass through the Windfarm Site were screened out, and the Band (2012) CRM was run for remaining species. As presented within **Table 2**, for all non-seabirds modelled using Migropath less than 1% of the UK population was predicted to pass through the Windfarm Site and therefore are not considered for CRM. The annual total number of collisions for each species based on the mean population size and mean results from 'broad front' modelling, are presented in **Table 8**. Results for the most appropriate avoidance rates are shown in bold and results are presented using both Band Option 1 (BO1) and Band Option 2 (BO2), where possible.

Table 8 Summary of annual collision risk for species screened in

Species	Avoidance Rate	Annual collision Rate BO1 WCS (18MW)	Annual collision Rate BO2 WCS (18MW)
Arctic skua	95.0%	<0.1	<0.1
	98.0%	<0.1	<0.1
	99.0%	**<0.1**	**<0.1**
	99.5%	<0.1	<0.1
Great skua	95.0%	<0.1	<0.1
	98.0%	<0.1	<0.1
	99.0%	**<0.1**	**<0.1**
	99.5%	<0.1	<0.1
Common gull	95.0%	0.4	0.3
	98.0%	0.2	0.1
	99.0%	0.1	0.1
	99.5%	**<0.1**	**<0.1**
Little tern	95.0%	<0.1	NA
	98.0%	<0.1	NA
	99.0%	**<0.1**	**NA**
	99.5%	<0.1	NA
Sandwich tern	95.0%	<0.1	<0.1
	98.0%	<0.1	<0.1
	99.0%	**<0.1**	**<0.1**
	99.5%	<0.1	<0.1
Common tern	95.0%	0.1	<0.1
	98.0%	<0.1	<0.1
	99.0%	**<0.1**	**<0.1**
	99.5%	<0.1	<0.1
Arctic tern	95.0%	0.1	0.1
	98.0%	<0.1	<0.1
	99.0%	**<0.1**	**<0.1**
	99.5%	<0.1	<0.1

8. Conclusion

84. Within the White Cross Offshore Windfarm ES (**Chapter 13: Offshore Ornithology**) and RIAA (**Appendix 6.A**) of the White Cross Offshore Windfarm ES a qualitative assessment was undertaken to consider the potential risk of collision to migratory species. These assessments concluded **no significant adverse effect** on migratory species. The annual total of individuals subject to mortality due to collision (presented in **Table 8**) are estimated to be significantly less than one individual for all species at an EIA level. This level of predicted impact further validates the conclusions made within the ES and RIAA that a significant adverse effect can confidently be excluded for species considered.

9. References

Alerstam, T. (1990) Bird Migration. Cambridge: Cambridge University Press.

Alerstam, T., Rosén, M., Bäckman, J., Ericson, P.G.P., Hellgren, O. (2007) Flight speeds among bird species: allometric and phylogenetic effects. PloS Biology 5(8): 1656-1662. Balmer, D. E. *et al*. (2013) Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland. BTO books, Thetford.

Arcos, J. M. (1997) Kleptoparastic behaviour of Arctic skuas Stercorarius parasiticus migrating through the northwestern Mediterranean.

Band, W. (2012) Using a collision risk model to assess bird collision risks for offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. http://www.bto.org/science/wetland-and-marine/soss/projects. Original published Sept 2011, extended to deal with flight height distribution data March 2012.

BirdGuides (2011). BWPi: Birds of the Western Palearctic interactive (version 2.0). BirdGuides Ltd., Norfolk.

Bourne, W.R.P. and Patterson, I.J., 1962. The spring departure of Common Gulls Larus canus from Scotland. Scott. Birds, 2, pp.3-17.

Cook, A.S.C.P., Wright, L.J., and Burton, N.H.K. (2012) A review of flight heights and avoidance rates of birds in relation to offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS). http://www.bto.org/science/wetland-and-marine/soss/projects.

Cook, A. S. C. P. *et al*. (2014) The Avoidance Rates of Collision Between Birds and Offshore Turbines. 656. Thetford.

Dean, B.J., Webb, A., McSorley, C.A. and Reid, J.B. (2003) Aerial surveys of UK inshore areas for wintering seaduck, divers and grebes: 2000/01 and 2001/02. 333. Peterborough.

Del Hoyo, J., Elliott, A. and Sargatal, J. (1992-2013). Handbook of the Birds of the World Volumes 1-16. Lynx Edicions, Barcelona, Spain.

eBird. 2021. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org. (Accessed: 10/05/2023).

Forrester, R. W., Andrews, I. J., McInerny, C .J., Murray, R .D., McGowan, R .Y., Zonfrillo, B., Betts, M .W., Jardine, D .C. and & Grundy, D. S (eds) (2007). The Birds of Scotland. The Scottish Ornithologists' Club, Aberlady.

Frost, T.M., Calbrade, N.A., Birtles, G.A., Mellan, H.J., Hall, C.,Robinson, A.E., Wotton, S.R., Balmer, D.E. & Austin, G.E. (2020) Waterbirds in the UK 2018/19: The Wetland Bird Survey. Thetford: British Trust for Ornithology. Available at: www.bto.org/webs-publications (Accessed: May 10, 2023).

Furness, R.W., Monaghan, P., Furness, R.W. and Monaghan, P., 1987. Seabird life styles. Seabird Ecology, pp.3-22.

Furness, R. W. (2015) Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). NECR164. Natural England. Available at: http://publications.naturalengland.org.uk/publication/6427568802627584 (Accessed: May 10, 2023).

Furness, R.W., Crane, J.E., Bearhop, S., Garthe, S., Käkelä, A., Käkelä, R., Kelly, A., Kubetzki, U., Votier, S.C. and Waldron, S., 2006. Techniques to link individual migration patterns of seabirds with diet specialization, condition and breeding performance. Ardea, 94(3), pp.631-638.

Howell, J.E., McKellar, A.E., Espie, R.H. and Morrissey, C.A. (2020) 'Predictable shorebird departure patterns from a staging site can inform collision risks and mitigation of wind energy developments', Ibis. Blackwell Publishing Ltd, 162(2), pp. 535–547. doi: 10.1111/ibi.12771.

JNCC (no date) UK Protected Area Datasets for Download | JNCC - Adviser to Government on Nature Conservation. Available at: https://jncc.gov.uk/our-work/uk-protected-area-datasets-for-download/ (Accessed: May 10, 2023).

Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, E.H.K. (2014) Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology 51: 31-41.

King, S., Maclean, I.M.D., Norman, T. and Prior, A., (2009). Developing guidance on ornithological Cumulative Impact Assessment for offshore wind farm developers.

Kramer, D., 1995. Inland spring passage of Arctic Terns in southern Britain. British Birds, 88(5), pp.211-217.

Laursen, K., Blew, J., Eskildsen, K., Günther, K., Hälterlein, B., Kleefstra, R., Lüerßen, G., Potel, P., Schrader, S. (2010) *Migratory Waterbirds in the Wadden Sea 1987 - 2008*. No. 30. Wilhelmshaven, Germany. Available at: https://www.researchgate.net/publication/257762883_Migratory_Waterbirds_in_the_Wadden_Sea_1987-2008 (Accessed: May 10, 2023).

MacArthur Green, APEM and Royal Haskoning DHV (2015) Appendix 13.1 Offshore Ornithology Evidence Plan. Document Reference 6.3.13 (1).

Magnusdottir, E., Leat, E.H., Bourgeon, S., Strøm, H., Petersen, A., Phillips, R.A., Hanssen, S.A., Bustnes, J.O., Hersteinsson, P. and Furness, R.W., 2012. Wintering areas of great skuas Stercorarius skua breeding in Scotland, Iceland and Norway. Bird Study, 59(1), pp.1-9.

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. (2004). Seabird populations of Britain and Ireland. T. & AD Poyser, London.

Natural England (2023). Natural England SoS Consultation Response. Annex 1: Interim guidance on collision risk modelling avoidance rates.

Newnham, J. A. (1984) "Some aspects of the sea-bird movements observed from the Sussex coast during the spring 1983," Sussex Bird Report, 36, pp. 60–63.

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022). Offshore Wind Marine Environmental

Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp.

R Core Team (2020) "R: A language and environment for statistical computing." Vienna, Austria: R Foundation for Statistical Computing. Available at: https://www.r-project.org/.

Robinson, R. A. (2005) BirdFacts: profiles of birds occurring in Britain & Ireland. Thetford. Available at: https://www.bto.org/understanding-birds/birdfacts (Accessed: May 10, 2023).

Stienen, E.W., Van Waeyenberge, J., Kuijken, E.C.K.H.A.R.T. and Seys, J. (2007) "Trapped within the corridor of the southern North Sea: the potential impact of offshore wind farms on seabirds," in de Lucas, M., Janss, G. F. E., and Ferrer, M. (eds) Birds and wind farms: Risk assessment and mitigation. Madrid: Quercus/Libreria Linneo, pp. 71–80.

Stroud, D. A. (2001) "Volume 1: Rationale for the selection of sites," in The UK SPA network: its scope and content. Peterborough: JNCC.

Tasker, M. L. *et al.* (1987) Seabirds in the North Sea. Peterborough: Nature Conservancy Council.

Taylor, I. R. (1979) "The kleptoparasitic behaviour of the Arctic Skua Stercorarius parasiticus with three species of tern," Ibis. John Wiley & Sons, Ltd, 121(3), pp. 274–282. doi: 10.1111/j.1474-919X.1979.tb06844.x.

Tucker, G.M. and Heath, M.F., 1994. Birds in Europe. Their conservation status. BirdLife International, Cambridge.

Ward, R. M. (2000) "Migration patterns and moult of Common Terns Sterna hirundo and Sandwich Terns Sterna sandvicensis using Teesmouth in late summer," Ringing & Migration, 20(1), pp. 19–28. doi: 10.1080/03078698.2000.9674223.

Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002) The migration atlas: movements of the birds of Britain and Ireland. London: T. & A.D. Poyser.

Willis, J. and Teague, N. N. (2014) "Modelling Fish In Hydrodynamic Models: An Example Using The Severn Barrage SEA," WIT Transactions on State-of-the-art in Science and Engineering. WIT Press, 71, pp. 179–190. doi: 10.2495/978-1-84564-849-7/15.

Woodward, I., Aebischer, N., Burnell, D., Eaton, M., Frost, T., Hall, C., Stroud, S. & Noble, D. (2020) "Population estimates of birds in Great Britain and the United Kingdom - British Birds," British Birds, 113, pp. 69–104. Available at: https://britishbirds.co.uk/article/population-estimates-of-birds-in-great-britain-and-the-united-kingdom-2.

Wright, L.J., Ross-Smith, V.H., Austin, G.E., Massimino, D., Dadam, D., Cook, A.S.C.P., Calbrade, N.A. and Burton, N.H.K. (2012) Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species). Strategic Ornithological Support Services Project SOSS-05. 592. ThetfordWWT & MacArthur Green, (2014). Strategic assessment of collision risk of Scottish offshore wind farms to migrating birds. Scottish Marine and Freshwater Science Report. Marine Scotland Science.

Appendix 1: Screening Matrix

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Bewick's Swan	No	No	No	n/a	n/a	n/a	high	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Whooper Swan	No	No	No	None	low/mod	mod	high	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Bean Goose	No	No	No	None	n/a	n/a	mod	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Pink-footed Goose	No	No	No	None	low	low/mod	mod	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
European White-fronted Goose	No	No	No	None	low	low	mod	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Greenland White-fronted Goose	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Icelandic Greylag Goose	No	No	No	None	low	low	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Greenland Barnacle Goose	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Svalbard Barnacle Goose	No	No	No	None	low	low	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Dark-bellied Brent Goose	No	No	No	None	low	low/mod	mod	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Canadian Light-bellied Brent Goose	No	**Yes**	No	None	n/a	n/a	n/a	n/a			No	No	No	Mostly (approx. 21,750 individuals) winter in Ireland; a few hundred cross from staging grounds in Ireland to UK or continental Europe. Populations are unlikely to interact with the Project when migrating
Svalbard Light-bellied Brent Goose	No	No	No	None	n/a	n/a	mod	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Shelduck	**Yes**	No	No	None	low	low	n/a	n/a			**Yes**	No	**Yes**	Majority of migratory movements are across North Sea; however, approx. 14,610 shelduck from Ireland and some birds may cross the Celtic Sea. The total British wintering population is ~61,000. There may also be coastal movements around the UK. Shelduck is a qualifying feature of Burry Inlet SPA/Ramsar assessed for the Project.
Wigeon	**Yes**	No	No	None	low	low	n/a	n/a			**Yes**	No	**Yes**	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland and continental Europe. The highest concentrations of migrating birds are expected to be in the North Sea. Wigeon is a qualifying feature of Burry Inlet SPA/Ramsar assessed for the Project.
Gadwall	**Yes**	No	No	None	low	low	n/a	n/a			No	No	**Yes**	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland and continental Europe. The highest concentrations of migrating birds are expected to be around the south east UK.
Teal	**Yes**	No	No	Low	low	low	n/a	n/a			**Yes**	No	**Yes**	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland and continental Europe. Approximately 15% are estimated to fly at collision risk height (Wright *et al.* 2012).

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	Partial	White Cross Aerial Surveys (2020-2022)	Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.	Spring	Autumn	Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.	Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.	Percentage of Birds flying at Potential Collision Height (PCH)	Confidence Level attached to PCH	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Mallard	**Yes**	No	No	None	low	low	n/a	n/a			No	No	**Yes**	Most birds are fairly sedentary; however there is evidence of movement within and between UK, Ireland and continental Europe. Unlikely that mallard will migrate through the Project Windfarm Site in significant numbers. On a precautionary basis, this species has been screened in.
Pintail	**Yes**	No	No	None	low	low	n/a	n/a			**Yes**	No	No	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland, Iceland, Scandinavia and continental Europe. Pintail are highly localised winter visitors and significant concentrations occur in a small number of sites. Only small numbers of pintail winter in the southwest of Britain, and it is therefore unlikely that significant numbers would migrate through the Project.
Shoveler	**Yes**	No	No	None	low	low	n/a	n/a			**Yes**	No	**Yes**	Most migratory movement (approx. 18,000 individuals) is expected to be across the North Sea and English Channel; however, around 2,500 birds overwinter in Ireland. Shoveler is a qualifying feature of Burry Inlet SPA/Ramsar and has been screened in as a precaution.
Pochard	**Yes**	No	No	None	low	low	n/a	n/a			No	No	No	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland and continental Europe. Approximately 37,780 are assumed to cross the Irish Sea during each migration season. The sites are known to be mostly concentrated in sites in Northern Ireland, and therefore unlikely to fly through the Project.
Tufted Duck	**Yes**	No	No	None	low	low	n/a	n/a			No	No	**Yes**	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland, Iceland, Scandinavia and continental Europe. On a precautionary basis, this species has been screened in.
Scaup	**Yes**	No	No	Low	low	low	low	mod			No	No	No	Main migration is between Iceland and UK/Ireland. The northerly distribution of Scaup in Britain and Ireland, and the fact that most migrate to Iceland, suggests that migration routes over UK waters are likely to be concentrated in northerly areas around the coasts and large lakes of Scotland and Northern Ireland. Therefore unlikely to migrate through the Project.
Eider	No	**Yes**	No	None	low	low	low	mod	11.54	v low	No	No	No	Most breeding birds are fairly sedentary; however there is some evidence of movement around and between Britain and Ireland including across the Celtic Sea. Wintering birds crossing from the continent are concentrated on the west coast of Scotland. Therefore, unlikely to migrate through the Project.
Long-tailed Duck	No	**Yes**	No	n/a	low	low	low	low			No	No	No	Most migration is between Scandinavia and Scotland; however, a small number travel further around UK and Ireland. Unlikely to migrate through the Project in significant numbers.
Common Scoter	**Yes**	No	No	n/a	low	low	low	low	0.04	v high	No	No	No	It is considered unlikely that common scoter would migrate through the array in significant numbers based on the breeding distribution and main wintering locations. Additionally, a large proportion of migration is likely to be over land rather than across the Celtic Sea and therefore this species has been screened out.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Velvet Scoter	No	No	No	n/a	low	low	low	low			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project
Goldeneye	**Yes**	No	No	None	low	low	low	low			No	No	No	Migration routes are poorly understood; approximately 10,000 birds overwinter in Ireland and are assumed to cross the Celtic Sea, but few birds winter in southwest Britain. Therefore, the species is unlikely to migrate through the Project in significant numbers.
Smew	No	No	No	n/a	low	low	n/a	n/a			No	No	No	No flight path information. Scarce UK winter migrant, therefore unlikely to migrate through the Project in significant numbers.
Red-breasted Merganser	**Yes**	No	No	n/a	low	low	low	n/a			No	No	No	Migratory routes are poorly understood; however, birds from breeding grounds in Iceland migrating to wintering sites in Britain and Ireland likely to use the Celtic Sea. Few birds winter in southwest Britain, therefore the species is unlikely to migrate through the Project in significant numbers.
Goosander	No	No	No	None	low	low	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Red-throated Diver	**Yes**	No	No	None	n/a	n/a	low	mod			No	No	No	Although this species winters around the coast of Britain and Ireland, it is considered unlikely that significant numbers of red-throated diver would migrate through the Project, based on the breeding distribution and key wintering areas.
Black-throated Diver	No	No	No	n/a	n/a	n/a	n/a	mod/high	0.61	mod	No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Fulmar	**Yes**	No	**Yes**	Low	low	low	low	n/a			No	No	No	Wide ranging on migration. Some birds travel long distances out into the Atlantic while others remain around the coasts of Britain and Ireland. It is assumed that fulmar densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Manx Shearwater	**Yes**	No	**Yes**	Mod	n/a	n/a	low	low	0.00	mod	No	No	No	Main migratory movement is south-west across the Atlantic as far as the Brazilian coast. Tracking studies to date (e.g. Guilford *et al.*, 2009) do not have the spatial resolution to consider in detail patterns of movement within the Celtic Sea immediately before and after larger scale movements. It is assumed that Manx shearwater densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Balearic Shearwater	n/a	n/a	No	n/a	n/a	n/a					No	No	No	Balearic shearwater breed in the western Mediterranean, however are found in the English channel and Off the South West of Cornwall between June and October post breeding (Parsons *et al*, 2019). Movements between southeast Wales and Ireland have been recorded, though in low numbers only. Species considered of low risk of collision based on flight behaviour. Limited evidence suggesting significant numbers of birds flying through the Project.
Storm Petrel	**Yes**	No	**Yes**	Mod	n/a	n/a	low	low			No	No	No	Details of migratory routes are uncertain; however it is likely that birds do use the Celtic Sea when migrating between breeding grounds in Britain, Ireland and Iceland and pelagic feeding grounds outside. Due to species flight behaviour European storm petrel is considered of low risk of collision risk.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Leach's Petrel	**Yes**	No	**Yes**	None	n/a	n/a	low	low			No	No	No	Details of migratory routes are uncertain; however it is likely that birds do use the Celtic Sea when migrating between breeding grounds in Britain, Ireland and Iceland and pelagic feeding grounds outside. Due to species flight behaviour leach's storm petrel is considered of low risk of collision risk.
Gannet	**Yes**	No	**Yes**	Mod	mod/high	mod/high	mod	high			No	No	No	Details of migratory routes are uncertain; however it is likely that birds do use the Celtic Sea when migrating between breeding grounds in Britain, Ireland and Iceland and wintering grounds to the south. The potential effect from collision risk to gannet is considered in detail in the main assessment. It is assumed that gannet densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Cormorant	**Yes**	No	No	High	n/a	n/a	mod	low/mod	0.03	v low	No	No	**Yes**	Most birds are relatively sedentary; however, there is some movement and a small proportion of birds breeding in Britain and Ireland will use the Celtic Sea on migratory routes towards wintering sites along the coast of France, Portugal and northern Spain. Screened in on a precautionary basis.
Shag	**Yes**	No	No	None	n/a	n/a	low	mod	1.45	mod	No	No	No	The majority of birds remain within 100 km of their breeding sites, but there is still significant small-scale movement around the coasts of Britain and Ireland. A small proportion of birds undertake larger scale movements including between Britain, Ireland and continental Europe. Due to species flight behaviour shag is considered of low risk of collision risk.
Bittern	**Yes**	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	UK-breeding birds are relatively sedentary; however, there is movement of birds from continental Europe into the UK to overwinter, and the details of these movements are poorly understood. Unlikely to be significant numbers of birds passing through the Project array.
Little Egret	**Yes**	No	No	n/a	n/a	n/a	n/a	n/a			No	**Yes**	**Yes**	Little egret winters in southern Britain and Ireland, and it is likely that many of the birds migrate from France (SOSS-5, 2010). The wintering population has increased rapidly and there are believed to be 12,000 wintering birds. Little egret is a qualifying feature of Tamar Estuaries Complex SPA, although this is to the south of the Project, and SPA birds are unlikely to migrate through the Project in significant numbers. Screened in on a precautionary basis.
Great Crested Grebe	**Yes**	No	No	None	n/a	n/a	n/a	low			No	No	No	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland and continental Europe. Bird are likely to largely migrate over land, and there are unlikely to be significant numbers flying through the Project.
Slavonian Grebe	**Yes**	No	No	n/a	n/a	n/a	low	mod			No	No	No	Details of migratory movements are poorly understood; however, birds moving from Holarctic breeding grounds to overwinter in Britain, Ireland and Europe may use any of the waters around the UK. There are unlikely to be significant numbers flying through the Project.
Honey-buzzard	No	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
White-tailed Eagle	No	No	No	n/a	n/a	n/a	n/a	high			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Marsh Harrier	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Hen Harrier	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	**Yes**	Of the UK-breeding population, approximately half of first-year birds and 25% of older birds are believed to migrate outside of the UK. A small proportion of these may cross to Ireland, but the majority head south into France and the Iberian Peninsula, crossing the English Channel between Devon and Brittany. Over winter, the UK population is supplemented by birds from continental Europe, but those are not expected to cross the Celtic Sea. On a precautionary basis, this species has been screened in.
Montagu's Harrier	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Osprey	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Merlin	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	No	The majority of the UK population is relatively sedentary; however, there is evidence that in winter a small number of additional birds arrive from Iceland. The details of migratory routes followed by these birds is poorly understood, but some are likely to cross the Celtic Sea. Though unlikely that significant numbers of birds would pass through the Project.
Spotted Crake	No	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Corncrake	**Yes**	No	No	n/a	low	low	high	n/a			No	No	No	The UK-breeding population is largely restricted to islands on the west coast of Scotland. Migration takes place between those breeding grounds and wintering grounds in sub-Saharan Africa. The migratory routes are poorly understood, and could include the Celtic Sea. However, they are known to migrate at very high altitudes from breeding to wintering locations, meaning they are at very low risk of collision.
Coot	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Oystercatcher	**Yes**	No	No	Mod	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Details of migratory movements are poorly understood; however, there is widespread movement within and between UK, Ireland, Iceland, Scandinavia and continental Europe. Oystercatcher is a qualifying feature of a Burry Inlet SPA/Ramsar.
Avocet	No	No	No	n/a	n/a	n/a	n/a	n/a			No	**Yes**	No	Although a feature of Tamar Estuaries Complex SPA, this is to the south of the Project array, and SPA birds are unlikely to migrate through the array. Not selected for modelling as known migratory flight path does not overlap with the project.
Stone-curlew	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Ringed Plover	**Yes**	No	No	Mod	n/a	n/a	n/a	n/a			No	No	**Yes**	Most ringed plover that breed in the UK remain in the UK; however, a small number cross the Celtic Sea to overwinter in Ireland, and others are likely to use the Celtic Sea while making short distance movements around the UK, or slightly longer movements to France. In addition, a large number of ringed plover use the Celtic Sea on passage between breeding sites in arctic Canada, Greenland, Iceland and Scandinavia and wintering sites in Spain and West Africa. As a precaution this species has been screened in.
Dotterel	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	No	The small UK breeding population migrates southwards to Morocco during the winter, and some birds are expected to pass through the Celtic Sea. However, details of the migratory routes taken are unknown. Unlikely to be significant numbers of birds passing through the Project.
Golden Plover	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	**Yes**	Details of migratory movements are poorly understood, and there is evidence of birds travelling long distances to avoid harsh weather rather than following fixed migratory routes. Nonetheless, it is likely that the Celtic Sea is used on passage by both UK-breeding birds and birds that visit the UK during the non-breeding season, especially those from Iceland and the Faroes. As a precaution this species has been screened in.
Grey Plover	**Yes**	No	No	None	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	All birds in the UK and Ireland over winter are believed to be from the Russian breeding population. Details of migratory routes are uncertain; however it is evident that birds do not take a single direct route from breeding to wintering grounds and it is likely that birds use the Celtic Sea on passage around the UK and crossing from Britain to Ireland. Grey plover is a qualifying feature of the Burry Inlet SPA/Ramsar.
Lapwing	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	**Yes**	The majority of UK-breeding lapwings remain close to their breeding grounds; however some do migrate including across the Celtic Sea to Ireland, and southwards to continental Europe. In addition, in the non-breeding season birds migrate to the UK and Ireland from Europe and Scandinavia, with some crossing the Celtic Sea.
Knot	**Yes**	No	No	None	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Large numbers of knot overwinter in or pass through the UK on migration from breeding grounds in the high Arctic and via staging grounds in Iceland and Norway. The exact details of migratory routes are poorly understood, but it is evident that there is extensive movement of birds around all UK waters including the Celtic Sea, and large aggregations in estuaries. Knot is a qualifying feature of the Burry Inlet SPA.
Sanderling	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	**Yes**	Large numbers of sanderling pass through UK waters on migration from high Arctic breeding grounds to wintering grounds further south in Europe and Africa. The exact details of migratory routes are poorly understood, but it is evident that there is extensive movement of birds around all UK waters including the Celtic Sea.
Purple Sandpiper	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	Partial	White Cross Aerial Surveys (2020-2022)	Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.	Spring	Autumn	Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.	Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.	Percentage of Birds flying at Potential Collision Height (PCH)	Confidence Level attached to PCH	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Dunlin (breeding and passage populations)	**Yes**	No	No	Mod	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Both the majority of UK-breeding population of dunlin and migratory birds from breeding grounds further north in Iceland/Greenland (schinzii and arctica races) migrate to wintering grounds in Africa. The exact details of migratory routes are poorly understood, but it is evident that there is extensive movement of birds around all UK waters including the Celtic Sea.
Dunlin (wintering population)	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	**Yes**	Birds of the alpina race that overwinter in Britain and Ireland migrate from northern Scandinavia and Russia. Birds which overwinter in Ireland (an estimated 88,480 individuals) are expected to cross the Celtic Sea from Britain.
Ruff	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Small numbers of ruff overwinter or breed in UK; a larger number (although still a small proportion of the biogeographic population) pass through on migration between breeding sites in Scandinavia or Russia to wintering sites in sub-Saharan Africa, North Africa or further south in Europe. Migratory routes are poorly understood, but it is thought that the English Channel and North Sea are probably the main routes. Therefore, unlikely to pass through the Project in significant numbers.
Snipe	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	**Yes**	While many British-breeding birds make only small movements to stay within Britain, others migrate across the English Channel to Europe or across the Irish Sea to Ireland. In addition, outside of the breeding season there is an influx of birds from Iceland, northern Europe and Scandinavia to the UK and Ireland, with some birds also continuing southwards to Europe. Details of migratory routes are unknown but it is evident that there is extensive movement of birds around all UK waters including the Celtic Sea.
Black-tailed Godwit (breeding population)	No	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project.
Black-tailed Godwit (Icelandic)	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	**Yes**	The vast majority of the Icelandic population of Black-tailed Godwits either winters in or migrates across the UK and Ireland. Details of migratory routes are unknown but it is evident that there is extensive movement of birds around all UK waters including the Celtic Sea. As a precaution this species has been screened in.
Bar-tailed Godwit	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	**Yes**	Birds that overwinter in UK and Ireland migrate from breeding sites in Scandinavia and Russia. It is expected that the majority of birds that overwinter in Ireland (16,820 individuals) arrive by crossing the Irish & Celtic Seas from Britain.
Whimbrel	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	**Yes**	A small number of Whimbrel breed in the Shetland Isles but far larger numbers occur on passage migration. These passage birds breed in Iceland, Scandinavia and Russia and winter in West Africa, thus their migration routes take them across most parts of UK waters, including the Celtic Sea. As a precaution this species has been screened in.
Curlew	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Although most UK-breeding birds remain within the UK and Ireland, most do travel significant distances between breeding and wintering sites, including crossing the Irish Sea. In addition, the population is supplemented with birds that breed elsewhere in northern Europe, many of which also continue across the Celtic Sea to Ireland. Birds may also use the Celtic Sea when moving along the British coastline. Curlew is a qualifying feature of Burry Inlet SPA/Ramsar.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Greenshank	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	**Yes**	Migratory routes of UK-breeding birds (breeding sites restricted to Scottish uplands) are not known in detail, but they are thought to winter in Ireland, western Britain, southwest Europe or northwest Africa and therefore they may well utilise the Celtic Sea on passage. In addition, larger numbers of birds pass through UK waters on passage, and are found all around the UK including within the Celtic Sea.
Wood Sandpiper	**Yes**	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	A very small number of wood sandpipers breed in northern Scotland. These birds winter in West Africa and thus must migrate across UK waters. A small number of passage birds also use UK waters when migrating between wintering grounds and other Palearctic breeding grounds. Highly unlikely that any significant numbers would cross the Project.
Redshank	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Details of migratory movements are uncertain, but both the UK-breeding brittanica population and the robusta population (breeding in Iceland and the Faroes) are found all around UK waters on migration, including the Celtic Sea. Redshank is a qualifying feature of Burry Inlet SPA/Ramsar.
Turnstone	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			**Yes**	No	**Yes**	Birds from breeding populations in northern Greenland, arctic Canada and Scandinavia migrate to the UK, with some overwintering in the UK and others continuing to continental Europe. Details of migratory routes are uncertain but birds may use all waters around the UK. Turnstone is a qualifying feature of Burry Inlet SPA/Ramsar.
Red-necked Phalarope	**Yes**	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	A very small number of birds breed in the UK, in northern Scotland. They winter pelagically in the Atlantic. It is thought that the majority migrate via the east coast of the UK; however it is possible that some birds may use the Celtic Sea. As a scarce migrant it is highly unlikely that any significant numbers would cross the Project.
Arctic Skua	**Yes**	No	No	None	low/mod	mod/high	mod	high	0.07	mod	No	No	**Yes**	Birds breeding in northern Scotland and elsewhere in northern Europe migrate south and west towards the Atlantic, where they winter off the coasts of Europe, Africa and South America. It is thought that the majority follow a route through the North Sea and English Channel, however as a precaution this species has been screened in.
Great Skua	**Yes**	No	**Yes**	None	low/mod	mod/high	mod	high	0.34	high	No	No	**Yes**	Birds breeding in northern Britain migrate to wintering sites off the coasts of southern Europe. It is thought that birds breeding on the west coast of the UK are likely to use the Celtic Sea, while those from colonies in the Orkney and Shetland Isles probably migrate via the North Sea, as a precaution this species has been screened in.
Kittiwake	**Yes**	No	**Yes**	Low	n/a	n/a	n/a	high			No	No	No	Birds breeding in the UK migrate to pelagic wintering grounds in the Atlantic. They can migrate in all directions past all coasts of Britain and Ireland. The potential effect from collision risk to kittiwakes is considered in detail in the main assessment. It is assumed that kittiwake densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Black-headed Gull	**Yes**	No	No	Mod	low	low	n/a	high	2.01	v high	No	No	No	While most UK-breeding birds are fairly sedentary, some migrate including some movement across the Celtic Sea between UK and Ireland. Unlikely to migrate through the Project in significant numbers.
Mediterranean Gull	**Yes**	No	No	n/a	n/a	n/a	mod	n/a			No	No	No	A very small number of Mediterranean gulls breed in the UK and Ireland, with the majority in southern England. Although the Project falls within the migration zone, this species is unlikely to migrate through the Project in significant numbers.
Common Gull	**Yes**	No	**Yes**	Low	low	low	n/a	high			No	No	**Yes**	While most UK-breeding birds are fairly sedentary, some migrate including some movement across the Celtic Sea between UK and Ireland. Species recorded during migratory bio-season from site specific survey data. Screened in for assessment following broad-front approach.
Lesser Black-backed Gull	**Yes**	No	**Yes**	High	mod	mod	mod	high			No	No	No	Most UK-breeding birds migrate southwards to wintering sites on the coasts of Iberia and north-west Africa, and this includes movement through the Celtic Sea. In addition, a large number of birds from other populations visit the UK during the non-breeding season, migrating from Iceland or, in larger numbers, across the North Sea from Scandinavia. Some of these birds are also likely to use the Celtic Sea. It is assumed that lesser black-backed gull densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Herring Gull	**Yes**	No	**Yes**	Mod/High	mod	mod	mod	high			No	No	No	While most UK-breeding birds are fairly sedentary, some migrate including some movement across the Celtic Sea between UK and Ireland. The potential effect from collision risk to herring gulls is considered in detail in the main assessment. It is assumed that herring gull densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Great Black-backed Gull	**Yes**	No	**Yes**	Mod	mod	mod	mod	high			No	No	No	While most UK-breeding birds are fairly sedentary, some migrate including some movement across the Celtic Sea between UK and Ireland. The potential effect from collision risk to great black-backed gulls is considered in detail in the main assessment. It is assumed that great black-backed gull densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required.
Little Tern	**Yes**	No	No	n/a	low/mod	low/mod	low	mod			No	No	**Yes**	All little terns that breed in the UK migrate to and from wintering sites off western Africa, probably via the western coasts of Europe. The details of migratory routes are unknown, but likely include the Celtic Sea. Screened in as a precaution following broad-front approach.
Black Tern	No	No	No	n/a	low/mod	low/mod	n/a	n/a			No	No	No	Both UK-breeding birds and birds which use UK waters on passage overwinter in West Africa. Details of migratory routes are uncertain. Scarce species within the UK, therefore unlikely to migrate through the Project in significant numbers.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	Partial	White Cross Aerial Surveys (2020-2022)	Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.	Spring	Autumn	Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.	Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.	Percentage of Birds flying at Potential Collision Height (PCH)	Confidence Level attached to PCH	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Sandwich Tern	**Yes**	No	**Yes**	None	low/mod	low/mod	mod	mod/high	0.48	mod	No	No	**Yes**	Both UK-breeding birds and birds which use UK waters on passage overwinter in West Africa. Details of migratory routes are uncertain, but birds are found all around UK waters. Recorded within the Project on a single occasion and screened in as a precaution following broad-front approach.
Common Tern	**Yes**	No	**Yes**	None	low/mod	low/mod	mod	mod	0.54	low	No	No	**Yes**	Both UK-breeding birds and birds which use UK waters on passage overwinter in West Africa. Details of migratory routes are uncertain, but birds are found all around UK waters. Recorded within the Project array and screened in following broad-front approach.
Roseate Tern	**Yes**	No	No	None	low/mod	low/mod	mod	mod			No	No	**Yes**	A small number of roseate terns breed in the UK, and those birds migrate southwards to wintering sites on the west coast of Africa. This no doubt includes passage through the Celtic Sea. Tracking data indicates that birds migrate across the Celtic Sea, potentially through the Project. As a precaution this species has been screened in.
Arctic Tern	**Yes**	No	**Yes**	None	low/mod	low/mod	mod	mod	0.14		No	No	**Yes**	Both UK-breeding birds and birds which use UK waters on passage migrate past the west of Africa to wintering sites around the Antarctic. Details of migratory routes are uncertain, but birds are found all around UK waters. Recorded within the Project array and screened in following broad-front approach.
Guillemot	**Yes**	No	**Yes**	None	low	low	low	mod			No	No	No	Birds disperse from breeding colonies and can be found throughout UK waters and further afield in the non-breeding season. It is assumed that guillemot densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required. Guillemots were screened out of collision risk modelling due to very low sensitivity.
Razorbill	**Yes**	No	**Yes**	High	low	low	low	mod			No	No	No	Razorbills that breed in the UK generally migrate in a southerly direction following the breeding season, to wintering sites along the Atlantic coasts of France, Iberia and Morocco or in the Mediterranean Sea. Although more birds go via the North Sea, significant numbers migrate via the Celtic Sea too. It is assumed that razorbill densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required. Razorbills were screened out of collision risk modelling due to very low sensitivity.
Puffin	**Yes**	No	**Yes**	None	low	low	low	low			No	No	No	Birds disperse from breeding colonies and can be found throughout UK waters and further afield in the non-breeding season. It is assumed that puffin densities during migratory seasons are well represented by site-specific survey data and therefore no separate migratory assessment is required. Puffins were screened out of collision risk modelling due to very low sensitivity.
Short-eared Owl	**Yes**	No	No	Low	n/a	n/a	n/a	n/a			No	No	No	Movement patterns are poorly understood; however there is evidence of this species crossing almost all parts of the UK's waters, including the Celtic Sea, though unlikely that any significant numbers would cross the Project.

Species / Sub-Species	Flight Path through the Offshore Project		Observations from surveys	Literature Review	Species of CRM Concern (SOSS 03A)		Perceived Risk from Collision		SOSS 02 Flight Heights		Qualifying Feature of Assessed SPAs		Screened in?	Comments
	Main	**Partial**	White Cross Aerial Surveys (2020-2022)	**Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. (2002). The Migration Atlas: Movements of the Birds of Britain and Ireland. T & AD Poyser.**	**Spring**	**Autumn**	**Langston, R.H.W. (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39.**	**Furness, B. & Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report for Marine Scotland, The Scottish Government.**	**Percentage of Birds flying at Potential Collision Height (PCH)**	**Confidence Level attached to PCH**	Burry Inlet SPA / RAMSAR	Tamar Estuaries Complex SPA		
Nightjar	**Yes**	No	No	None	n/a	n/a	n/a	n/a			No	No	No	Nightjar migrate to Britain from the south, and a very small number of birds is thought to cross the Celtic Sea on migration between Britain and Ireland. It is unlikely that any significant numbers would cross the Project.
Woodlark	No	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project
Dartford Warbler	No	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project
Aquatic Warbler	No	No	No	n/a	n/a	n/a	n/a	n/a			No	No	No	Not selected for modelling as known migratory flight path does not overlap with the project
Great Northern Diver	n/a	n/a	No	n/a	n/a	n/a	n/a	mod/high			No	No	No	No Flightpath
Long-tailed Skua	n/a	n/a	No	n/a	n/a	n/a	n/a	n/a			No	No	No	No Flightpath
Pomarine Skua	n/a	n/a	No	n/a	n/a	n/a	n/a	n/a			No	No	No	No Flightpath
Sabine's Gull	n/a	n/a	No	n/a	n/a	n/a	n/a	n/a			No	No	No	No Flightpath
Little Gull	n/a	n/a	No	n/a	low	low	n/a	n/a	2.14	mod	No	No	No	No Flightpath
Little auk	n/a	n/a	No	n/a	low	low	n/a	low	0.13	high	No	No	No	No Flightpath

Appendix 2: Migropath Confidence Limits

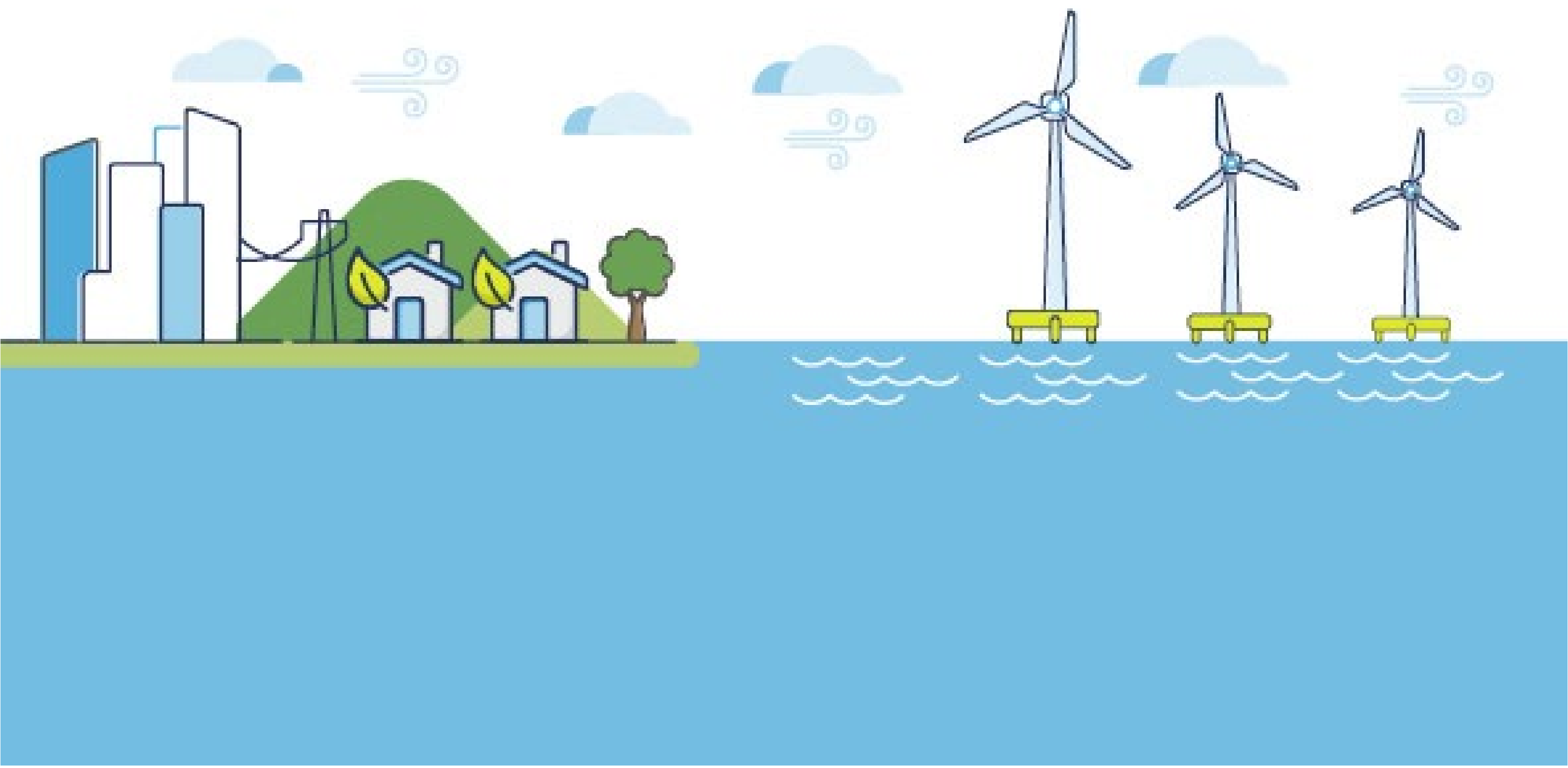
Species/Population	Migration route	Number of birds passing through the Offshore Project Windfarm Site each migration (mean)	Number of birds passing through the Offshore Project Windfarm Site each migration (Lower 95% CL)	Number of birds passing through the Offshore Project Windfarm Site each migration (Upper 95% CL)
Shelduck	South	0	0	0
Wigeon	South	69	57	83
Gadwall	South	0	0	0
Teal	South	0	0	0
Mallard	South	0	0	0
Shoveler	South	0	0	0
Tufted duck	South	75	54	93
	North	0	0	0
Cormorant	South	33	27	39
Little egret	South	0	0	0
Hen Harrier	South	0	0	0
Oystercatcher	South	0	0	0
Ringed plover	South	12	10	14
Golden plover	South	0	0	0
Grey plover	South	0	0	0
Lapwing	South	99	80	120
Knot	South	26	18	34
Sanderling	South	5	4	7
Dunlin	South	0	0	0
Snipe	South	0	0	0
Black-tailed godwit (Icelandic)	South	0	0	0
Bar-tailed godwit	South	0	0	0
Whimbrel	South	0	0	0
Curlew	South	0	0	0
Greenshank	South	0	0	0
Redshank	South	11	7	14
Turnstone	South	13	10	16

Appendix 13.C: Revised Collision Risk Modelling

WHITE CROSS

White Cross Offshore Windfarm Environmental Statement

Appendix 13.C: Revised Collision Risk Modelling



Document Code:	FLO-WHI-REP-0002-13	
Contractor Document Number:	PC2978-RHD-ZZ-XX-RP-Z-0148	
Version Number:	0	
Date:	17/08/2023	
Prepared by:	M Costagliola-Ray	*Electronic Signature*
Checked by:	M Boa	*Electronic Signature*
Owned by:	PT	*Electronic Signature*
Approved by Client :	MJ	*Electronic Signature*

Version Number	Reason for Issue / Major Changes	Date of Change
0	For issue	17/08/2023

Table of Contents

Table of Tables

Appendices

Glossary of Acronyms

Acronym	Definition
AfL	Agreement for Lease
BEIS	Department for Business, Energy and Industrial Strategy
CEA	Cumulative Effect Assessment
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
JNCC	Joint Nature Conservancy Council
MMO	Marine Management Organisation
MW	Megawatts
NE	Natural England
NF	Nocturnal Activity Factor
NPS	National Policy Statement
OWL	Offshore Wind Ltd
RIAA	Report to Inform an Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
WTG	Wind Turbine Generator

Glossary of Terminology

Defined Term	Description
Agreement for Lease	An Agreement for Lease (AfL) is a non-binding agreement between a landlord and prospective tenant to grant and/or to accept a lease in the future. The AfL only gives the option to investigate a site for potential development. There is no obligation on the developer to execute a lease if they do not wish to.
Applicant	Offshore Wind Limited
Cumulative effects	The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative Effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.
In-combination effects	In-combination effects are those effects that may arise from the development proposed in combination with other plans and projects proposed/consented but not yet built and operational.
Offshore Development Area	The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the project that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
Offshore Infrastructure	All of the offshore infrastructure including wind turbine generators, substructures, mooring lines, seabed anchors, Offshore Substation Platform and all cable types (export and inter-array). This encompasses the infrastructure that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
the Offshore Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required).
Offshore Wind Limited	Offshore Wind Ltd (OWL) is a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities associated with the Project.

Defined Term	Description
Project Design Envelope	A description of the range of possible elements that make up the Project design options under consideration. The Project Design Envelope, or 'Rochdale Envelope' is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact parameters are not yet known but a bounded range of parameters are known for each key project aspect.
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure
Wind Turbine Generators (WTG)	The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, nacelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present

1. Introduction

1.1 Project Background

1. Offshore Wind Ltd (OWL; "the Applicant") is proposing to develop The White Cross Offshore Windfarm Project (hereafter referred to as 'the Offshore Project'); which would be a demonstration scale Floating Offshore Windfarm (FLOW). The Windfarm Site is located in the Celtic Sea, approximately 52km off the North Cornwall and North Devon coast (west-north-west of Hartland Point). The Windfarm Site covers approximately 50km^2. Details of the location of the Offshore Project and the offshore elements (including the Wind Turbine Generator (WTG) layout, overall Offshore Project operational footprint, Windfarm Site layout, inter-array cables and associated protection, and the spatial footprints of the construction or decommissioning works) are set out within **Chapter 5: Project Description**.

2. As presented within **Chapter 13: Offshore Ornithology** and accompanying **Appendix 13.C: Revised Collision Risk Modelling**, the Project modelled a range of WTG scenarios for Collision Risk Modelling (CRM) considered within the Rochdale Envelope, with potential impacts assessed against the Worst-Case Scenario (WCS) design in relation to potential impacts on ornithological features. Since submission of the Environmental Statement (ES), Natural England have produced an interim guidance note on collision risk modelling and avoidance rates (Natural England, 2023).

3. Following this, APEM Ltd (hereafter APEM) was commissioned by the Applicant to undertake revised CRM using Natural England's recently submitted interim guidance on avoidance rates (Natural England, 2023) for the Application WCS. Following completion of additional CRM, APEM have also assessed whether the additional modelling results would materially change the assessment outcomes in relation to ornithological features considered within **Chapter 13: Offshore Ornithology** and **Report to Inform Appropriate Assessment (RIAA) (Appendix 6.A).**

2. Collision Risk Modelling following Natural England's Interim Guidance

4. There is the potential for birds flying through the Windfarm Site to collide with the rotating turbines and associated infrastructure, which would then be predicted to result in mortality (Drewitt & Langston, 2006). This potential collision risk can be estimated by modelling the predicted number of collisions for key seabird species using the known densities of birds in flight densities from baseline surveys.

5. In response to avoidance rate review undertaken by Cook (2021) and Ozsanlev-Harris *et al*. (2023), Natural England have produced an interim guidance note on collision risk modelling and avoidance rates (Natural England, 2023). The key changes proposed in contrast to current recommendations provided within Natural England's best practice guidance (Parker *et al*., 2022) is as follows:

- Avoidance rates have been revised following the evidence reviews undertaken by Cook (2021) and Ozsanlev-Harris *et al*. (2023). With respect to gannet and kittiwake, the new guidance now recommends significantly higher Band Option 2 (BO2) avoidance rates than previously advocated with an increase from a central estimate of 0.989 to 0.993. For large gull species, BO2 avoidance rates have been reduced from a central estimate of 0.995 to 0.994;
- A recommended stochastic nocturnal activity rate for kittiwake, large gulls and gannet.
- A reduction in the nocturnal activity rate recommended for gannet; and
- The inclusion of consideration of macro avoidance behaviour exhibited by gannets within modelling by reducing the monthly seabird density input value of gannets in flight within the model by a range of 65% to 85% or by selecting a single rate of 70% within the sCRM.

6. In line with the above, revised collision risk modelling has been undertaken in accordance with Natural England's interim guidance for the Application WCS (18MW WTG scenario).

7. As detailed within **Appendix 13.C: Revised Collision Risk Modelling**, five seabird species were identified for which potential collision risk should be considered in relation to the Offshore Project, in accordance with Natural England's interim guidance note (Natural England, 2023). These species were:

- Kittiwake, *Rissa tridactyla*
- Great black-backed gull, *Larus marinus*
- Herring gull, *Larus argentatus*
- Lesser black-backed gull, *Larus fuscus*

- Gannet *Morus bassanus*.

8. All additional modelling presented within this report has, therefore, been undertaken for the five species above.

2.1 WTG parameters

9. Input parameters relating to the Application WCS are presented within **Table 1**. The estimated percentage of time that the WTGs are predicted to be operational per month (average across all turbines) is presented in **Table 2**, for clarity operational proportions remain the same as previously modelled within **Appendix 13.C: Revised Collision Risk Modelling**.

Table 1 WTG and array parameters used to inform Collision Risk Models

Input Parameter	Application WCS (18 MW)
Number of WTGs	7
Number of blades	3
Rotor radius (m)	131
Rotation speed (rpm)	7.0
Pitch (degrees)	3
Maximum blade width (m)	12
Minimum air gap (m)	22
Tidal offset (m)	0
Maximum footprint width (km)	5.5
Latitude (degrees)	51.1
Large array correction	No

Table 2 Theoretical WTG operational time per month

Month	Operational Time (%)	Mean downtime (%)	SD downtime
January	97.3	3	0
February	96.7	3	0
March	96.1	3	0
April	93.7	3	0
May	93.6	3	0
June	91.5	3	0
July	92.2	3	0
August	91.6	3	0
September	93.7	3	0
October	96.2	3	0
November	96.5	3	0
December	97.4	3	0

2.2 Seabird Biometrics and Avoidance rates

10. For each species, a number of physical and behavioural characteristics were used to inform CRM (**Table 3**). These characteristics may increase or decrease collision risk and are as follows:

- Bird length
- Wingspan
- Flight speed
- Nocturnal activity.

11. Seabird biometric input parameters were derived from the input values recommended within the Natural England interim guidance note (Natural England, 2023), and are presented in **Table 3**.

12. Since most birds will exhibit avoidance behaviour when faced with WTGs, a key element of collision risk modelling is the inclusion of a parameter to describe this behaviour. Different species are expected to avoid wind farms to differing degrees (Cook, 2021; Ozsanlev-Harris *et al*. 2023).

13. The species-specific avoidance rates that were applied in the CRM are presented in **Table 4**. The avoidance rates for all species modelled, are derived from the Natural England's interim guidance note (Natural England, 2023).

2.3 Species Densities

14. Density estimates were determined for the Offshore Project using data collected across 24 months of baseline aerial digital surveys, carried out between July 2020 and June 2022. The density data that were applied in the CRM are presented in **Table 5**. The density estimates in **Table 5** remain the same as previously modelled within **Appendix 13.C: Revised Collision Risk Modelling**.

Table 3 Species biometric data used to inform CRM undertaken in accordance with Natural England's Interim Guidance

Species	Body Length (m)	SD	Wingspan (m)	SD	Flight Speed (m/s)	SD	Flight Type	Nocturnal Activity (%)	SD
Kittiwake	0.39	0.005	1.08	0.0625	13.1	0.4	Flapping	0.375	0.0637
Great black-backed gull	0.71	0.035	1.58	0.0375	13.7	1.2	Flapping	0.375	0.0637
Herring Gull	0.6	0.0225	1.44	0.0300	12.8	1.8	Flapping	0.375	0.0637
Lesser black-backed gull	0.58	0.03	1.42	0.0375	13.1	1.9	Flapping	0.375	0.0637
Gannet	0.94	0.0325	1.72	0.0375	14.9	0	Flapping	0.08	0.1

Table 4 Avoidance rates used to inform CRM undertaken in accordance with Natural England's Interim Guidance

Species	Basic Avoidance Rate (BO2)		Estimated proportion of Seabirds Flying at PCH	
	Estimate	SD	Estimate	SD
Kittiwake	0.993	0.0003	1	0
Great black-backed gull	0.994	0.0004	1	0
Herring Gull	0.994	0.0004	1	0
Lesser black-backed gull	0.994	0.0004	1	0
Gannet	0.993	0.0003	1	0

Table 5 Monthly densities of birds in flight

Species		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kittiwake	Mean	4.45	1.01	1.83	0.00	0.00	0.09	0.00	0.00	0.17	0.09	0.37	0.37
	SD	1.30	0.39	0.61	0.00	0.00	0.06	0.00	0.00	0.10	0.06	0.22	0.27
Great black-backed gull	Mean	0.00	0.00	0.09	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.00	0.07	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Herring Gull	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
	SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Lesser black-backed gull	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Gannet	Mean	0.00	0.00	0.37	0.18	0.17	0.18	0.17	0.47	0.18	0.83	0.00	0.00
	SD	0.00	0.00	0.19	0.15	0.13	0.13	0.11	0.23	0.13	0.32	0.00	0.00
Gannet 70% macro avoidance	Mean	0.00	0.00	0.11	0.05	0.05	0.05	0.05	0.14	0.05	0.25	0.00	0.00
	SD	0.00	0.00	0.06	0.05	0.04	0.04	0.03	0.07	0.04	0.10	0.00	0.00

2.4 Results

15. This section provides a summary of CRM results for each of the five seabird species modelled for the Application WTG scenario following Natural England's interim guidance.

16. CRM results are provided seasonally in **Table 6** to **Table 11** and comparisons are provided between seasonal predicted collisions for the WCS using Natural England's Best practice guidance (included within **Chapter 13: Offshore Ornithology**) and the WCS modelled following Natural England's interim guidance.

17. A summary of monthly CRM results for the WCS using Natural England's interim guidance approach for the five species modelled are presented in **Appendix 1**.

2.4.1 Kittiwake

Table 6 Kittiwake comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach

Season	Natural England's best practice guidance 18 MW NF 25 or 50	Natural England's interim guidance 18 MW	Change in predicted collisions
Return migration	10.6 – 13.5	9.0	-1.6 to -4.5
Breeding	4.4 – 5.2	3.6	-0.8 to -1.6
Post-breeding migration	2.1 – 2.8	1.8	-0.3 to -1.0
Annual	17.1 – 21.5	14.4	-2.7 to -7.1

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.4.2 Great black-backed gull

Table 7 Great black-backed gull comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach

Season	Natural England's best practice guidance 18 MW NF 25 or 50	Natural England's interim guidance 18 MW	Change in predicted collisions
Breeding	0.6 – 0.7	0.9	+0.2 to +0.3
Non-breeding	0.0	0.0	0.0
Annual	0.6 – 0.7	0.9	+0.2 to +0.3

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.4.3 Herring gull

Table 8 Herring gull comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach

Season	Natural England's best practice guidance	Natural England's interim guidance	Change in predicted collisions
	18 MW NF 25 or 50	18 MW	
Breeding	0.0	0.0	0.0
Non-breeding	0.2 – 0.3	0.3	0.0 to +0.1
Annual	0.2 – 0.3	0.3	0.0 to +0.1

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.4.4 Lesser black-backed gull

Table 9 Lesser black-backed gull comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach

Season	Natural England's best practice guidance	Natural England's interim guidance	Change in predicted collisions
	18 MW NF 25 or 50	18 MW	
Return migration	0.0	0.0	0.0
Breeding	0.3	0.4	+0.1
Post-breeding migration	0.0	0.0	0.0
Winter	0.0	0.0	0.0
Annual	0.3	0.4	+0.1

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.4.5 Gannet

Table 10 Gannet comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach

Season	Natural England's best practice guidance	Natural England's interim guidance	Change in predicted collisions
	18 MW NF 25 or 50	18 MW	
Return migration	0.0	0.0	0.0
Breeding	4.4 – 4.7	3.3	-1.1 to -1.4
Post-breeding migration	1.7 – 1.8	1.2	-0.5 to -0.6
Annual	6.1 – 6.6	4.6	-1.5 to -2.0

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.4.6 Gannet 70% macro avoidance

Table 11 Gannet comparison of seasonal predicted collisions for the WCS using Natural England's Best practice guidance and interim guidance approach (taking into account 70% macro avoidance)

Season	Natural England's best practice guidance	Natural England's interim guidance	Change in predicted collisions
	18 MW NF 25 or 50	18 MW	
Return migration	0.0	0.0	0.0
Breeding	1.3 – 1.4	1.0	-0.3 to -0.4
Post-breeding migration	0.5 – 0.6	0.4	-0.1 to -0.2
Annual	1.8 – 2.0	1.4	-0.4 to -0.6

Note: NF relates to the nocturnal activity factor rate used within CRM.

2.5 Changes in predicted CRM results following Natural England's interim guidance

18. As presented in **Section 2.4**, the updated CRM results for the Application WCS using Natural England's interim guidance predicted an increase of less than a single additional collision mortality (0.3 at most) per annum for the three large gull species (great black-backed gull, herring gull and lesser black-backed gull). It also predicted lower collision mortality estimates for kittiwake and gannet, in comparison to the Application WCS impacts when following Natural England's best practice guidance (Parker *et al.,* 2022).

3. Consideration of Environmental Statement and Report to Inform Appropriate Assessment conclusions.

19. The above sections present revised CRM results for the Application WCS using Natural England's interim guidance note (Natural England, 2023) and comparisons are made between these results and the Application WCS modelled using Natural England's best practice guidance (Parker *et al*., 2022).

20. As CRM results for the Application WCS using Natural England's best practice guidance were used to inform assessments within the ES and RIAA, a screening exercise (as presented in **Table 12** and **Table 13**) has been undertaken to identify whether the updated modelling impacts would materially affect the outcomes within the ES and RIAA.

Table 12 Summary of effects presented in the Environmental Statement

Assessment	ES Assessment Conclusion	Change in ES conclusions? Natural England's Interim guidance results
Kittiwake alone	Negligible (not significant)	No – as presented within **Table 6**, impacts were predicted to decrease by a maximum of seven (7.1) individuals per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Kittiwake cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to decrease by a maximum of seven (7.1) individuals per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Great black-backed gull alone	Negligible (not significant)	No – as presented within **Table 7**, impacts were predicted to increase by less than a single bird (0.3) per annum at most. This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.
Great black-backed gull cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to increase by less than a single bird (0.3) per annum at most. This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.

Assessment	ES Assessment Conclusion	Change in ES conclusions? Natural England's Interim guidance results
Herring gull alone	Negligible (not significant)	No – as presented in **Table 8**, impacts were predicted to increase by less than a single bird (0.1) per annum at most. This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.
Herring gull cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to increase by less than a single bird (0.1) per annum at most. This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.
Lesser black-backed gull alone	Negligible (not significant)	No - as presented in **Table 9**, impacts were predicted to increase by less than a single bird (0.1). This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.
Lesser black-backed gull cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to increase by less than a single bird (0.1) per annum. This level of increase does not represent a material change; thus, the conclusions made within the ES remain the same.

Assessment	ES Assessment Conclusion	Change in ES conclusions? Natural England's Interim guidance results
Gannet alone	Negligible (not significant)	No – as presented in **Table 10**, impacts were predicted to decrease by a maximum of two (2.0) individuals per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Gannet cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to decrease by a maximum of two (2.0) individuals per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Gannet 70% macro avoidance alone	Negligible (not significant)	No – as presented in **Table 11**, impacts were predicted to decrease by less than a single bird (0.6) per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Gannet 70% Macro avoidance cumulative effects – Total (All developments)	Negligible (not significant)	No – cumulative impacts were predicted to decrease by less than a single bird (0.6) per annum at most. This level of decrease means that no adverse effect can confidently be concluded.
Notes: **It is important to note that cumulative totals presented have been updated for the Offshore Project using Natural England Interim Guidance. However, all other developments have not been updated following Natural England Interim Guidance.**		

Table 13 Summary of effects presented in the Appropriate Assessment. Collision risk apportioned to SPAs annually

Assessment	RIAA Assessment Conclusion	Change in RIAA conclusions? Natural England's Interim guidance results
Gannet: Grassholm SPA	No potential for an AEoI	No – impacts apportioned to the Grassholm SPA were predicted to decrease by less than a single bird (0.6) per annum. This level of decrease means that no adverse effect can confidently be concluded.
Gannet: Grassholm SPA – 70% Macro avoidance	No potential for an AEoI	No – impacts apportioned to the Grassholm SPA were predicted to decrease by less than a single bird (0.2) per annum. This level of decrease means that no adverse effect can confidently be concluded.
Gannet: Saltee Islands SPA	No potential for an AEoI	No – impacts apportioned to the Saltee Islands SPA were predicted to decrease by less than a single bird (0.1) per annum. This level of decrease means that no adverse effect can confidently be concluded.
Gannet: Saltee Islands SPA – 70% Macro avoidance	No potential for an AEoI	No – impacts apportioned to the Saltee Islands SPA were not predicted to change. Therefore, no adverse effect can confidently be concluded.

Assessment	RIAA Assessment Conclusion	Change in RIAA conclusions? Natural England’s Interim guidance results
Gannet: Ailsa Craig SPA	No potential for an AEoI	No – impacts apportioned to the Ailsa Craig Islands SPA were not predicted to change. Therefore, no adverse effect can confidently be concluded.
Gannet: Ailsa Craig SPA – 70% Macro avoidance	No potential for an AEoI	No – impacts apportioned to the Ailsa Craig Islands SPA were not predicted to change. Therefore, no adverse effect can confidently be concluded.

4. References

Cook, A.S.C.P. (2021). Additional analysis to inform SNCB recommendations regarding collision risk modelling. BTO Research Report 739.

Drewitt, A.L. and R.H.W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148: 29–42.

Natural England (2023). Natural England SoS Consultation Response. Annex 1: Interim guidance on collision risk modelling avoidance rates.

Ozsanlav-Harris, L., Inger, R. & Sherley, R. 2023. Review of data used to calculate avoidance rates for collision risk modelling of seabirds. JNCC Report 732, JNCC, Peterborough, ISSN 0963-8091.

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp.

Appendix 1: Monthly collision rates – CRM outputs for the Application Worst-Case Scenario run in accordance with Natural England Interim Guidance

Table 1.1 Monthly kittiwake collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	7.4	5.2	9.6	3.1	11.6
Feb	1.6	1.0	2.2	0.4	2.9
Mar	3.4	2.3	4.5	1.0	5.6
Apr	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0
Jun	0.2	0.1	0.3	0.0	0.4
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.3	0.2	0.5	0.0	0.7
Oct	0.2	0.1	0.3	0.0	0.4
Nov	0.6	0.3	1.0	0.1	1.3
Dec	0.7	0.3	1.0	0.1	1.5

Table 1.2 Monthly great black-backed gull collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0
Mar	0.4	0.2	0.7	0.0	1.0
Apr	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0
Jun	0.5	0.2	0.7	0.0	1.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0

Table 1.3 Monthly herring gull collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0
Dec	0.3	0.1	0.5	0.0	0.8

Table 1.4 Monthly lesser black-backed gull collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.4	0.2	0.6	0.0	0.9
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0

Table 1.5 Monthly gannet collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0
Mar	0.6	0.3	0.9	0.1	1.2
Apr	0.4	0.2	0.6	0.0	0.9
May	0.4	0.2	0.6	0.0	0.9
Jun	0.4	0.2	0.6	0.0	0.8
Jul	0.4	0.2	0.6	0.0	0.8
Aug	0.9	0.5	1.3	0.1	1.6
Sep	0.3	0.1	0.5	0.0	0.7
Oct	1.2	0.8	1.7	0.4	2.3
Nov	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0

Table 1.6 Monthly gannet (70% macro avoidance) collision risk estimates for the Application WCS (18MW WTG) run in accordance with Natural England Interim Guidance

Month	Mean	Mean – 1SD	Mean + 1SD	Lower CI (2.5%)	Upper CI (97.5%)
Jan	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0
Mar	0.2	0.1	0.3	0.0	0.4
Apr	0.1	0.0	0.2	0.0	0.3
May	0.1	0.1	0.2	0.0	0.3
Jun	0.1	0.1	0.2	0.0	0.3
Jul	0.1	0.1	0.2	0.0	0.2
Aug	0.3	0.1	0.4	0.0	0.5
Sep	0.1	0.0	0.2	0.0	0.2
Oct	0.4	0.2	0.5	0.1	0.7
Nov	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0