BERWICK BANK WIND FARM
REPORT TO INFORM APPROPRIATE ASSESSMENT

PART THREE: SPECIAL PROTECTION AREAS

Habitats Regulations Appraisal

EOR0766
HRA Report
Final

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GLOSSARY

Term	Description
Appropriate Assessment	An assessment to determine the implications of a plan or project on a European site in view of that site's conservation objectives. An Appropriate Assessment forms part of the Habitats Regulations Appraisal (HRA) and is required when a plan or project (either alone or in combination with other plans or projects) is likely to have a significant effect on a European site.
Annex I	Bird species defined in annex I of the Directive 2009/147/EC on the conservation of wild birds (Birds Directive). The designation of Special Areas of Conservation is required in the UK to ensure the conservation of these species and for regularly occurring migratory species. The protection afforded to sites designated prior to EU Exit persists in UK law.
Birds Directive	The Birds Directive is the short name for European Union Council Directive 2009/147/EC on the conservation of wild birds. The Directive provides a comprehensive framework for the protection, management and control of all wild birds naturally occurring in the EU.
Competent Authority	The term derives from the Habitats Regulations and relates to the exercise of the functions and duties under those Regulations. Competent authorities are defined in the Habitat Regulations as including "any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office". In the context of a plan or project, the competent authority is the authority with the power or duty to determine whether or not the proposal can proceed (SNH, 2014).
EU Exit	The withdrawal of the United Kingdom from the European Union.
European site	A Special Area of Conservation (SAC), or candidate SAC, (cSAC), a Special Protection Area (SPA), a site listed as a site of community importance (SCI), or, as per Scottish Planning Policy (SPP), a possible SAC (pSAC) or potential SPA (pSPA). Ramsar sites which are also Natura 2000 sites (taken as European sites) are protected under the relevant statutory regimes' (SPP, paragraph 211 (published in December 2020).
Habitats Directive	The Habitats Directive is the short name for European Union Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. The Directive led to the establishing of European sites and setting out how they should be protected, it also extends to other topics such as European protected species.
Habitats Regulations	The Conservation (Natural Habitats, &c.) Regulations 1994, the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species 2017.
Habitats Regulations Appraisal	A process required by the Habitats Regulations of identifying likely significant effects of a plan or project on a European site and (where likely significant effects are predicted or cannot be discounted) carrying out an Appropriate Assessment to ascertain whether the plan or project will adversely affect the integrity of the European site. If adverse effects on integrity cannot be ruled out, the latter stages of the process require consideration of the derogation provisions in the Habitats Regulations.
In-combination Effect	The combined effect of the Proposed Development in-combination with the effects from a number of different projects on the same feature/receptor.
Likely Significant Effect	Any effect that may reasonably be predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the European site was designated, but excluding trivial or inconsequential effects. A likely effect is one that cannot be ruled out on the basis of objective information. A 'significant' effect is a test of whether a plan or project could undermine the site's conservation objectives (SNH, 2014).
Migratory waterbirds	Species of waders and waterfowl that are ecologically dependant on wetlands and which make regular migrations along the coast of the UK and/or non-breeding individuals that overwinter in the UK.
National Site Network	The National Site Network comprises Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) designated (or proposed) on EU Exit day and which formerly formed part of the Natura 2000 network. The term "National Site Network" is used in each of the Habitats Regulations and the terms refer to the same network of sites ((Scottish Government, 2020).
Natura 2000 network	A coherent European ecological network of Special Areas of Conservation and Special Protection Areas comprising sites located within European Union Member States.
Proposed Development	The offshore components of the Project, as described in section 5 and volume 1, chapter 3 of the Offshore EIA Report.
Ramsar Site	Wetlands of international importance, designated under the Ramsar Convention on Wetlands of International Importance.
Seabirds	Birds that spend most of their lives feeding and living on the open ocean, coming ashore only to breed.
Special Area of Conservation (SAC)	Special Areas of Conservation (SACs) are areas designated for the conservation of certain plant and animals species listed in the Habitats Directive.
Special Protection Area (SPA)	Special Protection Areas (SPAs) are sites that are designated to protect rare or vulnerable birds (as listed on annex I of the Directive 2009/147/EC on the conservation of wild birds), as well as regularly occurring migratory species.

ACRONYMS AND ABBREVIATIONS

Acronym	Description
AEoI	Adverse Effect on Integrity
AfL	Agreement for Lease
AON	Apparently Occupied Nests
AOS	Apparently Occupied Sites
BDMPS	Biologically Defined Minimum Population Scales
BEIS	Department for Business, Energy and Industrial Strategy
BTO	British Trust for Ornithology
CAP	Conservation Advice Package
CEA	Cumulative Effect Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CMA	Conservation and Management Advice
CoCP	Code of Construction Practice
CPS	Counterfactual of population size
CPGR	Counterfactual of population growth rate
CRM	Collision risk model
CTV	Crew Transfer Vessel
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
EC	European Commission
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
ELC	East Lothian Council
EMF	Electromagnetic fields
EMP	Environmental Management Plan
EU	European Union
HRA	Habitats Regulation Appraisal
HVAC	High Voltage Alternating Current
ICOL	Inch Cape Offshore Limited
INNS	Invasive Non-Native Species
IROPI	Imperative reasons of overriding public interest
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effects
LSEI	Likely Significant Effect In-Combination

Acronym	Description
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MS-LOT	Marine Scotland Licensing Operations Team
MSS	Marine Science Scotland
N/A	Not Applicable
NSVMP	Navigational Safety and Vessel Management Plan
OSP	Offshore Substation Platforms
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SACOs	Supplementary Advice on Conservation Objectives
SD	Standard deviation
SMP	Seabird Monitoring Programme
SNCBs	Statutory Nature Conservation Bodies
SOSS	Strategic Ornithological Support Services
SOV	Service Operation Vessel
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TCE	The Crown Estate
UK	United Kingdom
UXO	Unexploded Ordnance
WWT	Wildfowl and Wetlands Trust
ZOI	Zone of Influence

UNITS

Unit	Description
%	Percentage
GW	Gigawatt (power)
Hrs	Hours
km	Kilometres (distance)
km²	Square kilometres
M	Metre (distance)
m²	Square metres
MW	Mega Watt
nm	Nautical mile (distance)
s	second

SPECIES GLOSSARY

British (English) Vernacular Species Name	Scientific Species Name
Light-bellied brent goose	*Branta bernicla*
Greylag goose	*Anser anser*
Taiga bean goose	*Anser fabalis*
Pink-footed goose	*Anser brachyrhynchus*
Whooper swan	*Cygnus cygnus*
Shelduck	*Tadorna tadorna*
Shoveler	*Spatula clypeata*
Gadwall	*Mareca strepera*
Wigeon	*Mareca penelope*
Mallard	*Anas platyrhynchos*
Teal	*Anas crecca*
Pochard	*Aythya ferina*
Tufted duck	*Aythya fuligula*
Scaup	*Aythya marila*
Eider	*Somateria mollissima*
Velvet scoter	*Melanitta fusca*
Common scoter	*Melanitta nigra*
Long-tailed duck	*Clangula hyemalis*
Goldeneye	*Bucephala clangula*
Goosander	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Great crested grebe	*Podiceps cristatus*
Slavonian grebe	*Podiceps auritus*
Oystercatcher	*Haematopus ostralegus*
Lapwing	*Vanellus vanellus*
Golden plover	*Pluvialis apricaria*
Grey plover	*Pluvialis squatarola*
Ringed plover	*Charadrius hiaticula*
Curlew	*Numenius arquata*
Bar-tailed godwit	*Limosa lapponica*
Black-tailed godwit	*Limosa limosa*
Turnstone	*Arenaria interpres*
Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Dunlin	*Calidris alpina*
Purple sandpiper	*Calidris maritima*
Redshank	*Tringa totanus*
Kittiwake	*Rissa tridactyla*
Black-headed gull	*Chroicocephalus ridibundus*
Little gull	*Hydrocoloeus minutus*
Common gull	*Larus canus*
Herring gull	*Larus argentatus*
Lesser black-backed gull	*Larus fuscus*
Sandwich tern	*Thalasseus sandvicensis*
Common tern	*Sterna hirundo*
Arctic tern	*Sterna paradisaea*
Great skua	*Stercorarius skua*
Guillemot	*Uria aalge*
Razorbill	*Alca torda*
Puffin	*Fratercula arctica*
Red-throated diver	*Gavia stellata*
Fulmar	*Fulmarus glacialis*
Manx shearwater	*Puffinus puffinus*
Gannet	*Morus bassanus*
Cormorant	*Phalacrocorax carbo*
Shag	*Gulosus aristotelis*

1. INTRODUCTION

1.1. THE PURPOSE OF THIS REPORT TO INFORM APPROPRIATE ASSESSMENT (RIAA)

1. The Report to Inform Appropriate Assessment (RIAA) has been prepared by RPS (Parts One and Two) and Royal HaskoningDHV, Pelagica Environmental Consultancy Ltd and APEM (Part Three - this document) on behalf of the Applicant, to support the Habitats Regulations Appraisal (HRA) of the Proposed Development in the determination of the implications for European sites. The RIAA builds upon the Offshore HRA Screening Report (SSER, 2021b)(hereafter 'The HRA Stage One LSE Screening Report') completed in October 2021 and subsequent joint Environmental Impact Assessment (EIA) Scoping and Likely Significant Effect (LSE) Screening advice received in the Berwick Bank Wind Farm Scoping Opinion (MS-LOT, 2022) in February 2022 and considers the environmental effects of the Proposed Development as they relate to relevant European site integrity at Stage Two of the HRA process.

1.2. STRUCTURE OF THE RIAA

2. As detailed in section 1.5 of Part One of this RIAA for the Proposed Development, for clarity and ease of navigation, the RIAA is structured and reported in several 'Parts', as follows:

- Executive Summary and Conclusions;
- Part One – Introduction and Background;
- Part Two – Consideration of Special Areas of Conservation (SACs); and
- Part Three (this document) – Consideration of Special Protection Areas (SPAs).

3. Each 'Part' of the RIAA is supported by a series of topic specific appendices and relevant documentation including European Site Summaries.

1.3. STRUCTURE OF THIS DOCUMENT

4. This document constitutes Part Three of the RIAA and provides consideration of the implications of the Proposed Development on SPAs.

5. This document is structured as follows:

- Chapter 1: Introduction – this section details the purpose and structure of the RIAA.
- Chapter 2: Consultation – this section provides a summary of the consultation undertaken with regards to the qualifying features of SPAs, the responses provided, and how these have been addressed within this Part of the RIAA.
- Chapter 3: Summary of HRA Screening – this section presents the SPAs potentially at risk of LSE and the features and pathways for which HRA Stage Two Appropriate Assessment is required, both alone and in-combination.

6. Information for the HRA Stage Two Appropriate Assessment is then provided in:

- Chapter 4: Information to inform the Appropriate Assessments, including maximum design scenarios, designed in measures, an outline of the approach taken to baseline data, conservation objectives, and the in-combination assessment.
- Chapter 5: Appraisal of Adverse Effects on Integrity on European sites designated for ornithological features, alone and in-combination.
- Chapter 6: Site conclusions – the conclusions of chapter 5 are summarised for clarity and the overall finding of this Part of the RIAA is provided.

7. The scope of this Part of the RIAA covers all relevant SPAs (and Ramsar sites) and relevant qualifying interest features where LSEs have been identified due to impacts arising from the Proposed Development. This report will provide the competent authority with the information required to undertake an HRA Stage Two Appropriate Assessment (see Part One of the RIAA for more detail on the HRA process).

1.4. CONTRIBUTING AUTHORS

8. Further detail on the contributing authors, their qualifications and experience is provided below:

1.4.1. ROYAL HASKONINGDHV: DR MURRAY GRANT (BSC, PHD)

9. Murray is the Technical Director for ornithology at Royal HaskoningDHV. He has over 25 years' experience as an applied ornithologist, with a science background and expertise in HRA and EIA gained from leading and managing a wide range of projects concerned with assessing and advising on the ornithological impacts of (primarily) offshore renewables developments. This has included the EIA and HRA productions and provision of post-consent support for a range of major offshore wind farm projects. Murray also provided technical support for the Judicial Review (and subsequent appeal) of the Forth and Tay wind farms, has provided Expert Witness and technical support for Public Inquiries, and represented projects at Planning Inspectorate Hearings. He has published widely in the peer reviewed scientific literature, as well as being a contributory author for several books on ornithology and ecology. Prior to working in consultancy he was a Principal Conservation Scientist at RSPB.

10. Sections:

- Lead Author.
- Chapter 1 Introduction up to and including section 5.6 Highly Pathogenic Avian Influenza (HPAI).
- Section 5.7 Appropriate Assessments: Breeding Seabird Colony SPAs including sections 5.8.1 to 5.8.8 inclusive.
- Chapter 6 Conclusions.
- Appendix 3A.

1.4.2. PELAGICA ENVIRONMENTAL CONSULTANCY LTD: PHIL BLOOR (BSC)

11. Over 25 years' experience as either a regulator, environmental consultant or for a statutory nature conservation body, with 19 years' experience in the consenting of offshore wind farms. Phil has had significant involvement in the consenting of twenty UK offshore wind farm developments focussed on undertaking HRA's and assessing the potential impacts on birds and marine mammals. Since 2005, Phil has prepared 57 HRAs, over half of which have been related to offshore wind farm projects and undertaken EIAs relating to either birds, marine mammals and bats for five offshore wind farm projects.

12. Sections:

- Contributing Author.
- Section 5.6 Appropriate Assessments: Marine SPA including section 5.7.1
- Section 5.7 Appropriate Assessments: Breeding Seabird Colony SPAs including sections 5.8.9 to 5.8.20 inclusive.

1.4.3. APEM LTD. SEAN SWEENEY, DR TIM KAOSOAR AND JAMES CHAPMAN

13. Sean is an Associate Director and head of APEM's Ornithology Consultancy Team. He has over 15 years' experience in delivering ornithological EIA, SEA and HRA assessments for offshore wind, acting as expert witness for clients at PINS Examinations. Tim is a technical specialist and has most recently led the ornithology EIA chapters for both Awel y Môr and Rampion 2. Tim is an experienced biometrician with experience in a range of ornithological assessment tools. James is a senior ornithologist completing his PhD in relation to the marine renewable industry. James supports the APEM team with his statistical background in impact assessment modelling.

14. Sections:

- Contributing Author.
- Section 5.8 Appropriate Assessment: Migratory Waterbird SPAs including sections 5.8.1 to 5.8.19 inclusive.
- Appendices 3B and 3C.

2. CONSULTATION

15. Consultation has been undertaken with statutory stakeholders during key stages of the Proposed Development with regards to ornithological features of SPAs.

16. A summary of the details of all consultation undertaken to date which is relevant to this Part of the RIAA on SPAs, and the HRA process in general, is presented in Table 2.1.

Table 2.1: Consultation Summary

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
Relevant Consultation to Date (Relevant Advice Received for 2020 Berwick Bank Proposal)				
18 December 2019	Marine Scotland Licensing Operations Team (MS-LOT), Marine Scotland Science (MSS), NatureScot. Teleconference	Advised that revised guidance relating to foraging ranges for breeding seabirds was due to be published (Woodward *et al.,* 2019).	No	Noted.
11 May 2020	MS-LOT Screening response on the 2020 Berwick Bank proposal LSE Screening Report	The HRA must fully align with the impact pathways identified for assessment in the scoping opinion adopted by the Scottish Ministers in relation to the Proposed Development, dated 09 March 2021.	No	Updated throughout the HRA Screening Report for the revised Proposed Development (SSER, 2021b).
02 June 2020	MS-LOT, MSS, NatureScot Teleconference	Seabird breeding colony surveys for the Seabirds Count census are complete for east coast sites and data are available through the Seabird Monitoring Programme (SMP) online database. Outputs of the assessment will be the ornithology chapter, with various technical annexes on assessments and the HRA report. The Woodward *et al*., (2019) report on foraging ranges would lead to a larger long list but could be informed by the proposed interim baseline report due in Q4 2020 which would reduce LSE requirements. The Applicant reviewed the feasibility within the programme of the Proposed Development to delay LSE Screening submission until after production of the interim baseline report and has decided to proceed earlier as planned because there would not be sufficient time in the programme to accommodate a later submission of the LSE Screening report to after the publication of the interim baseline report. Noted to consider large gulls in the assessment as well as five key species: gannet, kittiwake, guillemot, razorbill and puffin.	No	Noted. The potential for LSE for gull species have been considered as part of the HRA Stage One LSE Screening.
30 June 2020	MS-LOT, MSS, NatureScot Teleconference	Pre-scoping meeting which included presentation of the approach to the LSE Screening and confirmation that it will be a single report including consideration of designated sites for ornithology, marine mammals, fish and shellfish and benthic ecology. Nationally/locally designated sites and the relevant qualifying features screened will be fully considered and assessed in the relevant chapter of the Offshore EIA Report. Programme for submission of Berwick Bank LSE Screening for stakeholder review is September 2020.	No	Both the HRA Stage One LSE Screening Report and the Stage Two RIAA follow the same approach and include designated sites for ornithology, marine mammals, fish and shellfish and benthic ecology.
14 December 2020	NatureScot Screening response on the 2020 Berwick Bank proposal LSE Screening Report.	Issues with report formatting and viewing embedded hyperlinks	No	The HRA Stage One LSE Screening Report for the revised Proposed Development (SSER, 2021b) was reformatted to A3 and all hyper-links were checked and updated.
Road Map Meetings 1 to 5 (July 2021 to January 2022)				
22 July 2021	Road Map Meeting 1 MS-LOT, MSS, NatureScot, Royal Society for Protection of Birds (RSPB) Teleconference	The Berwick Bank Wind Farm project design was outlined and discussed along with the project programme and key dates. Stakeholder engagement and consultation including the road map process was outlined. Initial discussions were had on technical ornithology elements including baseline characterisation, collision risk and displacement.	No	Road Map Meeting 1 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. The advice provided has been noted and taken into account by the assessment. The final baseline characterisation report is presented in the Offshore EIA Report volume 3, appendix 11.1. The final approach to Collision Risk Modelling (CRM) is presented in the Offshore EIA Report volume 3, appendix 11.3., and the final approach to displacement assessment is presented in the Offshore EIA Report volume 3, appendix 11.5.
09 August 2021	Road Map Meeting 2 MS-LOT, MSS, NatureScot, RSPB	Methods to be used to determine connectivity and apportion effects to breeding seabird SPA populations were discussed. The Applicant raised concerns on problems in operating the Marine MSS Apportioning Tool given this tool relies on use of the Seabird 2000 census data as reference	No	Road Map Meeting 2 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. The advice provided has been noted and taken into account by the assessment. Final apportioning methods are presented in the Offshore EIA Report volume 3, appendix 11.5.

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
	Teleconference	population sizes. The suggestion that breeding season apportioning is undertaken using the NatureScot Interim Guidance method not agreed by consultees. NatureScot were content that apportioning using the MSS Apportioning Tool relied on Seabird 2000 data and advised the Tool should be re-tried. NatureScot and MSS advised that connectivity (in the breeding season) should be determined by the species' mean-maximum plus 1 SD foraging range or the maximum foraging range (whichever is least). Applicant's proposal that the BDMPS population sizes should be used for apportioning in non-breeding season agreed for all species except guillemot, for which a regional population should be based upon the breeding season estimates.		
28 September 2021	Road Map Meeting 3 MS-LOT, MSS, NatureScot, RSPB Teleconference	The Applicant presented a summary of approach and work done for LSE Screening. LSE Screening identified one marine SPA, 28 breeding seabird colony SPAs and 17 migratory waterbird SPAs (and Ramsar sites) with potential connectivity to the Proposed Development. This includes breeding seabird SPAs and migratory waterbird SPAs (and Ramsar sites) in northern England, as advised by Natural England. Consideration of potential effect pathways reduced the list of breeding seabird colony SPAs for which LSE could not be excluded to 19 (but did not affect inclusion of the marine SPA or the 17 migratory waterbird SPAs and Ramsar sites). Consultees advised that collision assessments for the features of the migratory waterbird SPAs (and Ramsar sites) may have to rely on the 2014 Marine Scotland Science (MSS) commissioned report on the strategic collision risk of offshore wind farms to migratory birds (WWT 2014) if the updated report was not published in time for the Applicant's submission.	No	Road Map Meeting 3 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. The issues raised are essentially superseded by the consultee comments received as part of (and associated with) the Scottish Minister's Scoping Opinion, as detailed in this table below. The update to the 2014 report (WWT 2014) has not been published in time for the assessment and as such a qualitative approach to assessment of potential collision risk to migratory waterbirds and seabirds on passage has been undertaken in section 0.
08 December 2021	Road Map Meeting 4 MS-LOT, MSS, NatureScot, RSPB Teleconference	The Applicant sought further information regarding the likely availability of the update to the 2014 MSS commissioned report on the strategic collision risk of offshore wind farms to migratory birds (WWT 2014). It was noted that qualifying features of migratory waterbird SPAs (and Ramsar sites) for which LSE could not be excluded included species which were not covered in the 2014 report. NatureScot and MSS requested further information as to the species involved. In subsequent written advice (email of 14 January 2022 from MS-LOT), it was confirmed that the updated report on strategic collision risk to migratory birds may not be available in time for inclusion in the Applicant's submission and that assessment for any migratory species which are features of SPAs (and Ramsar sites) screened in for HRA Stage Two and which are not included in the 2014 report should be undertaken on a qualitative basis. It was also stated in this written advice that further assessment may be required following publication of the updated report, and that this could trigger additional information. In discussions on the approach to in-combination assessment: • NatureScot identified the need for in-combination effects to be considered at the scales of both the Forth and Tay region and 'UK waters'. • NatureScot and MS-LOT advised that in relation to the in-combination totals, information should be provided on the stage of the contributory projects (e.g. operational, consented, PEIR). • NatureScot and MS-LOT stated that for Scottish projects it was appropriate to use 'as-built' (as opposed to 'consented') designs due to greater clarity on this issue than in England. • NatureScot and MS-LOT identified a need to consider the 2014 design for Inch Cape because this project held consents for both the 2014 and 2017 designs. However, subsequent discussions between MS-LOT and Inch Cape Offshore Limited (referred to during Road Map Meeting 5) identified that the 2014 consented design did not need to be considered and that the 2017 design should be used.	No	Road Map Meeting 4 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. The advice provided has been noted and taken into account by the assessment. The update to the 2014 report (WWT 2014) has not been published in time for the assessment and as such a qualitative approach to assessment of potential collision risk to migratory waterbirds and seabirds on passage has been undertaken in section 0 The approach to in-combination assessment is presented in section 5.3, with detailed methodology for calculating in-combination totals outlined in the Offshore EIA Report volume 3, appendix 11.6, annex E. In-combination effects are considered at both regional and UK North Sea scales. The stage of projects included in in-combination totals has been provided in the Offshore EIA Report volume 3, appendix 11.6, annex E. Options based on consented and 'as-built' designs were also considered but this had minimal effects on the in-combination totals. As such, only estimates for consented designs were considered. Displacement effects for small projects were considered on a quantitative basis where such information was available. Following NatureScot advice, all sites with potential connectivity to the Proposed Development were screened in for assessment in order to consider the potential for in-combination effects.

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
		• NatureScot and MS-LOT advised that displacement effects for 'small' projects (e.g. Kincardine Wind Farm) should be included on a quantitative basis where such information was available (in contrast to the approach advised in the Scoping Opinions for the revised designs of the Forth and Tay projects (e.g. Marine Scotland 2017)). • The Applicant raised the issue of the practical challenges posed by determining the potential for LSE for very distant breeding seabird colony SPAs (meaning that a very large number of qualifying features are considered at HRA Stage Two), despite the fact that the Proposed Development's effects on such sites could only ever be very small. However, NatureScot considered that the regulations make it necessary to include all such SPAs due to the need to account for possible in-combination effects.		
31 January 2022	Road Map Meeting 5 MS-LOT, MSS, NatureScot, RSPB Teleconference	Following further discussions and work on the MSS Apportioning Tool, the Applicant confirmed that breeding season apportioning to SPA colonies would use this tool for kittiwake, guillemot and razorbill, with the NatureScot Interim Guidance method used for other seabird species. NatureScot confirmed this was likely to acceptable but noted that it was subject to the further discussions to be had at the February 'Tools Workshop'. NatureScot also advised that the non-breeding season apportioning of herring gull to breeding colony SPA populations should be based upon a population as defined on a regional basis (as opposed to the BDMPS), contrary to the advice provided at Road Map Meeting 2. It was advised that this should include consideration of the influx of birds from other countries/regions during the winter period. Following discussion between consultees it was also confirmed that the baseline for in-combination assessments should consider effects from all projects and not exclude those which are now operational.	No	Road Map Meeting 5 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. Advice on non-breeding season apportioning of herring gull has been noted and accounted for by the assessment. Further detail on apportioning methods is presented in the Offshore EIA Report volume 3, appendix 11.5. Operational sites have been considered in the in-combination assessment, with further details on the in-combination totals provided in the Offshore EIA Report volume 3, appendix 11.6, annex E.
Formal Response to HRA Stage One LSE Screening – February 2022 (MS-LOT, 2022)				
04 February 2022	MS-LOT	Highlight NatureScot December 2021 representation regarding updated conservation objectives and Conservation Management Advice for the Outer Firth of Forth and St Andrews Bay Complex SPA.	Yes	Noted and assessment has been undertaken with reference to these updates in section 5.6.
	MS-LOT	Highlight the NatureScot December 2021 representation and MSS December 2021 advice that connectivity for breeding seabird SPAs should be based upon by-sea distances and not straight-line distances.	No	Although the HRA Stage One LSE Screening Report used straight-line distances as a first sift, the final conclusions regarding breeding season connectivity are effectively based on the by-sea distances as recognised and accepted by MS-LOT. No change made.
	MS-LOT	Confirm that all of the species associated with the Farne Islands SPA as detailed in the representation of Natural England should be screened in	Yes	Natural England identified one qualifying feature and six named components of the breeding seabird assemblage feature of the Farne Islands SPA which had been omitted from consideration in the HRA Stage One LSE Screening Report (erroneously in one case and because the Natural England Designated Sites View does not yet identify their inclusion for the other cases). Of these species, black-headed gull and great black-backed gull do not have potential for connectivity with the Proposed Development, Sandwich tern has potential connectivity but is screened out on the basis of so few birds being recorded during baseline surveys (as detailed in the HRA Stage One LSE Screening Report) and fulmar has potential connectivity but no identified pathway to effect (and is also screened out). Therefore, of the species identified in this regard by Natural England, only lesser black-backed gull, herring gull and razorbill were advanced to HRA Stage Two Appropriate Assessment.
	MS-LOT	Advise that any UK SPA contributing to the BDMPS for the non-breeding season assessment must be screened in and taken forward for determination of LSE, as per the NatureScot December 2021 representation and MSS December 2021 advice.	Yes	Following NatureScot advice, all sites with potential connectivity to the Proposed Development were screened in for assessment in order to consider the potential for in-combination effects. Further details on the in-combination totals are provided in the Offshore EIA Report volume 3, appendix 11.6, annex E and in the Offshore EIA Report volume 3, appendix 11.5.

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
	MS-LOT	Advise that common guillemot from the Flamborough and Filey Coast SPA is screened in for potential impacts during the non-breeding season, as indicated in the Natural England representation (meaning that apportioning would be based upon use of the BDMPS).	No	Further correspondence and discussion on this issue highlighted that this meant different SNCBs were advocating different approaches to apportioning non-breeding season effects on SPA breeding guillemot populations (K. Bell, 02/03/2022; Offshore EIA Report volume 3, appendix 11.8, annex A). This would mean two different approaches to the assessment of these populations. Subsequent advice from NatureScot was that the available evidence suggested that apportioning should be based upon the breeding season foraging range and not the BDMPS (K. Taylor, email 20/05/2022), with Natural England agreeing that it would be acceptable for the project alone effects as calculated using the BDMPS approach to be provided to them for future use in assessments for other projects without the need for inclusion in the Applicant's assessment (B. Rogers, email 24/06/2022).
	MS-LOT	Impact pathways and determination of LSE to be implemented as indicated in the NatureScot December 2021 representation and MSS December 2021 advice.	Yes	Details of responses to the individual points raised by the NatureScot December 2021 representation and MSS December 2021 advice are provided below.
	MS-LOT	Potential collision risk to migratory waterbirds and seabirds on passage should be assessed with reference to site-specific survey results and the Marine Scotland commissioned update to the 2014 report (WWT 2014). If the updated report is not available in time for inclusion in the Applicant's assessment, then a qualitative assessment is required for any species not included in the 2014 report but, in this circumstance, further assessment may be required following publication of the update to the 2014 report.	No	The update to the 2014 report (WWT 2014) has not been published in time for the assessment and as such a qualitative approach to assessment of potential collision risk to migratory waterbirds and seabirds on passage has been undertaken in section 0.
	MS-LOT	Water quality/suspended sediment during construction and decommissioning to be considered as an impact pathway.	No	It was agreed at Road Map Meeting 6 that this impact pathway is encompassed by the 'effects on prey availability pathway' and that it can be addressed via specific reference within the consideration of this pathway. Road Map Meeting 6 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A.
	MS-LOT	Direct habitat loss to be assessed for all development phases (including decommissioning) for all of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA.	Yes	This effect pathway is included in the HRA Stage Two Appropriate Assessment for the qualifying features of this SPA for the decommissioning phase as well as the construction and operation and maintenance phases.
	MS-LOT	Geese and other migratory waterbird features of the Outer Firth of Forth and St Andrews Bay Complex SPA to be screened for collision and barrier to movement.	Yes	These qualifying features of this SPA are considered in relation to both the collision and barrier to movement effect pathways in the HRA Stage Two Appropriate Assessment.
	MS-LOT	Breeding and non-breeding gannet from the Outer Firth of Forth and St Andrews Bay Complex SPA to be screened for barrier to movement.	No	Following discussion at Road Map Meeting 6 (the Offshore EIA Report volume 3, appendix 11.8, annex A), it was agreed that this change should not be made because non-breeding gannet are not a feature of this SPA. It was also agreed that the colony SPAs are the source SPAs for the breeding seabird qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA, so there is no need to consider barrier effects in this instance because it would lead to double counting of impacts on the relevant population.
07 December 2021	NatureScot	Highlights that the conservation objectives and Conservation Management Advice for the Outer Firth of Forth and St Andrews Bay Complex SPA are currently being revised.	No	See response above on this issue, as raised by MS-LOT.
	NatureScot	Connectivity for breeding seabird SPAs should be based upon by-sea distances and not straight-line distances.	No	See response above on this issue, as raised by MS-LOT.
	NatureScot	Incorrect breeding season foraging range value from Woodward *et al*., (2018) used in the HRA Screening Report for common tern	No	The value used in the HRA Stage One LSE Screening Report is incorrect but the difference with the correct value is small and this error does not affect any of the conclusions reached in the HRA Stage One LSE Screening Report.
	NatureScot	Advise that any UK SPA contributing to the BDMPS for the non-breeding season assessment must be screened in and taken forward for determination of LSE.	Yes	See response above on this issue as raised by MS-LOT.
	NatureScot	Advise that for HRA Stage Two, disturbance and displacement effects should be separated out but understand why treated together at the Screening stage.	No	Noted. These two effects are separated in the HRA Stage Two Appropriate Assessment for the breeding seabird colony SPAs.

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
	NatureScot	For East Caithness Cliffs SPA, seek understanding as to why guillemot screened out but razorbill screened in.	No	Neither qualifying feature of this SPA has connectivity during the breeding season (as the Proposed Development is beyond the respective mean maximum foraging ranges plus 1 SD). The contrasting Screening conclusions are due to the different apportioning methods NatureScot advise for the non-breeding season for guillemot and razorbill (with guillemot considered at a regional level whereas the BDMPS is used for razorbill).
	NatureScot	Seek understanding as to why Hoy SPA puffin are screened in.	No	Hoy SPA was concluded to be just within breeding season foraging range for puffin in the HRA Stage One LSE Screening Report. With the change in the boundary of the proposed Development array area since the submission of the HRA Stage One LSE Screening Report, this SPA is just beyond the foraging range but, given the small difference and coarse level, generic, foraging range measure on which connectivity is determined, no changes to the conclusion of HRA Stage One LSE Screening Report have been made in this regard.
	NatureScot	Potential collision risk to migratory waterbirds and seabirds on passage should be assessed with reference to site-specific survey results and the approach outlined in the Marine Scotland commissioned report on strategic collision risk of Scottish offshore wind farms to migratory birds (WWT 2014), taking account of any updates in the revised report should it be available in time.	No	See response above on this issue as raised by MS-LOT.
	NatureScot	Water quality/suspended sediment during construction and decommissioning to be considered as an impact pathway.	No	See response above on this issue as raised by MS-LOT.
	NatureScot	Direct habitat loss to be assessed for all development phases (including decommissioning) for all of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA.	Yes	See response above on this issue as raised by MS-LOT.
	NatureScot	Geese and other migratory waterbird features of the Outer Firth of Forth and St Andrews Bay Complex SPA to be screened for collision and barrier to movement.	Yes	See response above on this issue as raised by MS-LOT.
	NatureScot	Breeding and non-breeding gannet from the Outer Firth of Forth and St Andrews Bay Complex SPA to be screened for barrier to movement.	No	See response above on this issue as raised by MS-LOT.
	NatureScot	In-combination effects should be screened out for the qualifying features of the migratory waterbird SPAs for the construction and decommissioning phases (because no effect pathways are identified from the Project on these qualifying features during these phases).	Yes	In-combination effects for these SPA features are not considered for the construction and decommissioning phases in the HRA Stage Two Appropriate Assessment.
07 December 2021	Natural England	Advise that common guillemot from the Flamborough and Filey Coast SPA is screened in for potential impacts during the non-breeding season, on the basis of apportioning the non-breeding season effects using the BDMPS approach.	No	See response above on this issue as raised by MS-LOT.
	Natural England	Advise that all of the species associated with the Farne Islands SPA as detailed in the representation of Natural England should be screened in.	Yes	See response above on this issue as raised by MS-LOT.
16 December 2021	MSS	Connectivity for breeding seabird SPAs should be based upon by-sea distances and not straight-line distances.	No	See response above on this issue as raised by MS-LOT.
	MSS	Advise that any UK SPA contributing to the BDMPS for the non-breeding season assessment must be screened in and taken forward for determination of LSE and consider that all sites with potential for LSE from project alone or in combination should be advanced to HRA Stage Two. Further clarification is sought on how this is resolved.	Yes	See response above on this issue as raised by MS-LOT.
	MSS	MSS generally support the NatureScot comments regarding impact pathways and determination of LSE.	Yes	See responses above on the specific points, as raised in this regard by NatureScot and MS-LOT (noting that no issues additional to those raised by NatureScot and MS-LOT are identified by MSS).
Road Map Meeting 6 (May 2022)				
10 May 2022	Road Map Meeting 6 MS-LOT, MSS, NatureScot, RSPB Teleconference	Regarding approaches to apportioning to breeding seabird SPA colonies, the Applicant confirmed that the proposed approach was to use the MSS Apportioning Tool and NatureScot Apportioning method in the breeding season (as above for Road Map Meeting 5).	Yes	Road Map Meeting 6 minutes including actions are presented in the Offshore EIA Report volume 3, appendix 11.8, annex A. In-combination totals methodology is presented in the Offshore EIA Report volume 3, appendix 11.6, annex E. Approach to in-combination assessment is presented in section 4.5.

Date	Consultee and Type of Consultation	Issue(s) Raised	Change Required to Screening Outcomes Y/N?	Response to Issue Raised and/or Where Addressed
		Following the receipt of the Scottish Ministers' Scoping Opinion and the associated advice from consultees, the issue over the apportioning method to be used for guillemot in the non-breeding season was raised by the Applicant with clarification sought on whether the method advocated by NatureScot or by Natural England (or both) was to be applied. This was resolved via subsequent correspondence as detailed above. MS-LOT advised that the Applicant should seek further engagement with Natural England, including on HRA Screening and the high-level comment related to the level of evidence for concluding no LSE. Reference to this point is made in the letter of 01 June 2022 from the Applicant to Natural England, with assurance provided that conclusions of no LSE will be fully evidenced in the final HRA Report. There was also discussion of a number of specific HRA-related issues as raised in the consultee advice on the HRA Stage One LSE Screening Report, with the outcomes detailed in this table below (under the section on formal response to the HRA Stage One LSE Screening). Regarding the in-combination assessment, there was discussion over the approach that is to be taken to the collation of the in-combination effects on the breeding colony seabird SPAs. This was based upon an excel spreadsheet with summarised collision and displacement totals for relevant SPA qualifying features and an accompanying note that had been circulated to consultees ahead of Road Map Meeting 6. In relation to this material (and the associated presentation at Road Map Meeting 6), NatureScot indicated: Agreement with the broad approach adopted to the overall collation. Disagreement with restricting the non-breeding season displacement effects on SPA kittiwakes to the Forth and Tay Wind Farms (which had been on the basis that there was no previous collation of such effects for Scottish or English projects, as there was no previous requirement to assess them). Therefore, it was agreed to attempt to collate the information which would allow non-breeding displacement effects to be estimated from the larger and more recent developments in the UK North Sea region. The absence of in-combination totals for relevant SPA populations of lesser black-backed gull and Arctic tern was highlighted by the Applicant, with agreement from NatureScot that the absence of quantified effects from other relevant projects prevented such collation.		

3. SUMMARY OF HRA SCREENING CONCLUSIONS FOR SPECIAL PROTECTION AREAS

17. This section summarises all LSEs identified from the HRA Stage One Screening (arising alone and/or in-combination) for SPAs (and Ramsar sites) and defines the scope of the Stage Two assessments within this Part of the RIAA. An account is provided of any updates made to the screening outcomes as reported in the HRA Stage One Screening Report, which was shared with consultees in October 2021 (SSER, 2021b).

3.1. SCREENING OUTCOMES FOR THE PROPOSED DEVELOPMENT ALONE

18. As detailed in the HRA Stage One Screening Report (SSER, 2021b), a total of 37 European sites designated for ornithological features were originally advanced to HRA Stage Two Appropriate Assessment. These comprised one marine SPA, 19 breeding seabird colony SPAs and 17 migratory waterbird SPAs (and Ramsar sites).

19. Following receipt of the Berwick Bank Wind Farm Scoping Opinion and associated representations and advice (volume 3, appendix 6.2 of the Offshore EIA Report; Table 2.1), it was concluded that a further four qualifying features from breeding seabird colony SPAs should be advanced to HRA Stage Two.

20. These additional qualifying features included three named components of the breeding seabird assemblage feature from the Farne Islands SPA (i.e. lesser black-backed gull, herring gull and razorbill) which are not currently identified in the current version of the Conservation Advice provided in Natural England's Designated Sites System[1]. Natural England's scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report) also identified that the HRA Stage One Screening Report had erroneously omitted consideration of the Sandwich tern qualifying feature of the Farne Islands SPA. However, although the Farne Islands SPA Sandwich tern qualifying feature does have connectivity with the Proposed Development (including during the breeding season), there is no potential for LSE because of its low level of occurrence within the Offshore Ornithology Study Area and absence from the Proposed development array area (HRA Stage One Screening Report, volume 3, appendix 11.1 of the Offshore EIA Report).

21. The NatureScot scoping advice (volume 3, appendix 11.8 of the Offshore EIA Report) identified concerns with the screening out of SPA populations which had connectivity with the Proposed Development in the non-breeding season only and which comprised a small proportion of the relevant BDMPS population, making it likely that few individuals from these populations would occur within the area occupied by the Proposed Development (as detailed in paragraphs 142 – 146 of the HRA Stage One Screening Report). Therefore, this was investigated in more detail using the baseline survey data, which demonstrated for:

- Red-throated diver: Based on the mean peak population estimate within the Proposed Development array area for the non-breeding period (i.e 12 – volume 3, appendix 11.1, annex H of the Offshore EIA Report), no SPA population would be estimated to contribute more than a fraction of an adult bird to the non-breeding population within the Proposed Development array area. Up to five adult birds would be estimated to derive from the Ronas Hill – North Roe and Tingon SPA within the Offshore Ornithology Study Area but a high proportion of the birds recorded in the non-breeding period surveys (including for the peak counts) were located towards the outer parts of the 16km buffer where effects from the Proposed Development are unlikely (volume 3, appendix 11.1 of the Offshore EIA Report).
- Arctic tern: Based on the mean peak population estimate within the Proposed Development array area for the non-breeding period (i.e 19.5 – volume 3, appendix 11.1, annex H of the Offshore EIA Report), no SPA population would be estimated to contribute more than a fraction of an adult bird to the non-breeding population within the Proposed Development array area. Up to five adult birds would be estimated to derive from the Farne Islands SPA within the Offshore Ornithology Study Area but the vast majority of birds recorded in the non-breeding period surveys (including for the peak counts) were located towards the outer parts of the 16km buffer where effects from the Proposed Development are unlikely (volume 3, appendix 11.1 of the Offshore EIA Report).
- Common tern: Based on the mean peak population estimate within the Proposed Development array area for the non-breeding period (i.e 28.5 – volume 3, appendix 11.1, annex H of the Offshore EIA Report), no SPA population would be estimated to contribute more than a fraction of an adult bird to the non-breeding population within the Proposed Development array area. Up to a single adult bird would be estimated to derive from the Coquet Island SPA within the Offshore Ornithology Study Area but the vast majority of birds recorded in the non-breeding period surveys (including for the peak counts) were located towards the outer parts of the 16 kilometre buffer where effects from the Proposed Development are unlikely (volume 3, appendix 11.1 of the Offshore EIA Report).
- Great black-backed gull: Based on the mean peak population estimate within the Proposed Development array area for the non-breeding period (i.e. 63.5 – volume 3, appendix 11.1, annex H of the Offshore EIA Report), no SPA population would be estimated to contribute more than a fraction of an adult bird to the non-breeding population within the Proposed Development array area.
- Great skua: Based on the mean peak population estimate within the Proposed Development array area for the non-breeding period (i.e 28.5 – volume 3, appendix 11.1, annex H of the Offshore EIA Report), none of the SPA populations considered in Table 4.6 of the HRA Stage One Screening Report would be estimated to contribute more than a fraction of an adult bird to the non-breeding population within the Proposed Development array area. Up to a single adult bird would be estimated to derive from the Noss SPA within the Offshore Ornithology Study Area but some of birds recorded in the non-breeding period surveys (including from the peak counts) were located towards the outer parts of the 16km buffer where effects from the Proposed Development are unlikely (volume 3, appendix 11.1 of the Offshore EIA Report).
- Kittiwake: For each of the SPA populations identified in Table 4.6 of the HRA Stage One Screening Report, the number of adult birds that would be estimated within the Proposed Development and two kilometre buffer was calculated using the maximum of the two passage period mean peak abundance estimates and the maximum BDMPS proportion (volume 3, appendix 11.4 of the Offshore EIA Report). This indicated that for most of these SPA populations, at most a few tens of birds would be estimated to occur on the Proposed Development and two kilometre buffer during the non-breeding periods, with the combined potential mortalities from displacement/barrier effects and collisions likely to be fewer than a single adult bird (based upon the approaches used in the Scoping Approach for estimating these effects – see section 5.8 below). The one exception was the West Westray SPA, for which the number of adult birds estimated to occur within the Proposed Development and two kilometre buffer would be likely to be approximately 320.
- Razorbill: For each of the SPA populations identified in Table 4.6 of the HRA Stage One Screening Report, the number of adult birds that would be estimated within the Proposed Development and two kilometre buffer was calculated using the maximum of the different non-breeding period mean peak abundance

[1] Marine site detail (naturalengland.org.uk)

estimates and the maximum BDMPS proportion (volume 3, appendix 11.4 of the Offshore EIA Report). This indicated that for most of these SPA populations a few tens of birds would be estimated to occur on the Proposed Development and two kilometre buffer during the non-breeding periods, with the combined potential mortalities from displacement / barrier effects and collisions likely to be fewer than a single adult bird in all cases (based upon the approaches used in the Scoping Approach for estimating these effects – see section 5.8 below).

22. Given the above, the only additional SPA population taken forward to the HRA Stage Two assessment on the basis of connectivity during the non-breeding period is the West Westray SPA kittiwake population. Thus, in addition to those SPA populations for which it was concluded that LSE could not be excluded in the HRA Stage One Screening Report, a further four populations from two SPAs (i.e. West Westray and the Farne Islands) were advanced to HRA Stage Two. The inclusion of these means that the final number of SPAs (and Ramsar sites) advanced to HRA Stage Two is 38, of which 20 are breeding seabird colony SPAs.

23. The effect pathways associated with a LSE for qualifying features were originally identified in Tables 5.17 – 5.62 of the HRA Stage One Screening Report (SSER, 2021b)[2]. However, the Berwick Bank Wind Farm Scoping Opinion and associated scoping advice from consultees (volume 3, appendix 6.2 of the Offshore EIA Report) highlighted a small number of concerns in relation to the conclusions in these tables, and following further discussion with consultees on these points at Road Map Meeting 6 (see Table 2.1 and volume 3, appendix 11.8, annex A of the Offshore EIA Report), the following changes were agreed:

- Direct habitat loss included as an effect pathway during the decommissioning phase for qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA.
- Collision and barrier to movement both included as effects pathways for the waterbird populations which are qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA.
- In-combination effects for the qualifying features of the migratory waterbird SPAs (and Ramsar sites) are restricted to the operation and maintenance phase (as no effect pathways are identified from the Proposed Development during the construction and decommissioning phases).

24. Furthermore, it should be noted that common terns using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at Imperial Dock Lock SPA. The Imperial Dock Lock SPA was omitted from the HRA Stage One Screening Report (SSER, 2021b). This SPA is designated solely for its population of breeding common terns. Given that the Proposed Development is situated well beyond the foraging range of common tern breeding at this SPA (based on colony tracking data and a mean maximum plus 1 SD foraging range of 18.0±8.9 km; Wilson *et al*. 2014; Woodward *et al*. 2019), it is considered that there is no pathway for effect on common terns breeding at this colony. The Imperial Dock Lock SPA has therefore not been advanced to HRA Stage Two but is considered as part of the assessment of the Outer Firth of Forth and St Andrews Bay Complex SPA.

25. The changes made to the boundary of the Proposed Development array area since the submission of the HRA Stage One Screening Report (see volume 1, chapter 4 of the Offshore EIA Report) also affect the conclusions regarding breeding season connectivity for a small number of breeding seabird colony SPA qualifying features for which the previous Proposed Development array area was close to the edge of their putative breeding season foraging range[3] (e.g. puffin from Hoy SPA – Tables 4.4 and 4.5 in the HRA Stage One Screening Report). However, since the boundary change was limited to contractions of less than 10 kilometre at any point, with no points of expansion, any such changes to the conclusions would be of little importance when considered in relation to the large extent of the foraging ranges and the coarse level, generic, way in which they are defined. Therefore, no changes were made to the conclusions regarding the potential for LSE on the basis of the boundary change.

26. The final list of the SPAs and Ramsar sites which are advanced to HRA Stage Two is presented in Table 3.1, along with details of the finalised list of qualifying features from these sites and the associated effect pathways for which the potential for LSE has been concluded. The locations of these SPAs and Ramsar sites is shown in Figure 3.1.

[2] Note that the summary of LSEs for the ornithology features of European sites presented in Table 7.1 of the HRA Stage One Screening Report contains a number of errors in terms of the effect pathways and project phases for which LSE is determined for the relevant qualifying features of the different SPAs (and Ramsar sites), and does not accurately reflect the conclusions for each SPA (and Ramsar site) as set out in Tables 5.17 – 5.62 of the HRA Stage One Screening Report.

[3] as defined by the mean maximum foraging range plus 1 standard deviation in Woodward *et al.,* (2019).

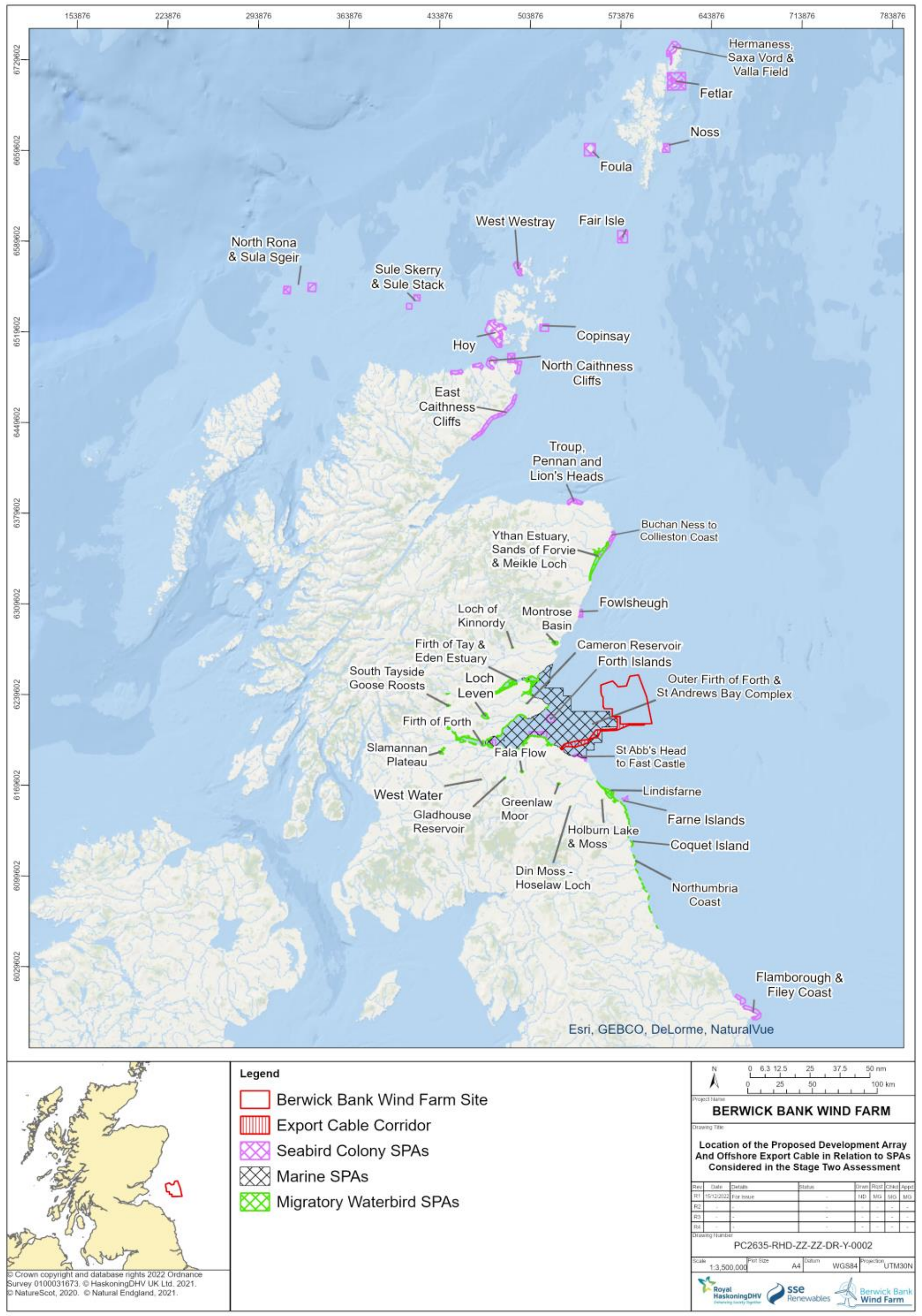

Figure 3.1: Location of European Sites Designated for Ornithological Features (Seabirds and Migratory Waterbirds) Taken Forward for the HRA Stage Two assessment.

3.2. SCREENING OUTCOMES FOR LIKELY SIGNIFICANT EFFECTS IN-COMBINATION

27. For all SPAs (and Ramsar sites) the potential for Likely Significant Effects In-Combination (LSEI) was identified for any qualifying features for which the potential for LSE in relation to the potential project alone effects could not be excluded. It was considered that there was no potential for LSEI where no LSE was concluded in relation to the potential project alone effects, given that effects were so low as to be inconsequential when added to in-combination totals. Therefore, no further SPAs (and Ramsar sites) were advanced to HRA Stage Two solely on the basis of the potential for LSEI.

3.3. SUMMARY TABLE OF LIKELY SIGNIFICANT EFFECTS IDENTIFIED AND CONSIDERED IN THE HRA STAGE TWO APPROPRIATE ASSESSMENT

28. A summary of the sites and features for which LSE has been identified, along with corresponding impact pathways for each phase of the Proposed Development, is provided in Table 3.1. Table 2.1 captures updates which have occurred following submission of the HRA Stage One Screening Report (SSER, 2021b).

Table 3.1: A Summary of all European Sites and Features for which LSE Could not be Discounted at HRA Stage One Screening and for which Appropriate Assessment is Required.

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
Marine SPAs						
1	Outer Firth of Forth and St Andrew's Bay Complex SPA	2.0	0.0	Common eider (non-breeding) Velvet scoter (non-breeding) Long-tailed duck (non-breeding) Common goldeneye (non-breeding) Red-breasted merganser (non-breeding) Red-throated diver (non-breeding) Slavonian grebe (non-breeding) Waterfowl assemblage (non-breeding)	Construction	Direct habitat loss Disturbance Displacement Changes to prey availability
					Operation and maintenance	Direct habitat loss Disturbance Displacement/barrier effects Changes to prey availability
					Decommissioning	Direct habitat loss Disturbance Displacement Changes to prey availability
				Kittiwake (breeding) Herring gull (breeding) Common tern (breeding) Arctic tern (breeding) Guillemot (breeding) Puffin (breeding) Manx shearwater (breeding) Gannet (breeding) Shag (breeding) Seabird assemblage (breeding)	Construction	Direct habitat loss Disturbance Displacement Changes to prey availability
					Operation and maintenance	Direct habitat loss Disturbance Displacement/barrier effects Collision (kittiwake, herring gull, common tern, Arctic tern, little gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Direct habitat loss Disturbance Displacement Changes to prey availability
				Kittiwake (non-breeding) Black-headed gull (non-breeding) Little gull (non-breeding) Common gull (non-breeding) Herring gull (non-breeding) Guillemot (non-breeding) Razorbill (non-breeding) Shag (breeding) Seabird assemblage (non-breeding)	Construction	Direct habitat loss Disturbance Displacement Changes to prey availability
					Operation and maintenance	Direct habitat loss Disturbance Displacement/barrier effects Collision (kittiwake, herring gull, little gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Direct habitat loss Disturbance Displacement Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
Breeding Seabird Colonies						
2	St. Abb's Head to Fast Castle SPA	36.7	5.4	Kittiwake (breeding) Herring gull (breeding) Guillemot (breeding) Razorbill (breeding) Seabird assemblage (breeding)	Construction	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, seabird assemblage only) Changes to prey availability
					Operation and maintenance	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement/barrier effects (kittiwake, guillemot, razorbill, seabird assemblage only) Collision (kittiwake, herring gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, seabird assemblage only) Changes to prey availability
3	Forth Islands SPA	38.3	13.7	Kittiwake (breeding) Herring gull (breeding) Lesser black-backed gull (breeding) Common tern (breeding) Arctic tern (breeding) Guillemot (breeding) Razorbill (breeding) Puffin (breeding) Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Displacement (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Changes to prey availability
					Operation and maintenance	Disturbance (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Displacement/barrier effects (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Collision (kittiwake, herring gull, lesser black-backed gull, common tern, Arctic tern, gannet, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Displacement (kittiwake, common tern, Arctic tern, guillemot, razorbill, puffin, gannet, seabird assemblage only) Changes to prey availability
4	Fowlsheugh SPA	54.2	80.6	Kittiwake (breeding) Herring gull (breeding) Guillemot (breeding) Razorbill (breeding) Seabird assemblage (breeding)	Construction	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, seabird assemblage only) Changes to prey availability
					Operation and maintenance	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement/barrier effects (kittiwake, guillemot, razorbill, seabird assemblage only) Collision (kittiwake, herring gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, guillemot, razorbill, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, seabird assemblage only) Changes to prey availability
5	Farne Islands SPA	55.6	50.5	Kittiwake (breeding) Guillemot (breeding) Puffin (breeding)	Construction	Disturbance (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
				Lesser black-backed gull (breeding) Herring gull (breeding) Razorbill (breeding) Seabird assemblage (breeding)	Operation and maintenance	Disturbance (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Displacement/barrier effects (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Collision (kittiwake, herring gull, lesser black-backed gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Displacement (kittiwake, guillemot, razorbill, puffin, seabird assemblage only) Changes to prey availability
6	Coquet Island SPA	90.2	83.2	Kittiwake (breeding) Lesser black-backed gull (breeding) Puffin (breeding) Seabird assemblage (breeding)	Construction	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement (kittiwake, puffin, seabird assemblage only) Changes to prey availability
					Operation and maintenance	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement/barrier effects (kittiwake, puffin, seabird assemblage only) Collision (kittiwake, lesser black-backed gull, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement (kittiwake, puffin, seabird assemblage only) Changes to prey availability
7	Buchan Ness to Collieston Coast SPA	96.1	125.0	Kittiwake (breeding) Guillemot (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
8	Troup, Pennan and Lion's Heads SPA	137.8	165.7	Kittiwake (breeding) Guillemot (breeding) Razorbill (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
9	East Caithness Cliffs SPA	213.4	239.6	Kittiwake (breeding) Razorbill (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
10	Flamborough and Filey Coast SPA	219.2	219.9	Kittiwake (breeding) Razorbill (breeding) Puffin (breeding) Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, gannet, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
11	North Caithness Cliffs SPA	248.1	274.7	Kittiwake (breeding) Puffin (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
12	Hoy SPA	271.8	298.2	Kittiwake (breeding) Great skua (breeding) Puffin (breeding) Seabird assemblage (breeding)	Construction	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement (kittiwake, puffin, seabird assemblage only) Changes to prey availability
					Operation and maintenance	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement/barrier effects (kittiwake, puffin, seabird assemblage only) Collision (kittiwake, great skua, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance (kittiwake, puffin, seabird assemblage only) Displacement (kittiwake, puffin, seabird assemblage only) Changes to prey availability
13	Copinsay SPA	273.8	301.9	Kittiwake (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
14	West Westray SPA	320.4	347.9	Kittiwake (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (kittiwake, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
15	Sule Skerry and Sule Stack SPA	325.1	351.3	Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (gannet, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
16	Fair Isle SPA	334.1	366.1	Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (gannet, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
17	North Rona and Sula Sgeir SPA	375.4	398.9	Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
					Operation and maintenance	Disturbance Displacement/barrier effects Collision (gannet, seabird assemblage only) Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
18	Foula SPA	402.4	433.4	Great skua (breeding) Seabird assemblage (breeding)	Construction	-
					Operation and maintenance	Collision
					Decommissioning	-
19	Noss SPA	404.3	437.2	Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability
20	Fetlar SPA	452.4	485.4	Great skua (breeding) Seabird assemblage (breeding)	Construction	-
					Operation and maintenance	Collision
					Decommissioning	-
21	Hermaness, Saxa Vord and Valla Field SPA	472.0	505.1	Gannet (breeding) Seabird assemblage (breeding)	Construction	Disturbance Displacement Changes to prey availability
					Operation and maintenance	Disturbance Displacement/barrier effects Collision Changes to prey availability
					Decommissioning	Disturbance Displacement Changes to prey availability

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
Migratory Waterbird Sites (Estuarine)						
22	Firth of Forth SPA and Ramsar site	41.6	5.9	Bar-tailed godwit (non-breeding) Common scoter (non-breeding) Cormorant (non-breeding) Curlew (non-breeding) Dunlin (non-breeding) Eider (non-breeding) Golden plover (non-breeding) Goldeneye (non-breeding) Great crested grebe (non-breeding) Grey plover (non-breeding) Knot (non-breeding) Lapwing (non-breeding) Long-tailed duck (non-breeding) Mallard (non-breeding) Oystercatcher (non-breeding) Pink-footed goose (non-breeding) Red-breasted merganser (non-breeding) Red-throated diver (non-breeding) Redshank (non-breeding) Ringed plover (non-breeding) Sandwich tern (passage) Scaup (non-breeding) Shelduck (non-breeding) Slavonian grebe (non-breeding) Turnstone (non-breeding) Velvet scoter (non-breeding) Wigeon (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
23	Montrose Basin SPA and Ramsar site	45.8	70.6	Dunlin (non-breeding) Eider (non-breeding) Greylag goose (non-breeding) Knot (non-breeding) Oystercatcher (non-breeding) Pink-footed goose (non-breeding) Redshank (non-breeding) Shelduck (non-breeding) Wigeon (non-breeding)	Operation and maintenance	Collision Barrier effects
24	Northumbria Coast SPA and Ramsar site	47.6	30.1	Purple sandpiper (non-breeding) Turnstone (non-breeding)	Operation and maintenance	Collision Barrier effects
25	Firth of Tay and Eden Estuary SPA and Ramsar site	47.7	45.3	Bar-tailed godwit (non-breeding) Common scoter (non-breeding) Cormorant (non-breeding) Dunlin (non-breeding) Eider (non-breeding) Goldeneye (non-breeding) Goosander (non-breeding)	Operation and maintenance	Collision Barrier effects

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
				Grey plover (non-breeding) Greylag goose (non-breeding) Icelandic black-tailed godwit (non-breeding) Long-tailed duck (non-breeding) Oystercatcher (non-breeding) Pink-footed goose (non-breeding) Red-breasted merganser (non-breeding) Redshank (non-breeding) Sanderling (non-breeding) Shelduck (non-breeding) Velvet scoter (non-breeding) Waterfowl assemblage (non-breeding)		
26	Lindisfarne SPA and Ramsar site	49.1	32.6	Bar-tailed godwit (non-breeding) Common scoter (non-breeding) Dunlin (non-breeding) Eider (non-breeding) Golden plover (non-breeding) Grey plover (non-breeding) Greylag goose (non-breeding) Light-bellied brent goose (non-breeding) Long-tailed duck (non-breeding) Red-breasted merganser (non-breeding) Redshank (non-breeding) Ringed plover (non-breeding) Sanderling (non-breeding) Shelduck (non-breeding) Whooper swan (non-breeding) Wigeon (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
27	Ythan Estuary, Sands of Forvie and Meikle Loch SPA, Ythan Estuary and Meikle Loch Ramsar site	79.7	106.8	Eider (non-breeding) Lapwing (non-breeding) Pink-footed goose (non-breeding) Redshank (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
Migratory Waterbird Sites (Inland Waterbodies)						
28	Cameron Reservoir SPA and Ramsar site	57.0	42.0	Pink-footed goose (non-breeding)	Operation and maintenance	Collision Barrier effects
29	Holburn Lake and Moss SPA and Ramsar site	60.2	44.9	Greylag goose (non-breeding)	Operation and maintenance	Collision Barrier effects
30	Greenlaw Moor SPA and Ramsar site	65.2	25.7	Pink-footed goose (non-breeding)	Operation and maintenance	Collision Barrier effects
31	Loch of Kinnordy SPA and Ramsar site	73.3	84.1	Pink-footed goose (non-breeding) Greylag goose (non-breeding)	Operation and maintenance	Collision Barrier effects

No.	European Site	Distance to (km)		Relevant Qualifying Interest Feature(s)	Phase	Impact
		Proposed Development Array Area	Proposed Development Export Cable Corridor			
32	Din Moss - Hoselaw Loch SPA and Ramsar site	73.8	43.7	Pink-footed goose (non-breeding) Greylag goose (non-breeding)	Operation and maintenance	Collision Barrier effects
33	Fala Flow SPA and Ramsar site	79.0	33.4	Pink-footed goose (non-breeding)	Operation and maintenance	Collision Barrier effects
34	Loch Leven SPA and Ramsar site	88.7	59.8	Cormorant (non-breeding) Gadwall (non-breeding) Goldeneye (non-breeding) Pink-footed goose (non-breeding) Pochard (non-breeding) Shoveler (non-breeding) Teal (non-breeding) Tufted duck (non-breeding) Whooper swan (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
35	Gladhouse Reservoir SPA and Ramsar site	92.5	47.3	Pink-footed goose (non-breeding)	Operation and maintenance	Collision Barrier effects
36	South Tayside Goose Roosts SPA and Ramsar site	100.7	81.9	Pink-footed goose (non-breeding) Greylag goose (non-breeding) Wigeon (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
37	Westwater SPA and Ramsar site	109.5	65.4	Pink-footed goose (non-breeding) Waterfowl assemblage (non-breeding)	Operation and maintenance	Collision Barrier effects
38	Slamannan Plateau SPA	128.8	90.5	Taiga been goose (non-breeding)	Operation and maintenance	Collision Barrier effects

4. INFORMATION TO INFORM THE APPROPRIATE ASSESSMENTS

29. As described in chapter 2 of Part One of the RIAA, a European site is progressed to the Appropriate Assessment stage (Stage Two of the HRA process) where it is not possible to exclude an LSE on one or more of its qualifying interest features in view of the site's conservation objectives. European sites, features and potential impacts requiring an Appropriate Assessment for the Proposed Development are therefore those for which LSE could not be ruled out during the Screening exercise and following consultation (see Table 3.1).

30. Information to help inform the Appropriate Assessment for SPAs (and Ramsar sites) is provided in the following sections of this Part of the RIAA. The information provided includes a description of the SPAs (and Ramsar sites) under consideration, their qualifying interest features, and an assessment of potential effects on site integrity in light of the conservation objectives of each site. A cross-referencing approach has been adopted to aide readability and reduce repetition where relevant, but that this has been carefully carried out to ensure that all information required for a robust HRA of each site is presented.

4.1. MAXIMUM DESIGN SCENARIO

31. Assessments for all European sites considered in this Part of the RIAA are based on a realistic maximum design scenario derived from the design envelope for the Proposed Development. An overview of the maximum design scenario considered for the assessment of potential impacts on ornithological features considered in this Part of the RIAA has been provided in Table 4.1.

32. The maximum design scenario is consistent with that used for assessment in the relevant chapter of the Offshore EIA Report (volume 2, chapter 11 of the Offshore EIA Report).

4.2. DESIGNED IN MEASURES

33. As part of the project design process, a number of designed in measures have been included in the Proposed Development and are committed to be delivered by the Applicant as part of the Proposed Development. These designed in measures are integrated into the project description for the Proposed Development and are not considered as mitigation measures intended to specifically avoid or reduce effects on European sites.

34. Measures intended specifically to avoid or reduce effects on European sites were not considered during the HRA Stage One Screening but are included within the HRA Stage Two Appropriate Assessment for determination of Adverse Effects on Integrity.

35. An overview of the designed in measures of relevance for ornithological features is provided in Table 4.2.

4.3. BASELINE INFORMATION

36. Baseline information on the European sites (i.e. SPAs for this Part of the RIAA) identified for further assessment within HRA Stage Two Appropriate Assessment has been gathered through a suite of contemporary site-specific surveys, in addition to a comprehensive desktop study of existing studies and datasets. Baseline information is presented in detail in volume 3, appendix 11.1 of the Offshore EIA Report and summarised in volume 2, chapter 11 of the Offshore EIA Report.

37. The key data sources are presented within volume 2, chapter 11 of the Offshore EIA Report. Notably, the assessment is underpinned by technical appendices that are derived from analyses of the baseline survey data which include:

- volume 3, appendix 11.1 Baseline Ornithology Technical Report;
- volume 3, appendix 11.3 Ornithology Collision Risk Modelling Technical Report;
- volume 3, appendix 11.4 Ornithology Displacement Technical Report;
- volume 3, appendix 11.5 Ornithology Apportioning Technical Report;
- volume 3, appendix 11.6 Ornithology Population Viability Assessment Technical Report; and
- volume 3, appendix 11.8 Offshore Ornithology Road Map.

38. Furthermore, a suite of supporting technical annexes to these appendices are referred to within the assessment, including:

- volume 3, appendix 11.3, annex B Boat-Based Kittiwake Collision Estimates;
- volume 3, appendix 11.3. annex C Stochastic Collision Risk Modelling;
- volume 3, appendix 11.4, annex B Monthly Apportioned Population Estimates;
- volume 3, appendix 11.4, annex E Analysis of GPS Data for Gannets from the Bass Rock Colony;
- volume 3, appendix 11.4, annex G Justification of Developer and Scoping Approach;
- volume 3, appendix 11.4, annex H SeabORD Sensitivity Analysis Report;
- volume 3, appendix 11.6, annex E Summary of Approach and Collation of In-Combination Totals;
- volume 3, appendix 11.6, annex F Asymptotic Age Distributions; and
- volume 3, appendix 11.8, annex A Road Map Meeting Minutes.

39. Any additional sources of information used in the HRA Stage Two Appropriate Assessment are summarised within the main body of this Part of the RIAA and in appendix 3A.

4.4. CONSERVATION OBJECTIVES AND CONSERVATION ADVICE

40. Conservation objectives set the framework for establishing appropriate conservation measures for each feature of a site and provide a framework against which plans or projects can be assessed. The conservation objectives set out the essential elements needed to ensure that the favourable conservation status (FCS) of a qualifying habitat or species is maintained or restored at a site. If all the conservation objectives are met, then the integrity of the site will be maintained.

41. In this Part of the RIAA, the Applicant has referenced the most up-to-date conservation objectives and conservation advice available. The statutory nature conservation bodies (SNCBs) have produced conservation advice for European sites under their statutory remit. This conservation advice provides supplementary information on sites and features, and although the content provided is similar, the format of the advice provided varies between the different SNCBs.

42. For European sites under the statutory remit of NatureScot, Conservation and Management Advice documents (CMAs) have been produced for all marine SPAs. These documents contain revised and updated conservation objectives for the features of each site, site-specific clarifications and advice in order for the conservation objectives to be achieved, and advice on management required to achieve the conservation objectives. Each objective includes site-specific supplementary advice.

43. For European sites under the statutory remit of Natural England, Supplementary Advice to the conservation objectives has been produced for some SPAs, which provide site-specific attributes and targets specific to the features of the site.

44. Where Ramsar interests coincide with qualifying features within an SPA, the advice for overlapping designations is considered to be sufficient to support the management of the Ramsar interests. Therefore, the conservation objectives are referenced for both designations.

45. Further details are provided in appendix 3A, and/or referenced in the course of the HRA Stage Two Appropriate Assessment.

4.5. APPROACH TO THE IN-COMBINATION ASSESSMENTS

46. The Marine Scotland Science Consenting and Licensing Guidance: For Offshore Wind, Wave and Tidal Energy Applications (Scottish Government 2018) states that 'Engagement with MS-LOT is required to identify which plans/projects/ongoing activities should be included in the in-combination element of the cumulative effects assessment.' The offshore wind projects in the Forth and Tay region have been considered, alongside other developments, including those which:

- became operational since baseline characterisation;
- are under construction;
- those with consent and submitted but not yet determined;
- those projects with a Scoping Report; and
- plans and projects which are "reasonably foreseeable" (i.e. developments that are being planned, including, for example, offshore renewable energy projects which have a Crown Estate Agreement for Lease (AfL), offshore renewable energy projects that have been scoped).

47. The in-combination assessment has considered all other relevant plans and projects where detail to inform the assessment is publicly available three months prior to the Proposed Development application.

48. The approach taken for the assessment of in-combination impacts in this Part of the RIAA has been informed by the cumulative effects assessment (CEA) carried out in volume 2, chapter 11 of the Offshore EIA Report. The plans and projects selected as relevant to the in-combination assessment presented in this Part of the RIAA are based upon the results of a Screening exercise undertaken for volume 2, chapter 11 of the Offshore EIA Report (see volume 3, appendix 6.3 of the Offshore EIA Report). Each plan or project has been considered on a case-by-case basis for inclusion based upon data confidence, effect pathways and the spatial/temporal scales involved.

49. In undertaking the in-combination assessment, it is important to bear in mind that other plans and projects under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to an in-combination effect alongside the Proposed Development. Therefore, a tiered approach has been adopted. This provides a framework for placing relative weight upon the potential for each plan or project to be included in the in-combination assessment to ultimately be realised, based upon the plan or project's current stage of maturity and certainty in the projects' parameters. The tiered approach which has been utilised within the in-combination assessment employs the following tiers:

- tier 1 assessment – Proposed Development (Berwick Bank Wind Farm offshore) with Berwick Bank Wind Farm onshore;
- tier 2 assessment – all plans/projects assessed under Tier 1, plus projects which are operational, under construction, those with consent, and those which have been submitted but are not yet determined;
- tier 3 assessment – all plans/projects assessed under Tier 2, plus those projects that have submitted Scoping Report but not a consent application; and
- tier 4 assessment – All plans/projects assessed under Tier 3, plus those projects likely to come forward where an Agreement for Lease (AfL) has been granted.

50. This tiered approach has been adopted to provide an explicit assessment of the Proposed Development as a whole.

51. The specific projects scoped into the in-combination assessment for this Part of the RIAA are detailed in Annex E in volume 3, appendix 11.6 of the Offshore EIA Report, noting that these differ between SPA populations according to variation in connectivity (which in turn is dependent on location, breeding season foraging ranges, and distribution and movements in the non-breeding periods).

52. The nature of effects that have been assessed for each ornithological feature, and the scale over which those effects may occur, are based on assessment criteria applied during the HRA Stage One Screening exercise as presented in section 3. These effects are detailed within the Proposed Development alone assessment (see section 3.1) and have not been re-iterated here. The overarching approach to the assessment of in-combination effects is set out in section 3.2. The range of potential in-combination effects is a subset of those considered for the Proposed Development alone assessment. This is because some of the potential impacts identified and assessed for the Proposed Development alone, are determined to be localised and temporary in nature. It is considered therefore, that these potential impacts have limited or no potential to interact with similar changes associated with other plans or projects.

53. Similarly, some of the potential effects considered within the Proposed Development alone assessment are specific to a particular phase of development (e.g. construction, operation and maintenance or decommissioning). Where the potential for in-combination effects with other plans or projects only have potential to occur where there is spatial or temporal overlap with the Proposed Development during certain phases of development, effects associated with a certain phase may be omitted from further consideration where no plans or projects have been identified that have the potential for in-combination effects during this period.

54. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the in-combination assessments were undertaken for the full suite of plan and projects considered to be potentially relevant and for the subset of these plans and projects represented by the other Forth and Tay wind farms (which are located in the same region as the Proposed Development). For the purposes of this assessment, the other Forth and Tay wind farms are taken to be the Seagreen 1, Seagreen 1A Project, Inch Cape and Neart na Gaoithe offshore wind farms. The in-combination assessment for this subset of plans and projects was undertaken in relation to those breeding seabird SPAs which were considered in the assessments for the revised designs of the other Forth and Tay wind farms – i.e. St Abb's Head to Fast Castle, Forth Islands, Fowlsheugh and Buchan Ness to Collieston Coast (e.g. Marine Scotland 2017a,b,c, ICOL 2018).

55. As described in volume 1, chapter 3 of the Offshore EIA Report, the Applicant is developing an additional export cable grid connection to Blyth, Northumberland (the Cambois Connection). Therefore, applications for necessary consents (including marine licences) will be applied for separately. The in-combination assessment for the Cambois Connection is based on information presented in the Cambois Connection Scoping Report (SSER, 2022e), submitted in October 2022. Although the Cambois Connection will overlap spatially and temporally with the Proposed Development, based on conclusions on the likely scale of impact from cable burial and installation of cable protection on key prey species and limited potential for indirect effects on qualifying features of SPAs as a result of temporary changes to prey distribution, the potential for in-combination impacts has been screened out (see volume 3, appendix 6.3 of the Offshore EIA Report). The CEA methodology is described in detail in volume 1, chapter 6 of the Offshore EIA Report and summarised below.

56. Furthermore, The Applicant is aware that on 04 July 2022, Inch Cape Offshore Limited (ICOL) applied to Scottish Ministers to vary its offshore consent to construct and operate Inch Cape Offshore Wind Farm[4]. The proposed variation(s) are at a very early stage in the development process. It was concluded in the supporting EIA and HRA Screening report[5] that there are no new or materially different impacts arising from the variation compared to the initial proposal (ICOL revised design as consented). Given that this is the most current information available (as of October 2022), the Applicant has continued to assess the ICOL revised design (as consented).

[4] Inch Cape Offshore Windfarm (Revised Design), Firth of Forth – Proposed Variation – Screening Request and Report | Marine Scotland Information

[5] Screening – Inch Cape Offshore Windfarm (Revised Design), Firth of Forth – Proposed Variation | Marine Scotland Information

Table 4.1: Maximum Design Scenario Considered for the Assessment of Potential Impacts on Ornithological Features.

Potential Impact	Phase[6] C	O	D	Maximum Design Scenario	Justification
Direct habitat loss (Outer Firth of Forth and St Andrews Bay Complex SPA only)	✓	✓	✓	**Construction Phase** Temporary subtidal habitat loss/disturbance within the SPA due to: • up to 400 km offshore export cables with seabed disturbance width of up to 15 m for cable burial; • offshore export cables installation at the landfall via trenchless burial techniques; • up to 8 exit punches out, each 20 m x 5 m, for removal of up to 8 cables from the landfall. Other impacts on fish and shellfish communities include: • increased SSC and associated deposition from construction activities; • injury and/or disturbance to fish and shellfish from underwater noise and vibration as a result of the clearance of UXOs. **Operation and Maintenance Phase** • routine annual cable inspections; • predicted maximum design scenario is four export cable reburial events and four export cable repair events of up to 1,000 m each over Proposed Development lifetime; • temporary subtidal habitat loss/disturbance due to export cable repair/reburial events; • increased SSCs and associated sediment deposition from cable repair/reburial events; • direct habitat loss due to cable protection for cable crossing: 33% of cable requiring protection resulting in a maximum volume of crossing protection material of 47,040 m^3. **Decommissioning Phase** As described for construction disturbance above	Maximum design scenarios described for fish and shellfish will result in the greatest potential impact.
Disturbance	✓	✓	✓	**Construction Phase** Vessels associated with site preparation, foundation installation, OSPs/Offshore convertor station platforms installation, inter-array cables, offshore export cables, and landfall works, with up to 11,484 vessel round trips over the construction phase; maximum vessels on site at any one time including: • up to 9 main installation vessels making up to 297 return trips; • up to 14 cargo barges making up to 194 return trips; • up to 9 support vessels making up to 714 return trips; • up to 22 tug/anchor handlers making up to 794 return trips; • up to 6 cable installation vessels making up to 36 return trips; • up to 22 guard vessels making up to 1,488 return trips; • up to 8 survey vessels making up to 464 return trips; • up to 14 crew transfer vessels (CTVs) making up to 3,342 return trips; • up to 10 scour/cable protection installation vessels making up to 3,390 return trips; and • up to 20 resupply vessels making up to 245 return trips. Other activities: • up to 10% of piles are anticipated to require drilling at wind turbine foundations (144 piles) with a maximum drilling duration of 96 days;	Maximum numbers of vessels on site at any one time and largest numbers of round trips during each phase of the Proposed Development and broad range of vessel types representative of vessels to be used during construction, operation and maintenance and decommissioning will result in the greatest potential impact. Range of other activities including maximum timescales (where available) during which activities are conducted.

[6] C = Construction, O = Operation and maintenance, D = Decommissioning

Potential Impact	Phase[6] C	O	D	Maximum Design Scenario	Justification
				• up to 32 piles will require drilling at OSPs/Offshore convertor station platforms foundations with a maximum drilling duration of up to 39 days; and • burial of 1,225 km of inter-array cables and 828 km of offshore export cables via jet trenching; along with cable laying and jack up rigs. **Operation and Maintenance Phase** Vessels used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys; maximum vessels on site at any one time including: • up to 4 CTVs making up to 832 return trips per year; • up to 1 jack up vessel making up to 2 return trips per year; • up to 2 support vessels making up to 26 return trips per year; • up to 1 cable repair vessel making up to 5 return trips per operational lifetime; • up to 2 service operations vessels (SOV, daughter craft) making up to 4 movements within Proposed Development array area per day; • up to 1 cable survey vessel making one return trip per year; and • up to 1 excavator/backhoe dredger making up to 5 return trips over operational lifetime. **Decommissioning Phase** Vessels used for a range of decommissioning activities such as removal of foundations, cables and cable protection. Vessels assumed to be similar to vessel activity described for construction phase above.	
Changes to prey availability	✓	✓	✓	**Construction Phase** Up to 113,974,700 m^2 of temporary subtidal habitat loss/disturbance due to: • use of jack-up vessels during foundation installation, with up to 4 jack-up events per wind turbine and 4 jack-up events per OSPs/Offshore convertor station platforms; • installation of up to 1,225 km of inter-array cables, up to 94 km of interconnector cable, up to 872 km offshore export cables with seabed disturbance width of: up to 25 m for sandwave clearance, up to 25 m for boulder clearance and up to 15 m for cable burial; • sandwave clearance for up to 20% of the Proposed Development export cable corridor length, up to 30% of inter-array cables and OSPs/ Offshore convertor station platforms interconnector cables; • Boulder clearance for up to 20% of offshore export cable length, inter-array cables and OSPs/Offshore convertor station platforms interconnector cables; • anchor placement; • offshore export cables installation at the landfall via trenchless burial techniques; • up to 8 exit punches out, each 20 m x 5 m, for removal of up to 8 cables from the landfall; and • clearance of up to 14 UXO. Other impacts on fish and shellfish communities include: • increased SSC and associated deposition from construction activities, such as drilling of 179 foundations, installation of up to 1,225 km of inter-array and up to 872 km of offshore export cables; • injury and/or disturbance to fish and shellfish from underwater noise and vibration as a result of the clearance of up to 14 UXOs and installation of 179 offshore wind turbines and up to 10 OSPs/ Offshore convertor station platforms; and. • up to 7,798,856 m^2 of long-term habitat loss due to presence of wind turbine and OSPs/Offshore convertor station platforms foundations as well as cable protection for cable crossing. Maximum duration of the offshore construction phase includes up to 373 days piling activity.	See volume 2, chapter 7, chapter 8 and chapter 9 of the Offshore EIA Report.

Potential Impact	Phase[6] C	O	D	Maximum Design Scenario	Justification
				Operation and Maintenance Phase • up to 989,000 m^2 temporary subtidal habitat loss/disturbance due to: major component replacements for wind turbines and OSPs/Offshore convertor station platforms; inter-array, interconnector and offshore export cable repair/reburial events; • increased SSCs and associated sediment deposition from cable repair/reburial events; • up to 7,798,856 m^2 of long-term subtidal habitat loss due to presence of: wind turbines on suction caisson foundations and 10 OSPs/Offshore convertor station platforms on jacket foundations with associated scour protection; cable protection associated with inter-array, interconnector and offshore export cables; cable protection for cable crossings; • EMF from subsea electrical cabling due to presence of inter-array and offshore export cables; • colonisation of foundations, scour protection and cable protection leading to long term habitat creation of up to 10,198,971 m^2; and • EMF from presence of up to 1,225 km of 66 kV inter-array cables and up to 872 km of 275 kV High Voltage Alternating Current (HVAC) offshore export cables. **Decommissioning Phase** • up to 34,571,200 m^2 temporary subtidal habitat loss/disturbance due to: use of jack up vessels during decommissioning of wind turbine and OSPs/Offshore convertor station platform foundations; complete removal of inter-array, interconnector and offshore export cables; anchor placement during cable decommissioning; • increased SSCs and associated sediment deposition from: cutting and removal of piled jacket foundations and decommissioning of inter-array, interconnector and offshore export cables; and • up to 7,562,609 m^2 permanent subtidal habitat loss due to complete removal of cable protection and scour protection for inter-array, OSPs/Offshore convertor station platform interconnector and offshore export cables.	
Displacement and barrier effects		✓		**Operation and Maintenance Phase** Based on a Proposed Development array area of 1,010.2 km^2 and with displacement occurring out to 2 km a combined Proposed Development array area plus 2 km buffer of 1,308 km^2.	Evidence from existing offshore wind farms indicates that if there is displacement that it will be limited to within 2 km of the wind farm boundary for all the ornithological features considered in this part of the RIAA (see Offshore EIA Report, volume 3, appendix 11.4 for further detail on displacement).
Collision		✓		**Operation and Maintenance Phase** • minimum turbine capacity of 14 MW. • between 179 and 307 turbines. • minimum air gap of 37 m LAT. Worst-case scenario of 307 x 14 MW turbines.	Collision risk modelling shows that 307 x 14 MW turbines have the largest theoretical collision impact risk for all species considered (see Offshore EIA Report, volume 3, appendix 11.3 for further detail on collision risk).

Table 4.2: Designed in Measures of Relevance to the Assessment of Potential Impacts on European Sites Designated for Ornithological Interest Features.

	Designed in Measure
Measure	Development of, and adherence to, a Decommissioning Plan.
Subject	The aim of this plan is to adhere to the existing UK and international legislation and guidance relating to decommissioning. Overall, this will ensure the legacy of the Proposed Development will reduce the amount of long-term disturbance to the environment as far as reasonably practicable.
Measure	Development of, and adherence to, an appropriate Code of Construction Practice (CoCP).
Subject	These measures have been identified during the design of the offshore and intertidal elements of the Proposed Development. They include strategies, control measures and monitoring procedures for managing the potential environmental impacts of constructing the Proposed Development and limiting disturbance from construction activities as far as reasonably practicable.
Measure	Development of, and adherence to, an Environmental Management Plan (EMP), including Marine Pollution Contingency Plan (MPCP) and Invasive Non-Native Species (INNS) Management Plan.
Subject	These measures have been identified during the design of the Proposed Development. They include strategies, control measures and monitoring procedures for managing the potential environmental impacts during all phases of the Proposed Development.
Measure	Development of, and adherence to, a Pollution Prevention Plan.
Subject	These measures have been identified during the design of the Proposed Development. They include strategies and control measures designed to prevent pollution incidents during all phases of the Proposed Development.
Measure	Development of, and adherence to, a Navigational Safety and Vessel Management Plan (NSVMP)
Subject	Project Codes of Conduct included as a part of the NSVMP will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance and displacement during all phases of the Proposed Development.
Measure	Increased air gap between the lower tip height and sea surface
Subject	By raising the air gap to a minimum of 37 m above Lowest Astronomical Tide (LAT) as a designed in measure the risk of collision impacts to ornithological features is significantly reduced since a high proportion of seabird flights through the Proposed Development array area are predicted to occur at low heights above the sea surface (Johnston *et al*., 2014a,b)
Measure	Site boundary moved 2 km away from boundary of Outer Firth of Forth and St Andrews Bay Complex SPA.
Subject	During the refinement of the site boundary, a decision was made to move it 2 km from the boundary of this SPA in order to reduce the possibility of any displacement effects on ornithological features within the SPA.
Measure	Avoidance of relatively high densities of seabirds
Subject	Based on existing baseline data the Applicant selected a site boundary that avoided areas recognised to have relatively high densities of seabirds. Subsequently, the boundary has been further refined to reduce the potential impacts on ornithological features.

5. APPRAISAL OF ADVERSE EFFECTS ON INTEGRITY

5.1. INTRODUCTION

57. This section provides some background information and explanation for the approach taken to assessing the potential impacts of the Proposed Development on European sites designated for ornithological features and presents the Stage Two assessments for the site features for which LSE has been identified (Table 3.1), with the Stage Two assessments for the sites identified in Table 3.1 are presented in sections 5.7 to 5.9 (including consideration of both the project alone and in-combination effects).

58. The assessments for each European site in this section are structured such that they are presented in their entirety for each of the relevant qualifying features in turn (including consideration of all relevant effect pathways and of both the project alone and in-combination scenarios). A cross-referencing approach has been adopted to aide readability and reduce repetition where relevant, but that this has been carefully carried out to ensure that all information required for a robust HRA of each site is presented.

59. Furthermore, for the ornithological features of breeding seabird colony SPAs, a dual assessment approach has been adopted (see section 5.4), with the outputs from both approaches presented within the assessment section for each relevant qualifying feature. This enables the outputs and conclusions of the different assessment approaches for each qualifying feature to be more readily examined and compared.

60. A summary of all Appropriate Assessments undertaken within this report is provided in the concluding section of this report (see section 6).

61. Integrity matrices are not provided for this Part of the RIAA given that these are a requirement of the Planning Inspectorate of England and Wales (PINS 2022), rather than Scottish Ministers. Integrity matrices have not been requested in the Scoping Opinion or during the Roadmap Process (Offshore EIA Report, volume 3, appendix 11.8. annex A).

5.2. RELEVANT EFFECT PATHWAYS

5.2.1. CONSTRUCTION AND DECOMMISSIONING

Direct habitat loss

62. The potential for LSE as a result of this effect pathway during construction and decommissioning is identified in relation to the Outer Firth of Forth and St Andrews Bay Complex SPA only. This potential arises because the Proposed Development export cable corridor will pass through this SPA (HRA Stage One Screening Report; SSER, 2021b). Direct habitat loss associated with the Proposed Development export cable corridor during either construction or decommissioning will be temporary and of trivial extent relative to the foraging ranges used by qualifying features from the breeding seabird colony SPAs (e.g. Woodward et al., 2019) (as opposed to the Outer Firth of Forth and St Andrews Bay Complex SPA) whilst qualifying features of the migratory waterbird SPAs are not expected to forage or roost within or in the vicinity of the Proposed Development.

63. Effects during decommissioning of the Proposed Development export cable corridor are assumed to be as for construction (see Table 4.1), whilst indirect loss of habitats used by ornithological features is assessed as displacement.

64. There is considered to be potential for LSE from direct habitat loss during construction and decommissioning for all of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA (Table 3.1).

Disturbance

65. For the purposes of determining LSE, disturbance and displacement were considered together but they are treated as separate effect pathways in the current assessment, as advised in the Scoping Opinion (Offshore EIA Report, volume 3, appendix 6.2). As detailed in the HRA Stage One Screening Report (SSER, 2021b), disturbance during construction and decommissioning is relevant to all of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA, certain of the qualifying features of the breeding seabird colony SPAs (dependent on species' sensitivities to disturbance and as detailed in the HRA Stage One Screening Report) and the non-breeding red-throated diver feature of the Firth of Forth SPA (and Ramsar site). For the latter, the potential for LSE is identified due to the high sensitivity of this species to disturbance (Furness et al. 2013; Jarrett et al. 2018; Fliessbach et al. 2019; Goodship and Furness 2022). Disturbance during construction and decommissioning is screened out for other qualifying features of the migratory waterbird SPAs because they are not expected to forage or roost within or in the vicinity of the Proposed Development and there is no potential for effects on such species when passing through (or over) the Proposed Development on migration.

66. During construction, increased levels of vessel traffic and other activities associated with the installation of the wind turbine foundations and other infrastructure may cause disturbance to seabirds which use the Proposed Development array area and surrounding waters for purposes such as foraging and roosting. Potential effects from these sources of disturbance are relevant to qualifying features of the breeding seabird colony SPAs as well as to the seabird qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA which may use those parts of the SPA that are in closest proximity to the Proposed Development array area. Vessel activity associated with cable laying along the route of the Proposed Development export cable corridor, which transits the Outer Firth of Forth and St Andrews Bay Complex SPA, also has the potential to result in disturbance to the qualifying features of this SPA, as well as to qualifying features of the breeding seabird colony SPAs and to the non-breeding red-throated diver feature of the Firth of Forth SPA (and Ramsar site). Similar activities during the decommissioning phase mean that there is the potential for such disturbance effects to occur on the same range of SPAs (and Ramsar site) and qualifying features during this later phase.

67. Such temporary disturbance may cause changes in behaviour and could potentially lead to a reduction in foraging opportunities or increased energy expenditure, resulting in decreased survival rates or productivity in affected populations.

68. The European sites and qualifying features for which disturbance during construction and decommissioning is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Displacement

69. As stated above, disturbance and displacement were considered together in the HRA Stage One Screening Report (SSER, 2021b), but are treated as separate effect pathways in the current assessment, as advised in the Scoping Opinion (Offshore EIA Report, volume 3, appendix 6.2). Displacement during the construction and decommissioning phases could arise as a consequence of disturbance, with the potential for effects to occur on the same range of SPAs (and Ramsar site) and qualifying features as identified in relation to disturbance during construction and decommissioning (see above and as detailed in the HRA Stage One Screening Report.

70. Displacement may cause birds to be excluded from areas of preferred habitat and (where this affects foraging habitat) could potentially lead to a reduction in foraging opportunities, increased competition or increased energy expenditure, resulting in decreased survival rates or productivity in affected populations. As with disturbance, it is assumed that the potential for displacement during decommissioning is similar to that for the construction phase, with the potential for effects expected to extend over a period of similar, or shorter, duration.

71. The European sites and qualifying features for which displacement during construction and decommissioning is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Changes to prey availability

72. This effect pathway is relevant to the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA and the breeding seabird colony SPAs, but not of the migratory waterbird SPAs (and Ramsar sites). Indirect effects on seabirds may occur as a result of changes in prey distribution, availability or abundance. Reduction or disruption to prey availability for seabirds may cause displacement from foraging grounds in the area or reduced energy intake, affecting survival rates or productivity in the population in the short-term. Waterbird qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA could be similarly affected, given the Proposed Development export cable corridor passes through the SPA.

73. During construction there are several ways in which effects on prey availability may manifest, notably via underwater noise from piling affecting fish abundance and distribution, increases in suspended sediment concentrations (SSC) reducing the abundance and distribution of fish or the efficacy of foraging by seabirds and disturbance to prey species affecting their abundance and availability. Similar effects could occur during decommissioning but with the additional possibility that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Project lead to increases in fish abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats (Smyth *et al.*, 2015 and references therein).

74. The European sites and qualifying features for which changes to prey availability during construction and decommissioning is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

5.2.2. OPERATION AND MAINTENANCE

Direct habitat loss

75. The potential for LSE as a result of this effect pathway during operation and maintenance is identified in relation to the Outer Firth of Forth and St Andrews Bay Complex SPA only. This potential arises because the Proposed Development export cable corridor will pass through this SPA (HRA Stage One Screening Report; SSER, 2021b). Direct habitat loss associated with the Proposed Development during operation and maintenance will be of trivial extent relative to the foraging ranges used by qualifying features from the breeding seabird colony SPAs and the extent of marine habitats available for other functions e.g. roosting (e.g. Woodward *et al.* 2019). The qualifying features of the migratory waterbird SPAs are not expected to forage or roost within and around the vicinity of the Proposed Development, so that there is no LSE from this pathway in relation to the migratory waterbird SPAs (HRA Stage One Screening Report; SSER, 2021b).

76. The indirect loss of habitats used by ornithological features is assessed as displacement.

77. There is considered to be potential for LSE from direct habitat loss during operation and maintenance for all of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA (Table 3.1).

Disturbance

78. As for construction and decommissioning, disturbance and displacement during the operation and maintenance phase were considered together for the purposes of determining LSE but are treated as separate effect pathways in the current assessment (Offshore EIA Report, volume 3, appendix 11.8; SSER, 2021b). During operation and maintenance, levels of vessel traffic associated with the Proposed Development array area will be substantially lower than during construction and decommissioning, whilst there will also be an absence of activities analogous to those associated with the installation of infrastructure during construction (Table 4.1). The presence of the operational wind turbines in the Proposed Development array area has the potential to result in disturbance to seabirds foraging, roosting or commuting within the vicinity of this area. The offshore export cables are immobile structures on the seabed with minimal maintenance requirements, so that there will be little associated vessel activity during operation and maintenance (Table 4.1). As such, there is considered to be no potential for LSE due to disturbance associated with the Proposed Development export cable corridor during operation and maintenance.

79. As detailed in the HRA Stage One Screening Report (SSER, 2021b), disturbance during operation and maintenance is relevant to certain of the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA and of the qualifying features of the breeding seabird colony SPAs. This is dependent on species' sensitivities to disturbance, whilst for the Outer Firth of Forth and St Andrews Bay Complex SPA LSE is also excluded for those features which are unlikely to occur within the vicinity of the Proposed Development array area (i.e. the waterbirds and those seabird species with relatively restricted breeding season foraging ranges or which predominantly use inshore habitats). No LSE from disturbance during operation and maintenance is identified in relation to the qualifying features of the migratory waterbird SPAs because they are not expected to forage or roost within and in the vicinity of the Proposed Development and there is no potential for effects on such species when passing through (or over) the Proposed Development on migration (noting that the absence of effects associated with the Proposed Development export cable corridor means that there is no LSE in relation to the non-breeding red-throated diver feature of the Firth of Forth SPA and Ramsar site.

80. Disturbance effects during operation and maintenance may cause changes in behaviour and could potentially lead to a reduction in foraging opportunities or increased energy expenditure, resulting in decreased survival rates or productivity in affected populations.

81. The European sites and qualifying features for which disturbance during operation and maintenance is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Displacement

82. As stated above, disturbance and displacement were considered together in the HRA Stage One Screening Report (SSER, 2021b) but are treated as separate effect pathways in the current assessment, as advised in the Scoping Opinion (Offshore EIA Report, volume 3, appendix 6.2). Displacement during the operation and maintenance phase could arise as a consequence of disturbance, with the potential for effects to occur on the same range of SPAs (and Ramsar sites) and qualifying features as identified in relation to disturbance during operation and maintenance (see above and as detailed in the HRA Stage One Screening Report).

83. Displacement effects during operation and maintenance may cause birds to be excluded from areas of preferred habitat and (where this affects foraging habitat) could potentially lead to a reduction in foraging opportunities, increased competition or increased energy expenditure, resulting in decreased survival rates or productivity in affected populations.

84. The European sites and qualifying features for which displacement during operation and maintenance is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Barrier effects

85. As detailed in the HRA Stage One Screening Report (SSER, 2021b) and in Table 3.1, the potential for LSE as a result of this effect pathway is identified in relation to the migratory waterbird qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA, certain of the features from the breeding seabird colony SPAs (dependent on species' known susceptibility to barrier effects and as detailed in the HRA Stage One Screening Report) and the qualifying features of the migratory waterbird SPAs and Ramsar sites. Although the Scoping Opinion advised that a LSE as a result of barrier effects should also be considered for the breeding gannet qualifying feature of the Outer Firth of Forth and St Andrews Bay Complex SPA, further consultation determined that the original conclusions of the HRA Stage One Screening Report were valid and that LSE could be excluded for this feature (see Table 3.1 and volume 3, appendix 6.2 of the Offshore EIA Report).

86. Barrier effects may arise if offshore wind farms act as a barrier to the movement of birds due to the presence of the wind turbines, so that flight routes would deviate around or over the Proposed Development array area. This could impose additional flight time and energetic costs resulting in decreases in annual rates of survival and / or breeding productivity amongst affected populations (Masden *et al.,* 2010, Searle *et al.,* 2018). For the purposes of the current assessment, predicted impacts from barrier effects are incorporated with those of displacement, based on the application of the SNCB matrix approach (SNCBs 2022; Offshore EIA Report, volume 3, appendix 11.4). This follows the standard approaches used in the prediction of these effects in assessments for UK offshore wind farms, with outputs from SeabORD (Searle *et al*., 2018) provided in the Offshore EIA Report, volume 3, appendix 11.4, annex D for context (noting the conclusions of the SeabORD sensitivity analysis presented in the Offshore EIA Report, volume 3, appendix 11.4, annex H).

87. The European sites and qualifying features for which barrier effects during operation and maintenance is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Collision risk

88. As detailed in the HRA Stage One Screening Report (SSER, 2021b) and in Table 3.1, the potential for LSE as a result of this effect pathway is identified in relation to the migratory waterbird qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA, certain of the qualifying features of the breeding seabird colony SPAs and the qualifying features of the migratory waterbird SPAs (and Ramsar sites). The qualifying features of the breeding seabird colony SPAs for which LSE are concluded are those deemed to have potential sensitivity to collision risk which is, in part, based upon their typical flight heights (Garthe and Hüppop 2004, Furness *et al.,* 2013, Johnston *et al.,* 2014a, b).

89. Collision risk is associated with the Proposed Development array area and, specifically, with the potential for seabirds and/or migratory waterbirds to collide with the rotating blades of the wind turbines as they fly through this area (Skov *et al*., 2018). Collisions may result in direct mortality, which may be additive to existing (i.e. baseline) mortality within the population and could cause population declines or, in some situations, prevent population recovery. Therefore, seabird species which forage within, or commute through, the Proposed Development array area may be vulnerable to such effects, as is also the case for migratory waterbirds which transit this area during the passage periods. Given the offshore location of the Proposed Development array area, it is extremely unlikely that any of the migratory waterbird species

associated with the SPAs (and Ramsar sites) screened in for LSE would make more frequent movements across the Proposed Development array area (e.g. when commuting between foraging and roosting sites) and, for these species, it is considered that the potential for collisions is limited to their migration periods.

90. The European sites and qualifying features for which collision during operation and maintenance is considered to have the potential to result in an adverse effect are detailed in Table 3.1.

Changes to prey availability

91. As for the construction and decommissioning phases, this effect pathway is relevant to the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA and the breeding seabird colony SPAs, but not of the migratory waterbird SPAs (and Ramsar sites), during operation and maintenance. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, electromagnetic fields (EMF) from subsea electrical cabling, and colonisation of subsea structures could affect ornithological features foraging within and in the vicinity of the Proposed Development array area and export cable corridor.

92. The European sites and qualifying features for which changes to prey availability during operation and maintenance is considered to have the potential to result in an adverse effect are detailed in Table 3.1

5.3. PLANS AND PROJECTS FOR THE IN-COMBINATION ASSESSMENTS

93. The plans and projects set out in Table 5.1 have been considered within the in-combination assessment for European sites designated for ornithological features.

94. The plans and projects included in this in-combination assessment have been derived in part, from the CEA longlist presented in volume 3, appendix 6.4 of the Offshore EIA Report. Further detail on the plans and projects comprising the in-combination assessment is provided in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

Table 5.1: List of Other Developments with Potential for In-Combination Effects on Ornithological Features

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Description of Project/Plan	Overlap With the Proposed Development
Tier 1			
Offshore Wind Projects and Associated Cables			
No Tier 1 projects identified			
Tier 2			
Offshore Wind Projects and Associated Cables			
Beatrice Offshore Wind Farm	Active/In Operation	84 turbines	Operation
Blyth Demo Phase 1	Active/In Operation	15 turbines	Operation
Blyth Demo Phase 2	Consented	Up to 5 floating turbines	Possible Construction and Operation
Dogger Bank (Creyke Beck) A	Under Construction	Up to 200 turbines	Operation
Dogger Bank (Creyke Beck) B	Under Construction	Up to 200 turbines.	Operation
Dogger Bank C (Teesside A)	Under Construction	Up to 1,400 MW	Operation
Sofia Offshore Wind Farm (Teesside B)	Under Construction	Up to 1,400 MW	Operation
Dudgeon	Active/In Operation	67 turbines	Operation
East Anglia One	Active/In Operation	Up to 325 turbines	Operation
East Anglia One North	Consented	Up to 67 turbines	Possible Construction and Operation
East Anglia Two	Consented	Up to 75 turbines	Possible Construction and Operation
East Anglia Three	Consented	Up to 172 turbines	Possible Construction and Operation
European Offshore Wind Deployment Centre (EOWDC)	Active/In Operation	Up to 11 turbines	Operation
Galloper	Active/In Operation	Up to 56 turbines	Operation
Greater Gabbard	Active/In Operation	140 turbines	Operation
Gunfleet Sands I and II	Active/In Operation	Up to 30 turbines	Operation
Hornsea One	Active/In Operation	Up to 120 turbines	Operation
Hornsea Project Two	Under Construction	Up to 360 turbines	Operation
Hornsea Project Three (HOW03)	Consented	Up to 231 turbines	Possible Construction and Operation
Hornsea Project Four (HOW04)	Submitted	Up to 180 turbines	Possible Construction and Operation
Humber Gateway	Active/In Operation	Up to 83 turbines	Operation
Hywind	Active/In Operation	Up to 5 turbines	Operation
Inch Cape Offshore Wind Farm - 15680	Consented	Up to 72 turbines	Possible Construction and Operation
Kentish Flats	Active/In Operation	Up to 30 turbines	Operation
Kentish Flats Extension	Active/In Operation	Up to 17 turbines	Operation
Kircardine Offshore Wind farm	Active/In Operation	Up to 8 turbines	Operation
Levenmouth Demonstration Turbine	Active/In Operation	1 turbine	Operation
Lincs	Active/In Operation	75 turbines	Operation
London Array	Active/In Operation	175 turbines	Operation
Lynn and Inner Dowsing Wind Farms	Active/In Operation	54 turbines	Operation
Methil Offshore Wind Farm	Active/In Operation	1 turbine	Operation

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Description of Project/Plan	Overlap With the Proposed Development
Moray Offshore Windfarm (East)	Active/In Operation	100 turbines	Operation
Moray Offshore Windfarm (West)	Consented	Up to 85 turbines	Possible Construction and Operation
Neart na Gaoithe Offshore Wind farm	Under Construction	Up to 75 turbines	Operation
Norfolk Boreas offshore wind farm	Consented	Up to 158 turbines	Operation
Norfolk Vanguard Offshore Windfarm	Consented	Up to 200 turbines	Possible Construction and Operation
Race Bank	Active/In Operation	91 turbines	Possible Construction and Operation
Scroby Sands	Active/In Operation	30 Turbines	Operation
Sheringham Shoal	Active/In Operation	88 turbines	Operation
Teesside	Active/In Operation	27 turbines	Operation
Triton Knoll	Active/In Operation	90 turbines	Operation
Westermost Rough	Active/In Operation	35 turbines	Operation
Wind T and D Site (Dounreay Tri Ltd)	Active/In Operation	2 turbines	Operation
Seagreen 1	Under Construction	114 turbines	Operation
Seagreen 1A Project	Consented	36 turbines	Possible Construction and Operation
Tier 3			
Offshore Wind Projects and Associated Cables			
Sheringham Shoal Extension	Scoping	Up to 27 turbines	Possible Construction and Operation
Dudgeon Extension Project	Scoping	Up to 34 turbines	Possible Construction and Operation
Forthwind Demonstration Project	Scoping	1 turbine	Possible Construction and Operation
Green Volt Floating Offshore Wind Farm	Scoping	Up to 30 turbines	Possible Construction and Operation
West of Orkney Wind Farm	Scoping	Up to 125 turbines	Possible Construction and Operation
Five Estuaries	Pre-planning Application	Up to 79 turbines	Possible Construction and Operation
North Falls	Pre-planning Application	Up to 71 turbines	Possible Construction and Operation
Dogger Bank South (East)	Scoping	Up to 150 turbines	Possible Construction and Operation
Dogger Bank South (West)	Scoping	Up to 150 turbines	Possible Construction and Operation
Outer Dowsing	Scoping	Up to 100 turbines	Possible Construction and Operation
Tier 4			
Offshore Wind Projects and Associated Cables			
ScotWind 1, Site 1: BP and EnBW: Morven	Lease - Marine	Up to 2,907 MW capacity.	
ScotWind 1, Site 2: SSE Renewables, CIP and Marubeni: Project name TBC	Lease - Marine	Up to 2,610 MW capacity.	
ScotWind 1, Site 3: Falck Renewables and BlueFloat Energy: Bellrock	Lease - Marine	Up to 1,200 MW capacity.	
ScotWind 1, Site 4: ScottishPower Renewables and Shell - CampionWind	Lease - Marine	Up to 2,000 MW capacity.	
ScotWind 1, Site 5: Vattenfall and Fred Olsen Renewables: Cumhachd Ri Teachd	Lease - Marine	Up to 798 MW capacity.	
ScotWind 1, Site 6: Thistlewind Partners - Cluaran Deas Ear	Lease - Marine	Up to 1,008 MW capacity.	
NE1 - in clearing process	N/a	N/a	
ScotWind 1, Site 7: Thistlewind Partners: Cluaran Ear Thuath	Lease - Marine	Up to 1,008 MW capacity.	
ScotWind 1, Site 8: Flack Renewables, Orsted and Bluefloat Energy: Stromer	Lease - Marine	Up to 1,000 MW capacity.	

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Description of Project/Plan	Overlap With the Proposed Development
ScotWind 1, Site 9: Ocean Winds: Caledonia	Lease - Marine	Up to 1,000 MW capacity.	
NE5: Dropped since Draft	N/a	N/a	
ScotWind 1, Site 10: Falck Renewables, Orsted and Bluefloat Energy: BroadShore	Lease - Marine	Up to 500 MW capacity.	
ScotWind 1, Site 11: ScottishPower Renewables and Shell: MarramWind	Lease - Marine	Up to 3,000 MW capacity.	
ScotWind 1, Site 12: Floating Energy Alliance: Buchan	Lease - Marine	Up to 960 MW capacity.	
ScotWind 1, Site 13: RIDG, Corio Generation and TotalEngergies: West of Orkney	Lease - Marine	Up to 960 MW capacity.	
N3ScotWind 1, Site 14: Northland Power: Mhairi	Lease - Marine	Up to 1,500 MW capacity.	
ScotWind 1, Site 15: Magnora Offshore Wind: Project name TBC	Lease - Marine	Up to 496 MW capacity.	
ScotWind 1, Site 16: Northland Power: Sheena	Lease - Marine	Up to 840 MW capacity.	
ScotWind 1, Site 17: ScottishPower Renewables: Machairwind	Lease - Marine	Up to 840 MW capacity.	
ScotWind 1 Site 18: Ocean Winds: Project Name TBC	Lease - Marine	Up to 500 MW capacity.	
ScotWind 1 Site 19: Mainstream Renewables: Project Name TBC	Lease - Marine	Up to 1,500 MW capacity.	
ScotWind 1 Site 20: ESB Asset Development: Project Name TBC	Lease - Marine	Up to 500 MW capacity.	

5.4. THE DUAL APPROACH TO ASSESSMENT

95. The Applicant has for the most part adopted the advice on ornithological assessment parameters advised in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report). Nevertheless, the Applicant considers elements of the Scoping Opinion to be over-precautionary and a departure from standard advice/practice. As such, the Applicant has presented a dual assessment of potential displacement/barrier effects and collision effect pathways during operation based on:

- The 'Scoping Approach'; and
- The 'Developer Approach'.

96. With respect to assessing potential displacement/barrier effects, Scoping Opinion contained advice on the displacement rates and displacement mortality rates to be applied to the SNCB matrix approach (SNCBs 2022; volume 3, appendix 11.4 of the Offshore EIA Report). These rates have been used for the purposes of assessment under the Scoping Approach.

97. Under the Developer Approach, these rates differed in some cases, based upon available evidence for displacement, the extent of a features ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment (Table 5.2; volume 3, appendix 11.4 of the Offshore EIA Report).

98. Evidence and justification for the rates used under the Developer Approach is presented in volume 3, appendix 11.4, annex G of the Offshore EIA Report, with a summary of the rates taken forward for assessment purposes presented in Table 5.2.

Table 5.2: Displacement and Mortality Rates Used for the Scoping and Developer Approaches.

Species	Displacement Rate	Mortality Rate – Breeding Season	Mortality Rate – Non-Breeding Seasons
Scoping Approach			
Guillemot and razorbill	60%	3% and 5%	1% and 3%
Puffin	60%	3% and 5%	Not assessed
Gannet	70%	1% and 3%	1% and 3%
Kittiwake	30%	1% and 3%	1% and 3%
Developer Approach			
Guillemot and razorbill	50%	1%	1%
Puffin	50%	1%	Not assessed
Gannet	70%	1%	1%
Kittiwake	30% [4]	2% [4]	Not assessed

99. With respect to estimating collision risk, the Developer Approach is largely in accordance with the Scoping Opinion, as the two approaches differ only in their use of input monthly density estimates of flying birds of the assessed species within the Proposed Development. Justification for this difference is presented in volume 3, appendix 11.3 of the Offshore EIA Report.

5.5. HIGHLY PATHOGENIC AVIAN INFLUENZA (HPAI)

100. In October 2021, a new strain of Highly Pathogenic Avian Influenza (HPAI) was identified in the UK (H5N1). Since then, 120 further locations of infection in captive birds and poultry have been identified across the UK, and 354 separate locations of infection across wild birds of 63 species have been identified across 76 countries worldwide (DEFRA, 2022). The greatest proportion of infection to date has been observed in swans, geese and ducks, and these species may form a natural reservoir of the virus (DEFRA, 2022).

101. There have also been HPAI (H5N1) infections recorded in several seabird species, including gannet at Bass Rock and Hermaness, Shetland (Martin, 2022) and Isle of Noss (Philip and Tyler, 2022), guillemot at St Abb's Head (Hall, 2022), great skua at St Kilda, Fair Isle, Isle of Noss and Foula (Banyard *et al*., 2022; NatureScot, 2022a; Philip and Tyler, 2022) and kittiwake, great black-backed gull and terns at the Isle of May (Steel pers comm. 19 July 2022; NatureScot, 2022a). As of August 2022, there had been no mass mortalities observed in Scottish tern, razorbill or puffin colonies (Philip and Tyler, 2022). However, the full magnitude of impact is currently highly uncertain and a task force has been established to coordinate a national response to tackling the outbreak.

102. In response to the outbreak in the Forth and Tay region, the Applicant, in collaboration with other Forth and Tay developers, is currently co-funding a monitoring study of the Bass Rock gannet colony to examine the impacts of HPAI on gannet survival and to explore levels of immunity within the population which will be key to understanding the long-term implications of the outbreak.

103. Given the current uncertainty regarding the short, medium and long-term effects of the 2022 HPAI outbreak on seabird colony abundance and vital rates (productivity and survival), this Part of the RIAA has been compiled following the most recent advice received from MS-LOT and NatureScot, where the Applicant was advised to progress with assessment based on the advice received both prior to, and following the HPAI outbreak as outlined in the Offshore EIA Report Table 2.1, volume 3, appendix 5.1, the EIA Audit document (teleconference between the Applicant, NatureScot and MS-LOT on 28/07/2022). As such, no amendments or assumptions have been made to the assessment in light of the HPAI outbreak.

5.6. APPROPRIATE ASSESSMENTS: MARINE SPA

5.6.1. OUTER FIRTH OF FORTH AND ST ANDREWS BAY COMPLEX SPA

European Site Information and Conservation Objectives

104. The Outer Firth of Forth and St Andrews Bay Complex SPA provides supporting habitat for a range of breeding and non-breeding seabird and waterbird species.

105. The Outer Firth of Forth and St Andrews Bay Complex SPA stretches from Arbroath to St. Abb's Head encompassing the Firth of Forth, the outer Firth of Tay and St. Andrews Bay and comprises an area of 2,720.68 km^2. The site extends beyond the 12 nautical miles (nm) boundary of territorial and offshore waters to encompass key seabird feeding areas.

106. The Outer Firth of Forth and St Andrews Bay Complex SPA attracts one of the largest and most diverse concentrations of marine birds in Scotland. During the non-breeding season, it provides important wintering grounds used for feeding, moulting and roosting by a variety of waterfowl including the largest aggregations of red-throated diver and common eider in Scotland. The Firth of Forth is also notable for its concentrations of wintering gulls, including little gull, kittiwake, black-headed gull, common gull and herring gull. Together with guillemot, shag and razorbill these species contribute to an assemblage of over 40,000 seabirds using the site during the non-breeding season.

107. The site also encompasses feeding grounds for breeding common tern, Arctic tern and shag nesting colonies. During the breeding season, kittiwake, gannet, herring gull, guillemot, puffin, and Manx shearwater also contribute to the SPA assemblage of over 100,000 seabirds.

108. The nearshore boundary of the Outer Firth of Forth and St Andrews Bay Complex SPA follows the Mean Low Water Springs (MLWS) mark.

109. The Proposed Development offshore export cable corridor runs through this SPA, whilst the Proposed Development array area is 2 km from the SPA boundary at its closest point (Figure 3.1).

110. There are 21 Annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting breeding seabirds, non-breeding seabirds and waterfowl assemblages (Table 5.3). The potential for LSE has been identified in relation to all 21 species (Table 5.3), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

111. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

1. *To ensure that the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.*

2. *To ensure that the integrity of the Outer Firth of Forth and St Andrews Bay Complex SPA is restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature:*

   2a The populations of the qualifying features are viable components of the Outer Firth of Forth and St Andrews Bay Complex SPA.
   2b. The distribution of the qualifying features is maintained throughout the site by avoiding significant disturbance of the species.
   2c. The supporting habitats and processes relevant to qualifying features and their prey resources are maintained, or where appropriate restored, at the Outer Firth of Forth and St Andrews Bay Complex SPA.

112. On the basis that shag, kittiwake, common tern and herring gull are considered to be in unfavourable condition the overarching objective for this site is a restore objective (NatureScot and JNCC 2021)

113. Further information on this European site is presented in Appendix 3A.

114. The citation population size and site condition status for each qualifying feature are detailed in Table 5.3, along with whether the potential for LSE has been determined for the qualifying feature (as detailed in Table 3.1).

Table 5.3: Details on the qualifying features of the Outer Firth of Forth and St Andrews Complex SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential LSE
Eider	Non-breeding	Favourable	22,000 individuals	Yes
Velvet scoter	Non-breeding	Favourable	780 individuals	Yes
Common scoter	Non-breeding	Favourable	4,700 individuals	Yes
Long-tailed duck	Non-breeding	Favourable	1,950 individuals	Yes
Common goldeneye	Non-breeding	Favourable	590 individuals	Yes
Red-breasted merganser	Non-breeding	Favourable	430 individuals	Yes
Red-throated diver	Non-breeding	Favourable	850 individuals	Yes
Slavonian grebe	Non-breeding	Favourable	30 individuals	Yes
Kittiwake	Breeding and non-breeding	Unfavourable (breeding season) Favourable (non-breeding season	Breeding: as per: Forth Islands SPA, St Abb's Head to Fast Castle SPA, Fowlsheugh SPA, Buchan Ness to Collieston Coast SPA, Troup, Pennan and Lion's Head SPA Non-breeding: No site reference population	Yes
Black-headed gull	Winter	Favourable	Non-breeding: No site reference population	Yes
Little gull	Winter	Favourable	Non-breeding: No site reference population	Yes
Common gull	Winter	Favourable	Non-breeding: No site reference population	Yes
Herring gull	Breeding Winter	Unfavourable Favourable	Breeding: as per: Forth Islands SPA, St Abb's Head to Fast Castle SPA, Fowlsheugh SPA. Non-breeding: No site reference population	Yes
Common tern	Breeding	Unfavourable	Breeding: as per Imperial Dock Lock SPA and Forth Islands SPA	Yes
Arctic tern	Breeding	Favourable	Breeding: as per the Forth Islands SPA	Yes
Guillemot	Breeding and non-breeding	Favourable (breeding and non-breeding)	Breeding as per: Forth Islands SPA, St Abb's Head to Fast Castle SPA, Fowlsheugh SPA, Buchan Ness to Collieston Coast SPA. Non-breeding: No site reference population	Yes
Razorbill	Non-breeding	Favourable	Non-breeding: No site reference population	Yes
Puffin	Breeding	Favourable	Breeding: as per Forth Islands SPA)	Yes
Manx shearwater	Breeding	Favourable	No site reference population	Yes
Gannet	Breeding	Favourable	As per Forth Islands SPA	Yes
Shag	Breeding and non-breeding	Unfavourable (breeding season) Favourable (non-breeding season	Breeding as per Forth Islands SPA. Non-breeding: No site reference population	Yes
Breeding seabird assemblage	Breeding	Unfavourable	Puffin, kittiwake, Manx shearwater, guillemot, herring gull	Yes
Non-breeding seabird assemblage	Non-breeding	Favourable	Black-headed gull, common gull, herring gull guillemot, razorbill, shag, kittiwake	

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential LSE
Waterfowl assemblage	Non-breeding	Favourable	Long-tailed duck, common scoter, velvet scoter, red-breasted merganser	

Assessment for the Eider Population

115. Eider occur in coastal waters throughout northern Britain, particularly in shallow water of usually less than 3 m where suitable prey of molluscs and crustaceans. Breeding colonies are often large and flocks of many thousands of birds can occur in suitable nearshore areas. It is the commonest breeding seaduck in the UK with a breeding population of around 31,000 pairs of which approximately 20,000 pairs occur in Scotland (Forrester *et al*. 2007).

116. Following breeding, eiders may congregate into large moulting flocks in specific areas with main areas in eastern Scotland being Firth of Forth, Shetland, Ythan, Aberdeen Bay and Montrose Basin (Cork Ecology 2004).

117. Although eiders in the UK are largely non-migratory there is some winter dispersal away from the breeding areas with a proportion of birds from North-east Scotland wintering in the Tay Estuary. The east coast of Scotland holds a substantial proportion of the UK wintering population with approximately 59,000 birds. The major wintering areas along the east coast of Scotland are the Tay Estuary, Firth of Forth, Montrose Basin, Orkney, Ythan and the Moray Firth (Forrester *et al*. 2007).

118. The site reference population of 22,000 individuals has been calculated on multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al*. 2015). Based on Wetland Bird Survey (WeBS) data the peak mean population size has fluctuated annually but has remained relatively stable (Figure 5.1).

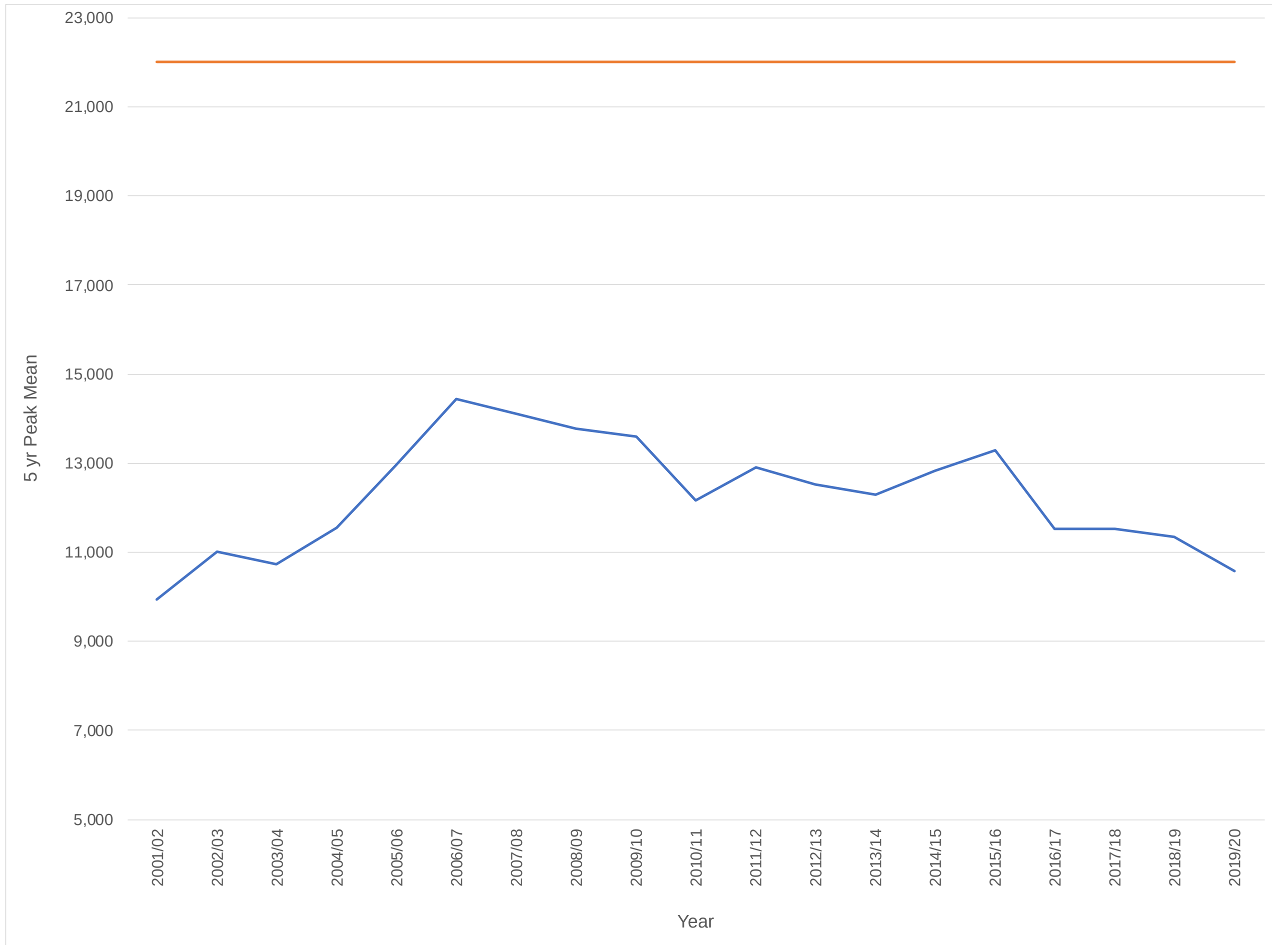

Figure 5.1: Eider population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2001/02 – 2004/05 peak mean 22,000 individuals). Data are from the Wetland Bird Survey Database (BTO 2022)

119. Site specific advice relating to eider is to:

- *Maintain the population of non-breeding eiders at a stable or increasing trend relative to the site reference population.*
- *Ensure eider can move safely between the site and important areas of functionally linked land outwith the site.*

<u>The Potential for Impacts on the Eider Population</u>

120. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA eider population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on eider with the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8)

121. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and

disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the conservation objectives

122. No eider were recorded during any of the site specific surveys undertaken across the Offshore Ornithology Study Area. Intertidal and nearshore monthly surveys undertaken at the Skateraw landfall between July 2020 and June 2021 recorded eider in each month with a maximum count of 111 birds in February.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

123. Direct disturbance and displacement to eider during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable. The Proposed Development array area lies outwith the SPA and no impacts on common eider are predicted to arise within the Proposed Development array area on the basis that no eider were recorded within the area during surveys and the known distribution of eider within the SPA is predominantly coastal (Lawson et al. 2015, SNH 2015, SNH and JNCC 2016).

124. Eider are considered to have a moderate to high sensitivity to such sources of direct disturbance (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign eider as '3' on a five-scale ranking system (Garthe and Hüppop 2004, Furness *et al*. 2013, Fliessbach *et al.* 2019).

125. Studies undertaken indicate that eider may be displaced by vessel traffic with one study reporting eider being flushed by approaching vessels at distances up to 1,000 m and the median distance at which eider did take flight being 208 m (Schwemmer *et al*. 2011). A similar study reported the maximum distance at which initial disturbance was first recorded amongst flocks of moulting eider was 700 m. with birds taking flight on average at 177 m from a vessel (Dehnhard *et al*. 2020). Individuals may be more susceptible to disturbance than flocks, with mean disturbance distances reported for individuals as being between 277 ± 21 m and for flocks of 255 ± 195 m (Fliessbach *et al.* 2019). Goodship and Furness (2022) present buffer zones that indicate the potential range of distances aimed to protect the majority of birds from human disturbance. For common eider during the breeding period the buffer zone is 100 – 200 m and during the non-breeding period 200 – 500 m.

126. Consequently, the area of impact from a single vessel at any one time (based on the maximum non-breeding period buffer zone of 500 m) is 0.78 km^2, equivalent to 0.03% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 9.36 km^2 could occur, equivalent to 0.34% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be smaller.

127. Not all birds that are disturbed by a vessel necessarily take flight with between 29% and 45% of all observed instance of disturbance not resulting in flight behaviour (Dehnhard *et al*. 2020, Fliessbach *et al*. 2019).

128. Eider that are displaced could return to the area following the departure of the vessel. Studies indicate that birds that are displaced will relocate in the wider vicinity with one study reporting a mean distance of 770 m from a vessel (Dehnhard *et al*. 2020). The number of eider present in an area where displacement has occurred return to the pre-disturbance total within two hours of a vessel departing (Schwemmer *et al*. 2011). Common eider that are disturbed will return to their pre-disturbance behaviour relatively quickly with reports of 75% of eider returning to previous behaviour within 10 minutes and a maximum of 45 minutes (Dehnhard *et al*. 2020)

129. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA will be localised, and temporary with recovery within two hours of the cessation of the activity causing disturbance.

130. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

131. Recognising the moderate to high sensitivity of eider to disturbance and displacement effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA eider population.

Changes to Prey Availability

132. Seaduck (eider, goldeneye, common scoter, velvet scoter and long-tailed duck) feed on a range of prey species but often specialise on one or two prey items (often bivalves or other molluscs) in any one location (e.g. Leopold *et al*. 2001). However, seaduck are also opportunistic and capable of adjusting diet in response to changes in prey availability or composition (e.g. Forni *et al*. 2022).

133. During construction there are a number of ways in which effects on key prey species may occur. The installation of infrastructure within the Proposed Development may lead to temporary subtidal habitat loss/disturbance as a result of a range of activities including installation of offshore export cables and associated seabed preparation. Activities will occur intermittently during the construction phase, with only a small proportion of the total footprint affected at any one time. Recovery of seabed habitats will commence immediately following installation of infrastructure allowing key prey species to repopulate the areas of previous disturbance (see volume 2, chapter 9 of the Offshore EIA Report). Furthermore, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the Mean High Water Springs (MHWS). Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

134. Increases in suspended sediment concentrations (SSC) and associated sediment deposition may also reduce the abundance and distribution of prey species. The installation of offshore export cables may result in short-term avoidance of affected areas by fish. Modelling of SSC for installation of inter-array and offshore export cables indicated concentrations of up to 500 mg/l and between 50 mg/l and 500 mg/l, respectively. Most bivalves are known to be tolerant to sediment deposition due to the nature of re-suspension and deposition within their natural high energy environment, and it is therefore very likely that any effect from increased SSC during construction will be limited (volume 2, chapter 9 of the Offshore EIA Report). Furthermore, deposited sediments are expected to be removed quickly by the currents resulting in small amount of sediment being deposited. Given the small amount of predicted deposition, local spatial extent and relatively short duration of predicted SSC increases, no effect on survival of key prey species is predicted (volume 2, chapter 9 of the Offshore EIA Report).

135. Increases in SSC and associated reductions in water clarity may also affect the ability of foraging seaduck to locate prey, reducing the availability of key prey species. However SSC concentrations are likely to be within the range of natural variability (generally <5 mg/l but can increase to over 100 mg/l during storm events/increased wave heights) and will reduce to background concentrations within a very short period (approximately two tidal cycles).

136. Such localised impacts on prey could cause the temporary relocation of eider to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

137. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for eider. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA

138. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect prey species (Peschko *et al*. 2020, BOWL 2021a, BOWL 2021b, Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to foraging areas.

139. It is therefore concluded that any impacts will be temporary and localised during construction and decommissioning and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of eider.

Direct Habitat Loss

140. Up to eight export cables will be trenched and buried, each a maximum of 109 km long. It is estimated that impacts from trenching and burying the cable will impact a 15 m wide corridor of seabed and therefore a total of 12.43 km^2 of seabed could be disturbed during the trenching and burying of the export cables. It is estimated that approximately 15% of the cable route may need protection, which would be a long-term habitat loss. If this is the case, then an estimated 2.616 km^2 of seabed could be lost due to cable protection; equivalent to 0.09% of the total area of the SPA.

141. Export cables will be trenched and buried using either mechanical ploughs or cutters or by high pressure jets depending on the ground conditions. If cable protection is not required, the trenches will be back-filled or backfill naturally over time. The length of time it takes for the trenches to backfill will be dependent on the local seabed conditions and currents.

142. In nearshore intertidal and subtidal waters the export cables will be buried without trenching out at least 488 m from the MHWS mark. Consequently there will be minimal, if any impact, on habitat nearshore.

143. In areas of soft mud or sand, natural infill is predicted to occur rapidly and studies have indicated that infill of trenches can occur at a rate of between 0.2 and 0.5 m every six months, with sediment communities returning to the area of disturbed sediment within 12 months of the cable laying having been undertaken (BERR, 2008). Consequently, the potential impacts from trenching cables within the SPA will be localised and temporary and will not have a long-term impact on the habitat.

144. It is concluded that the very small area of seabed habitat lost within the SPA as a result of cable protection will not cause a significant reduction in the extent, distribution or quality of habitats that support the qualifying species or their prey. The trenching of cables will cause a localised and temporary impact on the habitats within the SPA.

145. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on eider.

146. Eider typically feed in water depths of less than 12 m and therefore their distribution is limited to relatively shallow nearshore water and due to their restricted habitat preferences common eider are considered to have a relatively high sensitivity to loss of habitat. Reviews of the sensitivity of different seabird species to habitat use flexibility assigned eider as '4' on a five-scale ranking system. (Garthe and Hüppop 2004, Furness *et al.* 2013). Suggesting that eider are sensitive to the loss of habitat.

147. The distribution of eider within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with highest densities occurring in the Tay and inner Firth of Forth. Relatively low densities occur in waters along the export cable corridor (SNH 2015, SNH and JNCC 2016).

148. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA eider population, which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of eider.

Project Alone: Operation and Maintenance

Disturbance and Displacement

149. Direct disturbance and displacement to eider during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements.

150. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to or less than that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA eider population.

Changes to Prey Availability

151. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, electromagnetic fields (EMF) from subsea electrical cabling, and colonisation of subsea structures, could affect eider survival and productivity.

152. However, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA eider population.

Direct Habitat Loss

153. There will be no increase in direct habitat loss over and above that arising during the construction phase unless unplanned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection under the worst case. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on eider through the loss of habitat during the operation and maintenance phase.

154. On this basis it is concluded that the loss of habitat will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of eider

Project Alone: Conclusion

155. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA eider population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

156. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on eider and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA Report, volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement would not be detectable against current levels and therefore would not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA common eider population.

Changes to Prey Availability

157. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of eider and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where eider are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA eider population.

Direct Habitat Loss

158. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

159. Potential impacts on habitat from the Proposed Development alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to eider as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where eider are known to most frequently occur.

160. The potential impacts on eider will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA eider population.

In-combination: Conclusion

161. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA eider population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Velvet Scoter Population

162. In Europe velvet scoter breed in Scandinavia, Estonia and Russia and are a winter visitor to the UK. The UK wintering population is estimated to be approximately 3,350 individuals, with over 2,500 wintering in Scottish coastal waters (Robinson 2005, Forrester *et al*. 2007). Their distribution in Scottish waters is predominantly along the east coast, with in the Moray Firth, Firth of Tay, St Andrews Bay and the Firth of Forth.

163. The site reference population of 780 individuals has been calculated on multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). Based on WeBS data the peak mean population size has fluctuated annually but remains largely above the site reference population (Figure 5.2).

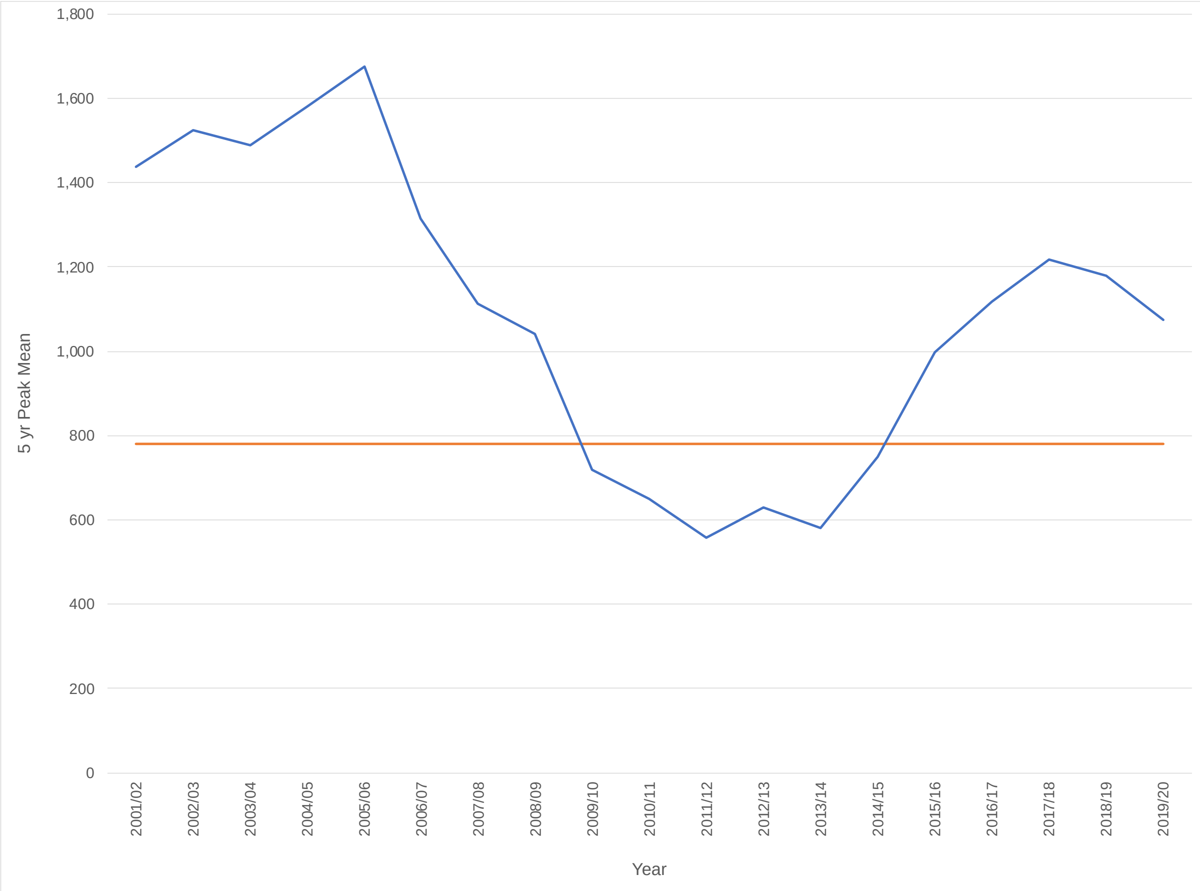

Figure 5.2: Velvet scoter population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2006/07-2010/11 peak mean of 780 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

164. Species specific advice for velvet scoter is:

- *Maintain the population of non-breeding velvet scoter at a stable or increasing trend relative to the site reference population.*

The Potential for Impacts on the Velvet Scoter Population

165. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on velvet scoter the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

166. There is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction, operation and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS mark. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

167. No velvet scoter were recorded during any of the site specific surveys undertaken across the Offshore Ornithology Study Area. No velvet scoter were recorded during intertidal and nearshore monthly surveys undertaken at the Skateraw landfall between July 2020 and June 2021.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

168. Direct disturbance and displacement to velvet scoter during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable. The Proposed Development array area lies outwith the SPA and no impacts on velvet scoter are predicted to arise within the Proposed Development array area on the basis that no velvet scoter were recorded within the area during surveys and the known distribution of velvet scoter within the SPA is predominantly coastal (Lawson *et al*. 2015, SNH 2015, SNH and JNCC 2016).

169. Velvet scoter were not considered in the review of bird sensitivities to disturbance undertaken by Goodship and Furness (2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed velvet scoter as having a relative high sensitivity from disturbance arising from vessels (Garthe and Hüppop 2004, Furness *et al.* 2013, Fliessbach *et al*. 2019).

170. The Proposed Development offshore export cable encompasses 168 km^2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

171. Studies undertaken indicate that velvet scoter may be displaced by vessel traffic with one study reporting velvet scoter being flushed by approaching vessels at distances from between 30 m and 2,000 m (Fliessbach *et al*. 2019). Consequently, the area of impact from a single vessel at any one time could vary from between 0.002 km^2 to 12.56 km^2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.0001% of the SPA and 0.46% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 150.7 km^2 could occur, equivalent to 5.54% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

172. Velvet scoter that are displaced could return to the area following the departure of the vessel. Studies indicate that the similar common scoter will return to the area following the departure of the vessel. However, studies indicate that common scoter that are flushed from an area by a vessel return relatively slowly compared to other seaduck species, with 13% returning within 180 minutes of being disturbed (Schwemmer *et al*. 2011).

173. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA will be relatively localised and temporary.

174. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

175. Recognising that no velvet scoter were recorded during any surveys, the relatively localised areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential

for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

Changes to Prey Availability

176. Seaduck (eider, goldeneye, common scoter, velvet scoter and long-tailed duck) feed on a range of prey species but often specialise on one or two prey items (often bivalves or other molluscs) in any one location (e.g. Leopold *et al*. 2001). However, seaduck are also opportunistic and capable of adjusting diet in response to changes in prey availability or composition (e.g. Forni *et al*. 2022).

177. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area

178. Any localised impacts on prey could cause the temporary relocation of velvet scoter to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

179. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for velvet scoter. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of velvet scoter.

Direct Habitat Loss

180. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on velvet scoter.

181. Velvet scoter typically feed in water depths of less than 20 m and therefore their distribution is limited to relatively shallow nearshore water (Fox 2003). Reviews of the sensitivity of different seabird species to habitat use flexibility assigned velvet scoter as '3' on a five-scale ranking system. (Furness *et al.* 2013), suggesting that velvet scoter are moderately sensitive to the loss of habitat.

182. The distribution of velvet scoter within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with highest densities occurring in the Tay and inner Firth of Forth. Relatively low densities occur in waters along the export cable corridor (SNH 2015, SNH and JNCC 2016).

183. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA velvet scoter population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of velvet scoter.

Project Alone: Operation and Maintenance

Disturbance and Displacement

184. Direct disturbance and displacement to velvet scoter during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements.

185. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to or less than that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

Changes to Prey Availability

186. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

Direct Habitat Loss

187. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on velvet scoter through the loss of habitat during the operation and maintenance phase.

188. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of velvet scoter.

Project Alone: Conclusion

189. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA velvet scoter population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

190. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on velvet scoter and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout

the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

Changes to Prey Availability

191. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of velvet scoter and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where velvet scoter are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

Direct Habitat Loss

192. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the Proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

193. Potential impacts on habitat from the Proposed Development alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to velvet scoter as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where velvet scoter are known to most frequently occur.

194. The potential impacts on velvet scoter will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA velvet scoter population.

In-combination: Conclusion

195. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA velvet scoter population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Common Scoter Population

196. Common scoter is a rare breeding bird in the UK, with between 16 and 47 pairs nesting in 2019 (Eaton 2021). The Scottish wintering population is estimated to be between 25,000 and 30,000 individuals (Forrester *et al*. 2007). Their distribution in Scottish waters is predominantly along the east coast, with in the concentrations occurring Moray Firth, Aberdeenshire, Firth of Tay, St Andrews Bay and the Firth of Forth.

197. The site reference population of 4,700 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has increased above the site reference population since 2016/17 (Figure 5.3).

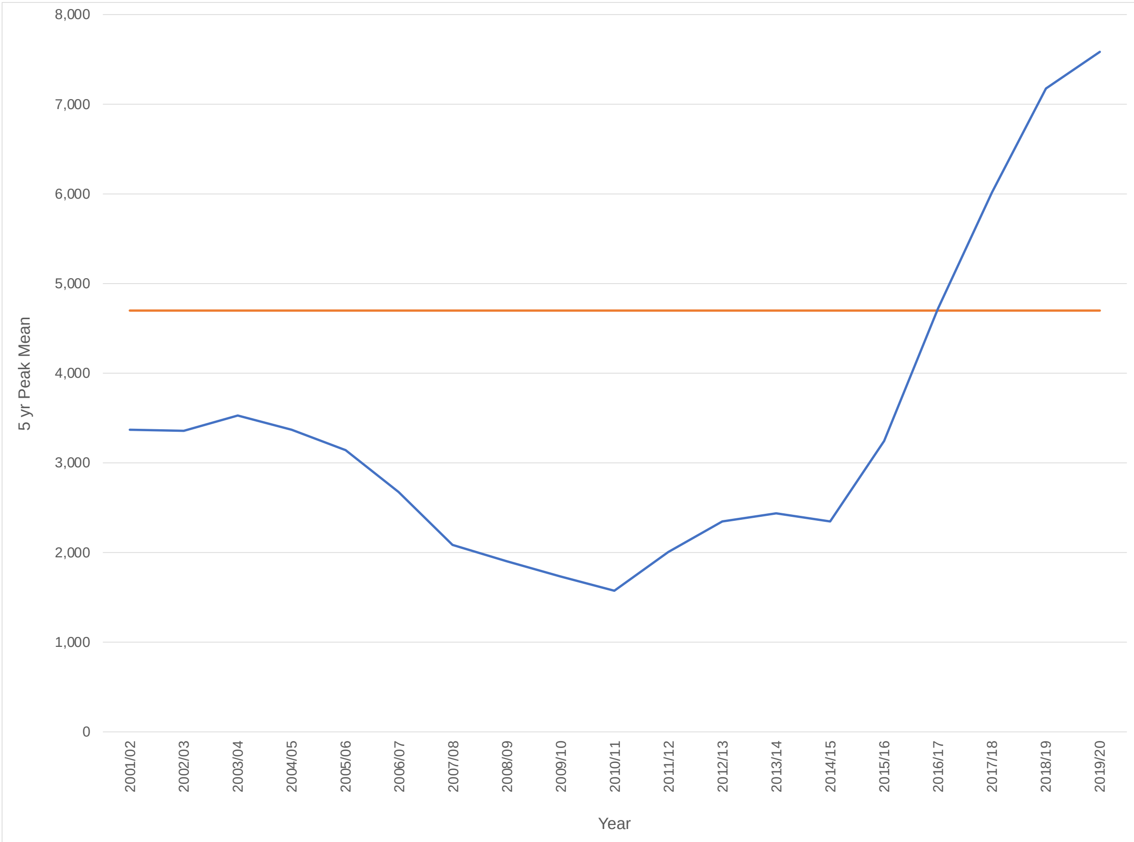

Figure 5.3: Common scoter population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 – 2020. The orange line shows the site reference population size for the SPA (2001/02 – 2004/05 peak mean of 4,700 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

198. Site specific advice for common scoter is to:

- *Maintain the population of non-breeding common scoter at a stable or increasing trend relative to the site reference population.*

The Potential for Impacts on the Common Scoter Population

199. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on common scoter the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

200. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

201. Three common scoter were recorded within the Proposed Development array area with two in June and one in January. During intertidal and nearshore surveys common scoters were recorded infrequently with typically counts of fewer than 30 individuals. Peak counts of 40 in August 2020 and 47 May 2021 were recorded with all records between 500m and 1 km from shore.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

202. Direct disturbance and displacement to common scoter during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

203. Common scoter are considered to be highly sensitive to disturbance from vessels (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed common scoter as having a relative high sensitivity from disturbance arising from vessels (Garthe and Hüppop 2004, Furness *et al*. 2013, Fliessbach *et al*. 2019).

204. The Proposed Development offshore export cable encompasses 168 km^2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

205. Studies undertaken indicate that common scoter may be displaced by vessel traffic with one study reporting common scoter being flushed by approaching vessels at distances from between 30 m and 2,000 m and for flocks a median distance of 800 m (Fliessbach *et al*. 2019).

206. Consequently, the area of impact from a single vessel at any one time could vary from between 0.003 km^2 to 32.17 km^2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.0001% of the SPA and 1.2% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 384 km^2 could occur, equivalent to 14.1% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

207. Common scoter that are displaced could return to the area following the departure of the vessel. However, studies indicate that common scoter that are flushed from an area by a vessel return relatively slowly compared to other seaduck species, with 13% returning within 180 minutes of being disturbed (Schwemmer *et al*. 2011).

208. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively wide area and although temporary common scoter will return more slowly compared with other species of seaduck.

209. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

210. The maximum count of 47 common scoter in nearshore and intertidal surveys is 0.77% of the SPA population (based on latest 5 year peak mean) and therefore less than 1% of the SPA population could be temporarily disturbed by vessel activity at any given time during the construction period. On the basis that the impacts will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

Changes to Prey Availability

211. Seaduck (eider, goldeneye, common scoter, velvet scoter and long-tailed duck) feed on a range of prey species but often specialise on one or two prey items (often bivalves or other molluscs) in any one location (e.g. Leopold *et al.* 2001). However, seaduck are also opportunistic and capable of adjusting diet in response to changes in prey availability or composition (e.g. Forni *et al.* 2022).

212. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

213. Any localised impacts on prey could cause the temporary relocation of common scoter to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

214. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for common scoter. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of common scoter.

Direct Habitat Loss

215. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on common scoter.

216. Common scoter typically feed in water depths of less than 20 m and therefore their distribution is limited to relatively shallow nearshore water (Kaiser *et al*. 2006). Reviews of the sensitivity of different seabird species to habitat use flexibility assigned common scoter as '4' on a five-scale ranking system. (Furness *et al*. 2013, Fliessbach *et al.* 2019). Suggesting that common scoter are moderately to highly sensitive to the loss of habitat.

217. The distribution of common scoter within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with highest densities occurring in the Tay, St Andrews Bay and inner Firth of Forth. Relatively low densities occur in waters along the export cable corridor (SNH 2015, SNH and JNCC 2016).

218. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA common scoter population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of common scoter.

Project Alone: Operation and Maintenance

Disturbance and Displacement

219. Direct disturbance and displacement to common scoter during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements.

220. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

Changes to Prey Availability

221. There will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

Direct Habitat Loss

222. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on common scoter through the loss of habitat during the operation and maintenance phase.

223. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of common scoter.

Project Alone: Conclusion

224. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA common scoter population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

225. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on common scoter and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report, volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

Changes to Prey Availability

226. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of common scoter and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where common scoter are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

Direct Habitat Loss

227. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (See Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

228. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to common scoter as they do not occur in the area where the majority of impacts on habitat from

cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where common scoter are known to most frequently occur.

229. The potential impacts on common scoter will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA common scoter population.

In-combination: Conclusion

230. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA common scoter population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Long-tailed Duck Population

231. Long-tailed duck is a winter visitor to the UK with the first birds returning in September and the winter population peaking between December and February. The Scottish wintering population estimated to be about 15,000 individuals (Forrester *et al*. 2007). They are widely distributed in waters around Scotland with the highest population estimated to occur in the Moray Firth.

232. The site reference population of 1,950 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has increased above the site reference population since 2016/17 (Figure 5.4).

233. The five year peak mean population size decreased between 2001 and 2010 but has since remained relatively stable (Figure 5.4).

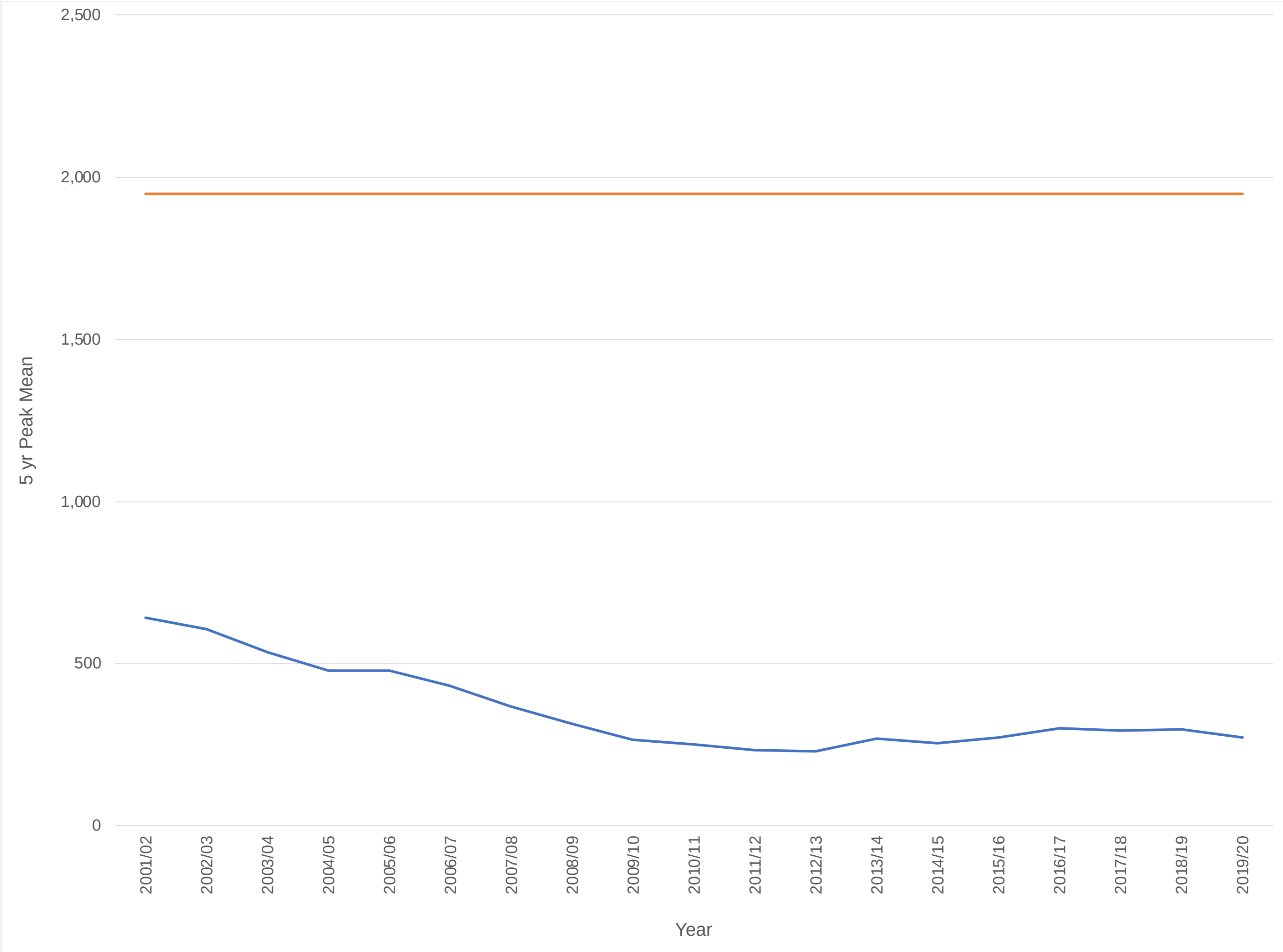

Figure 5.4: Long-tailed duck population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2001/02 – 2004/05 peak mean of 1,950 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

234. Species specifc advice in relation to long-tailed duck is to:

- *Maintain the population of non-breeding long-tailed ducks at a stable or increasing trend relative to the site reference population.*
- *Maintain the variety and abundance of food resources and the condition of supporting habitats and associated processes.*
- *Existing water quality should be maintained and any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats and/or prey, should be avoided.*

The Potential for Impacts on the Long-tailed Duck Population

235. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE

Renewables, 2021). The assessment of potential barrier and collision impacts on long-tailed duck the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

236. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

237. No long-tailed duck were recorded within the Proposed Development array area. During intertidal and nearshore surveys single long-tailed ducks were recorded on three occasions between December 2020 and March 2021.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

238. Direct disturbance and displacement to long-tailed duck during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the export cable. The Proposed Development array area lies outwith the SPA and no impacts on long-tailed duck are predicted to arise within the Proposed Development array area on the basis that no long-tailed duck were recorded within the area during surveys and the known distribution of long-tailed duck within the SPA is predominantly coastal (Lawson et al. 2015, SNH 2015, SNH and JNCC 2016).

239. Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed long-tailed duck as having a moderate sensitivity from disturbance arising from vessels and the lowest sensitivity of all the seaduck species considered within the reviews (Furness *et al.* 2013, Fliessbach *et al*. 2019). However, studies undertaken in Orkney reported long-tailed duck to be sensitive to vessel disturbance with a high propensity to fly away from marine vessels (Jarrett *et al.* 2018, 2022).

240. The Proposed Development offshore export cable encompasses 168 km2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

241. Studies undertaken indicate that long-tailed duck may be displaced by vessel traffic with one study reporting long-tailed duck being flushed by approaching vessels at distances from between 10 m and 1,500 m and for flocks a median distance of 250 m (Fliessbach *et al*. 2019). Flight distances of at least 400 m were reported for long-tailed ducks disturbed by vessel activity in Orkney (Jarrett *et al*. 2018, 2022).

242. Consequently, the area of impact from a single vessel at any one time could vary from between 0.0003 km^2 to 7.07 km^2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.0001% of the SPA and 0.26% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 84.8 km^2 could occur, equivalent to 3.11% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

243. Long-tailed duck that are displaced could return to the area following the departure of the vessel. with, studies reporting numbers returning to pre-disturbance levels within 180 minutes of the vessel disturbance occurring (Schwemmer *et al*. 2011).

244. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would occur over a relatively localised area and be temporary with long-tailed duck returning to the area within relatively short period of time.

245. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

246. The maximum count of 3 long-tailed duck in nearshore and intertidal surveys is 1.1% of the SPA population (based on latest 5 year peak mean). However, the impacts from disturbance or displacement caused by vessel activity will be temporary and localised and it is considered that there is no potential for construction or decommissioning related disturbance or displacement that would lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

Changes to Prey Availability

247. Long-tailed duck feed a wide range of prey items including bivalves, gastropods and crustaceans and habitats capable of supporting suitable prey items occur widely across the SPA (NatureScot and JNCC 2022). Although construction and decommissioning activities could cause a localised impact on prey within the SPA. The impacts are predicted to be temporary with benthic communities predicted to recover following cessation of activities.

248. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

249. Any localised impacts on prey could cause the temporary relocation of long-tailed duck to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

250. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for long-tailed duck. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Long-tailed duck.

Direct Habitat Loss

251. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on long-tailed duck.

252. Reviews of the sensitivity of different seabird species to habitat use flexibility assigned long-tailed duck as '4' on a five-scale ranking system. (Furness *et al.* 2013, Fliessbach *et al*. 2019). Suggesting that long-tailed duck are moderately to highly sensitive to the loss of habitat.

253. The distribution of long-tailed duck within the Outer Firth of Forth and St Andrews Bay Complex SPA have their highest concentrations in the Firth of Tay and the northern and central sections of the Firth of Forth. Relatively low densities occur in waters along the export cable corridor (NatureScot and JNCC 2022, SNH 2015, SNH and JNCC 2016).

254. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA long-tailed duck

population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of long-tailed duck.

Project Alone: Operation and Maintenance

Disturbance and Displacement

255. Direct disturbance and displacement to long-tailed duck during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements.

256. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

Changes to Prey Availability

257. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

Direct Habitat Loss

258. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on long-tailed duck through the loss of habitat during the operation and maintenance phase.

259. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of long-tailed duck.

Project Alone: Conclusion

260. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA long-tailed duck population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

261. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on long-tailed duck and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

Changes to Prey Availability

262. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of long-tailed duck and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where long-tailed duck are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

Direct Habitat Loss

263. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (See Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the Proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

264. Potential impacts on habitat from the project alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to long-tailed duck as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where long-tailed duck are known to most frequently occur.

265. The potential impacts on long-tailed duck will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA long-tailed duck population.

In-combination: Conclusion

266. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA long-tailed duck population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Goldeneye Population

267. Goldeneye is a rare breeding bird in the UK with an estimated breeding population of less than 200 pairs, of which approximately 150 pairs breed in Scotland (Woodward *et al*. 2020, Forrester *et al*. 2007). The Scottish wintering population is estimated to be between 10,000 and 12,000 individuals (Forrester *et al*. 2007). They are widely distributed in waters around Scotland with the highest wintering population occurring in the Firth of Forth with over 1,300 individuals counted in winter 2019/2020 (BTO 2022). Goldeneye winter in the SPA from between September and mid-April (NatureScot and JNCC 2022).

268. The site reference population of 590 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has remained above the site reference population since at least 2001 (**Figure 5.5**).

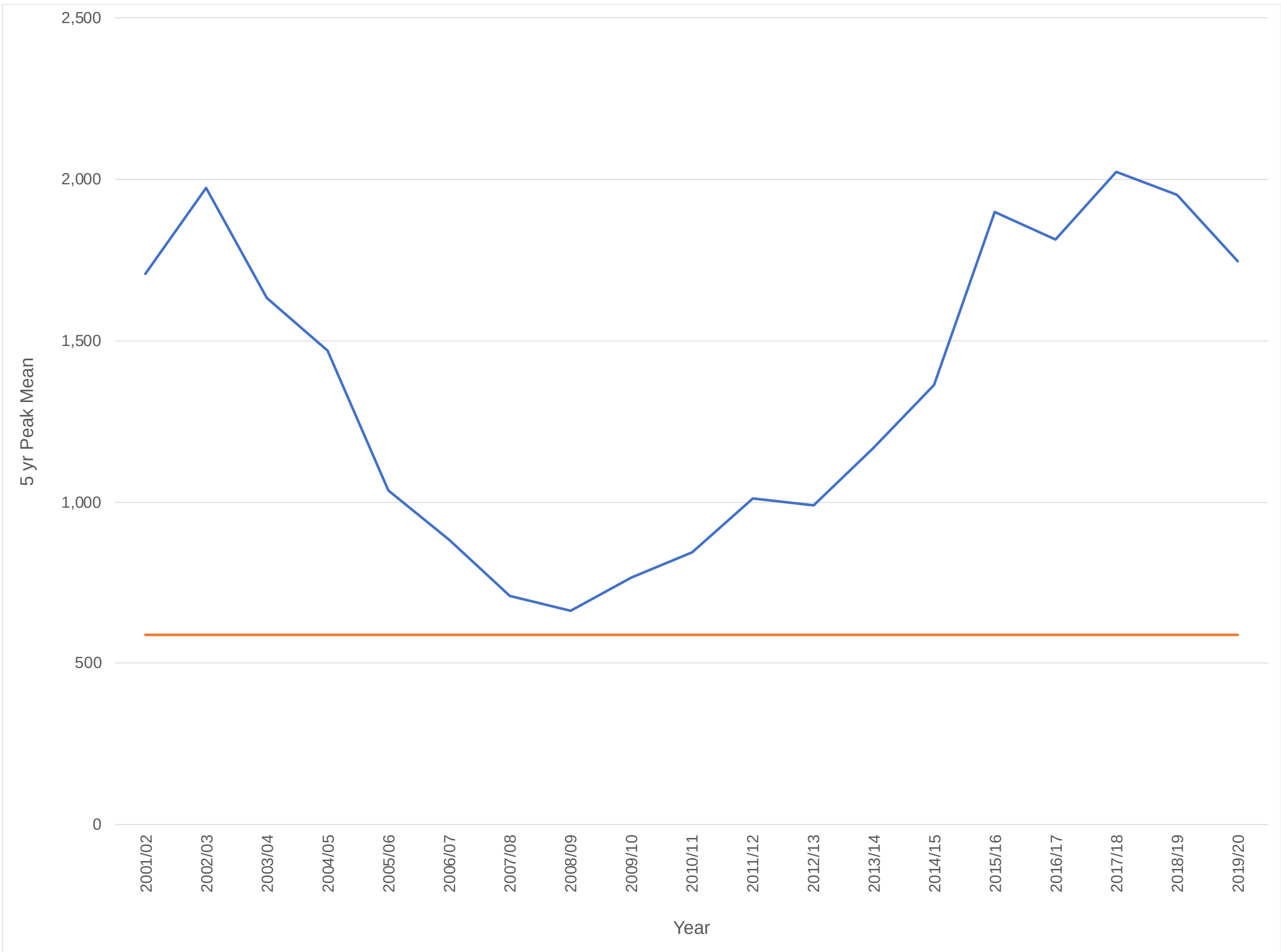

Figure 5.5: Goldeneye population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2006/07-2010/11 peak mean of 590 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

269. Species specifc advice for goldeneye is to:

- *Maintain the population of non-breeding goldeneye at a stable or increasing trend relative to the site reference population.*

Potential Impacts on the Goldeneye Population

270. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on goldeneye in the Firth of Tay and Eden estuary SPA and the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

271. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and

disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

272. No goldeneye were recorded within the Proposed Development array area. During intertidal and nearshore surveys goldeneye were recorded intermittently, predominantly during the winter and passage months in relatively low numbers of no more than seven in all surveyed sectors. The peak count of seven was recorded in February 2021. Almost all birds were recorded within 500 m of the shore.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

273. Direct disturbance and displacement to goldeneye during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable. The Proposed Development array area lies outwith the SPA and no impacts on goldeneye are predicted to arise within the Proposed Development array area as none were recorded there during surveys.

274. Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed goldeneye as having a moderate to high sensitivity from disturbance arising from vessels (Furness et al. 2013) and a high sensitivity from more general disturbance (Goodship and Furness 2022).

275. The Proposed Development offshore export cable encompasses 168 km2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

276. There are limited studies on the impacts from marine vessel traffic on goldeneye. Goodship and Furness (2022) suggest a disturbance buffer of between 150 m and 800 m.

277. Consequently, the area of impact from a single vessel at any one time could vary from between 0.07 km2 to 2.01 km^2 (based on the minimum and maximum suggested buffer distances), equivalent to between <0.002% of the SPA and 0.07% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 24 km^2 could occur, equivalent to 0.88% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

278. Goldeneye that are displaced could return to the area following the departure of the vessel, although the duration that the displacement caused by a marine vessel is unknown for all other seaduck species for which there are data, it is shown that displacement effects caused by marine vessel traffic are always temporary. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would occur over a relatively localised area and be temporary with goldeneye returning to the area once activities have ceased.

279. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

280. The maximum count of seven goldeneye in nearshore and intertidal surveys is 0.4% of the SPA population (based on latest 5 year peak mean). Any disturbance impacts will be temporary and localised and it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

Changes to Prey Availability

281. Seaduck (eider, goldeneye, common scoter, velvet scoter and long-tailed duck) feed on a range of prey species but often specialise on one or two prey items (often bivalves or other molluscs) in any one location (e.g. Leopold *et al*. 2001). However, seaduck are also opportunistic and capable of adjusting diet in response to changes in prey availability or composition (e.g. Forni *et al*. 2022).

282. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

283. Any localised impacts on prey could cause the temporary relocation of goldeneye to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

284. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for goldeneye. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of goldeneye.

Direct Habitat Loss

285. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on goldeneye.

286. Reviews of the sensitivity of different seabird species to habitat use flexibility assigned goldeneye as ‘4’ on a five-scale ranking system. (Furness *et al.* 2013). Suggesting that goldeneye are moderately to highly sensitive to the loss of habitat.

287. The distribution of goldeneye within the Outer Firth of Forth and St Andrews Bay Complex SPA is almost exclusively in nearshore waters within the Firth of Forth, with low numbers elsewhere (NatureScot and JNCC 2022, SNH 2015, SNH and JNCC 2016).

288. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA goldeneye population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of long-tailed duck.

Project Alone: Operation and Maintenance

Disturbance and Displacement

289. Direct disturbance and displacement to goldeneye during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity.

290. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

Changes to Prey Availability

291. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

Direct Habitat Loss

292. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on goldeneye through the loss of habitat during the operation and maintenance phase.

293. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of goldeneye.

Project Alone: Conclusion

294. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA goldeneye population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

295. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on goldeneye and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report, volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

Changes to Prey Availability

296. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of goldeneye and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where goldeneye are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

Direct Habitat Loss

297. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (See Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

298. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to goldeneye as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where goldeneye are known to most frequently occur.

299. The potential impacts on goldeneye will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA goldeneye population.

In-combination: Conclusion

300. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA goldeneye population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Red-breasted Merganser Population

301. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on red-

breasted merganser in the Firth of Tay and Eden estuary SPA and the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

302. Red-breasted merganser is a rare breeding bird in the UK, with between 16 and 47 pairs nesting in 2019 (Eaton 2021). The Scottish wintering population is estimated to be between 25,000 and 30,000 individuals (Forrester *et al*. 2007). Their distribution in Scottish waters is widespread occurring across both east and west coasts. Along the east coast highest numbers in recent years have occurred in the Firth of Forth, Inner Moray and Beauly Firths and the Montrose Basin.

303. The site reference population of 430 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has fluctuated but remained above the site reference population since at least 2001 (**Figure 5.6**).

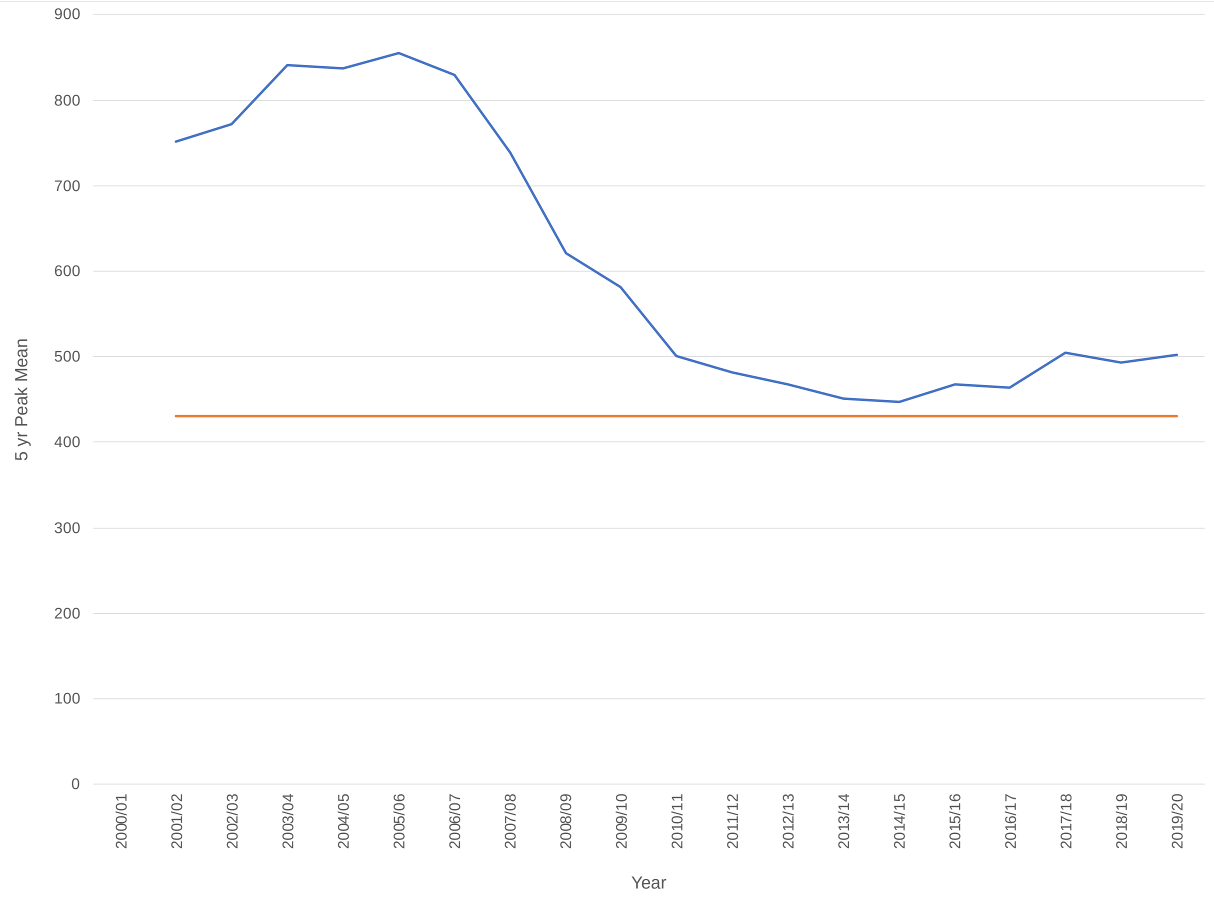

Figure 5.6: Red-breasted merganser population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the citation population size for the SPA (2006/07-2010/11 peak mean of 430 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

304. Species specific advice in relation to red-breasted merganser is to:

- *Maintain the population of non-breeding red-breasted mergansers at a stable or increasing trend relative to the site reference population*
- *Ensure red-breasted mergansers can move safely between the site and important areas of functionally linked land outwith the site.*

Potential Impacts on the Red-breasted Merganser Population

305. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

306. No red-breasted merganser were recorded within the Proposed Development array area. During intertidal and nearshore surveys no more than five individuals were recorded during any month. Almost all birds were recorded within 500 m of the shore.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

307. Direct disturbance and displacement to red-breasted merganser during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

308. Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed red-breasted merganser as having a relative high sensitivity from disturbance arising from vessels (Fliessbach et al. 2019).

309. The Proposed Development offshore export cable encompasses 168 km^2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

310. Studies undertaken indicate that red-breasted merganser may be displaced by vessel traffic with one study reporting individuals being flushed by approaching vessels at distances from between 120 m and 2,000 m and for flocks a median distance of 500 m (Fliessbach et al. 2019).

311. Consequently, the area of impact from a single vessel at anyone time could vary from between 0.07 km^2 to 32.17 km^2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.002% of the SPA and 1.2% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 386 km^2 could occur, equivalent to 14.2% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

312. Red-breasted merganser that are displaced could return to the area following the departure of the vessel. With studies reporting no significant changes in the numbers of birds present within 30 minutes of disturbance occurring (Jarrett et al. 2018).

313. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively wide area but will be temporary and localised with no significant changes in the numbers present.

314. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

315. The maximum count of five red-breasted mergansers in nearshore and intertidal surveys is 1.0% of the SPA population (based on latest five year peak mean) and therefore an estimated 1% of the SPA red-breasted merganser population could be temporarily disturbed by vessel activity at any given time during the construction period. However, on the basis that the impacts will be temporary and localised and will not cause change in the abundance within the SPA, it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

Changes to Prey Availability

316. Red-breasted merganser, feed primarily on a range of small fish species which occur widely throughout the SPA. Any localised impacts on prey could cause the temporary relocation of red-breasted merganser to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

317. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

318. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for red-breasted merganser. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of red-breasted merganser.

Direct Habitat Loss

319. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on red-breasted merganser.

320. Red-breasted merganser typically occur in relatively shallow nearshore water. The distribution of red-throated diver within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with highest densities or numbers occurring in the Tay Estuary and inner Firth of Forth (SNH and JNCC 2016).

321. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA red-breasted merganser population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of red-breasted merganser.

Project Alone: Operation and Maintenance

Disturbance and Displacement

322. Direct disturbance and displacement to red-breasted merganser during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity.

323. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

Changes to Prey Availability

324. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

Direct Habitat Loss

325. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on red-breasted merganser through the loss of habitat during the operation and maintenance phase.

326. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Red-breasted merganser.

Project Alone: Conclusion

327. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA red-breasted merganser population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

328. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on red-breasted merganser and therefore capable of causing an in-combination impact. Marine traffic occurs

widely throughout the region, including within the SPA (see Offshore EIA report volume 3, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

Changes to Prey Availability

329. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of red-breasted merganser and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where red-breasted merganser are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

Direct Habitat Loss

330. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (See Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

331. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to red-breasted merganser as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where red-breasted merganser are known to most frequently occur.

332. The potential impacts on red-breasted merganser will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA red-breasted merganser population.

In-combination: Conclusion

333. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA red-breasted merganser population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Red-throated Diver Population

334. Red-throated diver is a scarce breeding bird in the UK, with an estimated 1,255 breeding pairs, all of which breeding in northern and north-west Scotland (Woodward *et al*. 2020, Forrester *et al*. 2007). The Scottish wintering population is estimated to be 2,270 individuals (Forrester *et al*. 2007). They are widely distributed in waters around Scotland with the highest wintering population occurring along the east coast, including the Firth of Firth.

335. The site reference population of 850 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has remained relatively stable since 2001, although there may have been a slight decrease over the years (**Figure 5.7**).

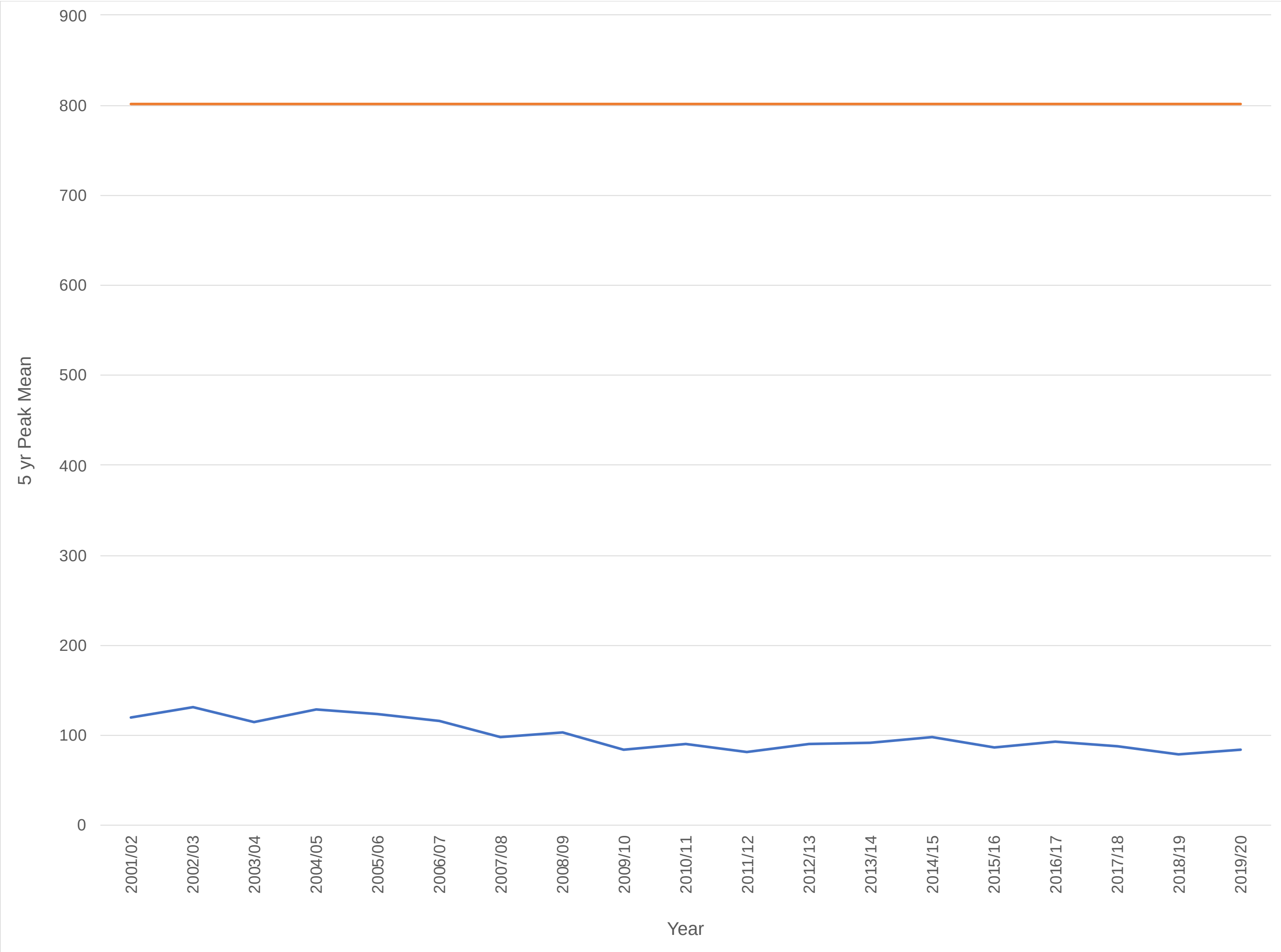

Figure 5.7: Red-throated diver population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2001/02 -2004/05 peak mean of 850 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

336. Site specific advice for red-throated diver is to:

- *Maintain the population of non-breeding red-throated divers at a stable or increasing trend relative to the site reference population*.

Potential Impacts on the Red-throated Diver Population

337. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021).

338. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

339. Red-throated diver were occasionally recorded within the Proposed Development array area in late spring and early winter, with peak density of 0.05 birds/km2 (95%CI 0.02 – 0.09) occurring in November 2020 and equating to an estimated 200 birds (95%CI 72 – 375). Spring peaks in abundance can be attributed to the presence of pre-breeding congregations of the species, which have previously been observed off the east coast of Scotland in late May. Birds occurring during passage could originate from any of the wintering areas located in the North Sea.

340. During intertidal and nearshore surveys red-throated divers were recorded frequently throughout the Survey Area during the autumn passage and early winter months. Although numbers were low, with an overall peak count of just nine individuals (December 2020), this species does not typically occur in large aggregations during the non-breeding season. Birds were generally recorded between 0-1 km from the shore.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

341. Direct disturbance and displacement to red-throated diver during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

342. Red-throated diver are recognised to be sensitive to disturbance from vessels (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed red-throated diver as having a relatively very high sensitivity from disturbance arising from vessels (Furness *et al.* 2013, Fliessbach *et al*. 2019).

343. The Proposed Development offshore export cable encompasses 168km^2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

344. Studies undertaken indicate that red-throated diver may be displaced by vessel traffic with studies reporting red-throated diver being flushed by approaching vessels at distances from between 250 m and 1,750 m and for flocks a median distance of 600 m (Fliessbach *et al*. 2019). Similar studies have reported up to 5% of individual red-throated divers and 15% of flocks were disturbed by vessels from between 800 and 1,000 m away, the majority of remained to within 600 m of a moving vessel. Up to 67% of all individual red-throated divers were not disturbed (i.e. fly away) until the vessel was within 200 m of them. The study also indicated that flocks of red-throated divers were more sensitive than individuals (Norman and Ellis 2005).

345. Consequently, the area of impact from a single vessel at any one time could vary from between 0.19 km^2 to 9.62 km^2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.04% of the SPA and 0.35% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 115.4 km^2 could occur, equivalent to 4.24% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

346. Not all red-throated divers fly in response to vessel disturbance with 67% either swimming or diving in response to a slow moving vessel (Jarrett *et al.* 2018, Norman and Ellis 2005). Red-throated diver that are displaced could return to the area following the departure of the vessel. Studies indicate that red-throated divers are largely absent in areas where there is regular vessel traffic, e.g. shipping lanes. However, where there is occasional or temporary disturbances at least one study reported no significant changes in abundance within 30 minutes of the vessels departure (Jarrett *et al*. 2018).

347. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively wide area but will be temporary, with red-throated diver abundance returning to pre-construction levels once the temporary disturbance caused by the vessels stops.

348. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

349. The maximum count of nine red-throated diver in nearshore and intertidal surveys is 7.9% of the SPA population (based on latest 5 year peak mean). These will be disturbed and displaced by the presence of vessel activity within the SPA. However, evidence shows that displacement is temporary and that birds that are displaced will be able to relocate to other locations within the SPA and return shortly after vessel activities cease. On this basis it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

<u>Changes to Prey Availability</u>

350. Red-throated divers appear capable of utilising a range of marine habitats and prey. They are generalist opportunistic feeders favouring pelagic schooling fish (Dierschke *et al*. 2017, Kleinschmidt *et al*. 2019). Red-throated divers wintering in the North Sea and Baltic Sea are thought to feed predominantly on small fish such as herring (*Clupea harengus*), sprats (*Sprattus sprattus*) and sandeels (*Ammodytes marinus*). However, they are believed to switch to alternative small prey, depending on the species of fish (Dierschke *et al*. 2017).

351. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

352. Red-throated divers appear capable of utilising a range of marine habitats and prey. They are generalist opportunistic feeders favouring pelagic schooling fish (Dierschke *et al*. 2017, Kleinschmidt *et al*. 2019). Red-throated divers wintering in the North Sea and Baltic Sea are thought to feed predominantly on small fish such as herring (*Clupea harengus*), sprats (*Sprattus sprattus*) and sandeels (*Ammodytes marinus*). However, they are believed to switch to alternative small prey, depending on the species of fish (Dierschke *et al*. 2017).

353. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for red-throated diver. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of red-throated diver.

<u>Direct Habitat Loss</u>

354. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on red-throated diver.

355. Red-throated diver typically feed in water depths of less than 10 m and therefore their distribution is limited to relatively shallow nearshore water (NatureScot and JNCC 2022). Reviews of the sensitivity of different seabird species to habitat use flexibility assigned red-throated diver as '4' on a five-scale ranking system. (Furness *et al.* 2013). Suggesting that red-throated diver are moderately to highly sensitive to the loss of habitat. However, it is also recognised that they are capable of using a range of marine habitats (Dierschke *et al*. 2017).

356. The distribution of red-throated diver within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with high concentrations recorded by St Andrews Bay and the Firth of Tay area. Relatively low densities occur in waters along the export cable corridor (SNH 2015, SNH and JNCC 2016).

357. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA red-throated diver population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of red-throated diver.

<u>Project Alone: Operation and Maintenance</u>

<u>Disturbance and Displacement</u>

358. Direct disturbance and displacement to red-throated diver during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity.

359. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

<u>Changes to Prey Availability</u>

360. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

<u>Direct Habitat Loss</u>

361. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried

without trenching. Consequently, there will be minimal, if any, additional impact on red-throated diver through the loss of habitat during the operation and maintenance phase.

362. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Red-throated diver.

Project Alone: Conclusion

363. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA red-throated diver population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

364. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on red-throated diver and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 8) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

Changes to Prey Availability

27. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of red-throated diver and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where red-throated diver are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

Direct Habitat Loss

365. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

366. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to red-throated diver as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where red-throated diver are known to most frequently occur.

367. The potential impacts on red-throated diver will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA red-throated diver population.

In-combination: Conclusion

368. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA red-throated diver population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Slavonian Grebe Population

369. Slavonian grebe is a rare breeding bird in the UK, with less than 30 breeding pairs, all of which breed in Scotland (Woodward *et al*. 2020, Forrester *et al*. 2007). The Scottish wintering population is estimated to be between 300 and 500 individuals (Forrester *et al*. 2007). They are widely distributed in waters around Scotland with the highest wintering population occurring around the islands of Orkney, the Moray Firth and the Firth of Forth.

370. The site reference population of 30 individuals has been calculated based on a multi-year programme of aerial, boat-based and land-based surveys (Lawson *et al.* 2015). WeBS data indicates that the peak mean population size has decreased since 2006 but has remained largely above the site reference populations.

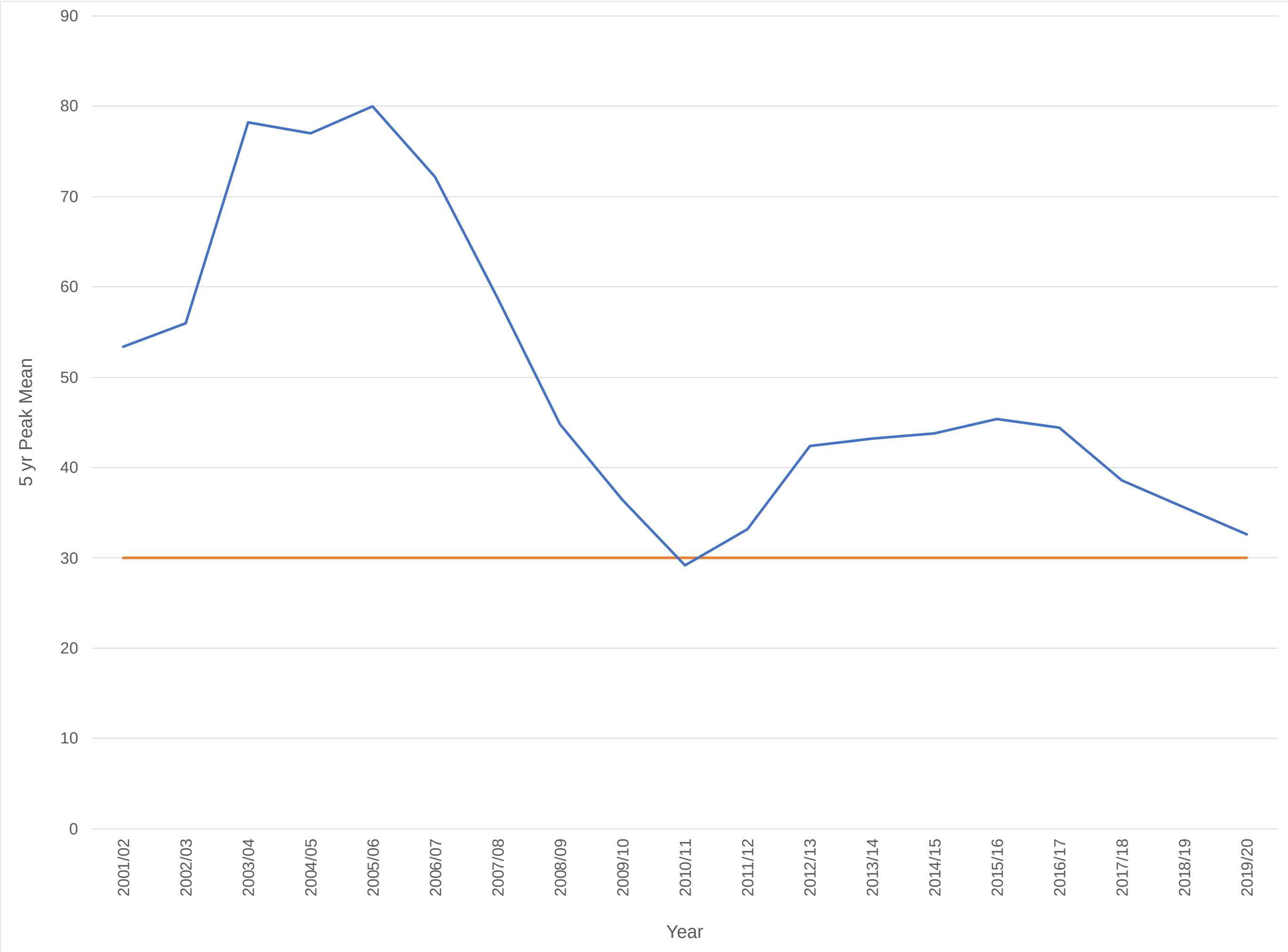

Figure 5.8: Slavonian grebe population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2006/07 -2010/11 peak mean of 30 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

371. Site specific advice for Slavonian grebe is to:

- *Maintain the population of non-breeding Slavonian grebes at a stable or increasing trend relative to the site reference population*

The potential Impacts on the Slavonian grebe population

372. Potential impacts on the Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population screened in for assessment are outlined in section 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021). The assessment of potential barrier and collision impacts on Slavonian grebe in the Firth of Forth SPA are addressed in the Migratory Bird Assessment (Section 5.8).

373. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

374. Slavonian grebe were not recorded within the Proposed Development array area. During intertidal and nearshore surveys one Slavonian grebe was recorded in March 2021.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

375. Direct disturbance and displacement to Slavonian grebe during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

376. Slavonian grebe are recognised to be moderately sensitive to disturbance from vessels (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed Slavonian grebe as having medium sensitivity from disturbance arising from vessels (Furness et al. 2013, Fliessbach et al. 2019). However, some studies have indicated that Slavonian grebe exhibit relatively high levels of behavioural and flight response to approaching vessels and therefore may be considered to be very highly sensitive to vessel disturbance (Jarrett et al. 2022).

377. The Proposed Development offshore export cable encompasses 168 km^2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km^2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

378. Studies undertaken indicate that Slavonian grebe may be displaced by vessel traffic with studies reporting Slavonian grebe being flushed by approaching vessels at distances from between 30 m and 1,100 m and for flocks a median distance of 265 m (Fliessbach et al. 2019).

379. Consequently, the area of impact from a single vessel at any one time could vary from between 0.003 km2 to 3.81 km2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.001% of the SPA and 0.14% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 45.7 km^2 could occur, equivalent to 1.68% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

380. Not all Slavonian grebe will take to flight in response to vessel disturbance with 59% either swimming or diving in response to a slow moving vessel (Jarrett et al. 2018). Slavonian grebe that are displaced could return to the area following the departure of the vessel. Studies indicate that where there is occasional or temporary disturbances there are no significant changes in abundance within 30 minutes of the vessels departure (Jarrett et al. 2018).

381. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively wide area but will be temporary, with Slavonian grebe abundance returning to pre-disturbance levels once the temporary disturbance caused by the vessels stops.

382. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

383. The maximum and only observation of Slavonian grebe during nearshore and intertidal surveys is of one bird, equivalent to 3.06% of the SPA population (based on latest 5 year peak mean). Although birds present could be disturbed and displaced by the presence of vessel activity within the SPA, evidence shows that displacement is temporary and that birds that are displaced will be able to relocate to other locations within the SPA and return shortly after vessel activities cease. On this basis it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

Changes to Prey Availability

384. Slavonian grebe feed primarily on a range of small fish species.

385. As outlined in the section on *project alone: construction and decommissioning – changes to prey availability* for eider, there is potential for temporary changes in prey availability caused by impacts on the habitat arising from construction and decommissioning activities. However, in intertidal and nearshore subtidal zone the impacts will be limited as the export cables will be buried without trenching out to at least 488 m from the MHWS. Consequently, there will be no habitat loss or impacts on the availability of prey within this area.

386. Any localised impacts on prey could cause the temporary relocation of Slavonian grebe to unaffected areas, with birds predicted to return once prey abundance recovers to pre-construction levels.

387. Surveys indicate that the export cable route does not occur in an area which is recognised to be significantly important for Slavonian grebe, with only one bird recorded during surveys. Therefore any impacts on prey species will only affect a localised area and birds will be able to relocate to areas of suitable habitat and prey availability within the SPA. Any impacts will be temporary and localised and not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Slavonian grebe.

Direct Habitat Loss

388. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on Slavonian grebe.

389. Slavonian grebe typically feed on small in water depths of less than 14 m and therefore their distribution is limited to relatively shallow nearshore water (NatureScot and JNCC 2022). Reviews of the sensitivity of different seabird species to habitat use flexibility assigned Slavonian grebe as '4' on a five-scale ranking system. (Furness *et al.* 2013). Suggesting that they are moderately to highly sensitive to the loss of habitat.

390. The distribution of Slavonian grebe within the Outer Firth of Forth and St Andrews Bay Complex SPA is predominantly in coastal waters with highest concentrations recorded in the Firth of Forth and to a lesser extent St Andrews Bay area (SNH 2015, SNH and JNCC 2016).

391. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA Slavonian grebe population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Slavonian grebe.

Project Alone: Operation and Maintenance

Disturbance and Displacement

392. Direct disturbance and displacement to Slavonian grebe during the operation and maintenance phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements.

393. The disturbance and displacement impacts arising from operational and maintenance vessel activity will be similar to, or less than, that arising during the construction and decommissioning phases. Consequently, it is considered that there is no potential for operational or maintenance related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

Changes to Prey Availability

394. There will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

Direct Habitat Loss

395. There will be no increase in direct habitat loss over and above that arising during the construction phase unless un-planned additional cable protection is required over and above the 15% of export cable that is already recognised as might requiring protection. If additional protection is required then it is predicted to be a relatively small increase in habitat loss. This will not be required where the cables will be buried without trenching. Consequently, there will be minimal, if any, additional impact on Slavonian grebe through the loss of habitat during the operation and maintenance phase.

396. On this basis it is concluded that the loss of habitat during operation and maintenance phase will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of Slavonian grebe.

Project Alone: Conclusion

397. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA Slavonian grebe population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

398. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on Slavonian grebe and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the

additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

Changes to Prey Availability

399. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of Slavonian grebe and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where Slavonian grebe are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

Direct Habitat Loss

400. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

401. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to Slavonian grebe as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where Slavonian grebe are known to most frequently occur.

402. The potential impacts on Slavonian grebe will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA Slavonian grebe population.

In-combination: Conclusion

403. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA Slavonian grebe population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Kittiwake Population

404. Kittiwake occur widely across the east coast of Scotland both during the breeding and non-breeding periods. Kittiwakes using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPAs:

- Forth Islands SPA;
- St Abb's Head to Fast Castle SPA;
- Fowlsheugh SPA;
- Buchan Ness to Collieston Coast SPA; and
- Troup, Pennan and Lion's Head SPA.

405. Consequently, these SPA populations are considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

406. No site-reference population is set for kittiwake at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of kittiwakes within the foraging area. For breeding kittiwake, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the above SPAs (NatureScot and JNCC 2022).

407. Species specific advice in relation to kittiwake is to:

- *Ensure breeding kittiwake have the ability to recover at the relevant SPA breeding colonies.*
- *Ensure kittiwake within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure kittiwake can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential Impacts on the Kittiwake Population

408. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

409. The potential impacts on kittiwake for each of the SPAs that are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed under each relevant SPA. The conclusions for each assessment for the Proposed Development alone are presented in Table 5.4 and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

410. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in Table 5.5 and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.4: Potential for adverse effects on kittiwake from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision Impacts
Forth Islands	No adverse effect	No adverse effect	No adverse effect	No adverse effect
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	Adverse effect	Adverse effect
Fowlsheugh	No adverse effect	No adverse effect	No adverse effect	No adverse effect
Buchan Ness to Collieston Coast	No adverse effect	No adverse effect	No adverse effect	No adverse effect
Troup Pennan and Lion's Head	No adverse effect	No adverse effect	No adverse effect	No adverse effect

Table 5.5: Potential for in-combination adverse effects on kittiwake from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA. * Adverse effected concluded under the Scoping Approach only.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision Impacts
Forth Islands	No adverse effect	No adverse effect	Adverse effect	Adverse effect
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	Adverse effect	Adverse effect
Fowlsheugh	No adverse effect	No adverse effect	Adverse effect	Adverse effect
Buchan Ness to Collieston Coast	No adverse effect	No adverse effect	Adverse effect*	Adverse effect*
Troup Pennan and Lion's Head	No adverse effect	No adverse effect	Adverse effect*	Adverse effect*

411. The following conclusions are supported by the assessments presented in sections 5.7.1 to 5.7.3 inclusive, and sections 5.7.5 to 5.7.6 inclusive.

412. For the Forth Islands SPA, whilst it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on the kittiwake population, it is concluded that there is the potential for an adverse effect as a result of the predicted effects from (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

413. For the St. Abb's Head to Fast Castle SPA kittiwake population, the potential effects from the Proposed Development alone and in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms due to mortality from displacement, barrier effects and collisions during the operation and maintenance phase are predicted to have the potential to result in marked reductions in population size relative to the size in the absence of these effects. Therefore, there is considered to be the potential for an adverse effect on the St Abb's Head to Fast Castle SPA kittiwake population as a result of the Proposed Development alone and in-combination according to both the Developer and Scoping Approaches.

414. It is considered that the predicted levels of impact from the Proposed Development alone on the Fowlsheugh SPA kittiwake population are of a small (for the Developer Approach) to, at most, moderate scale (for the upper range of the Scoping Approach). Thus, the effects from the Proposed Development alone would not result in an adverse effect on this SPA population, but it is concluded that there is the potential for an adverse effect on the Fowlsheugh kittiwake population as a result of the predicted effects from (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer and Scoping Approaches.

415. Similarly for the Buchan Ness to Collieston Coast SPA kittiwake population, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population, but it is concluded that there is the potential for an adverse effect as a result of the Proposed Development in-combination with the other UK North Sea wind farms, as determined by the Scoping Approach. However, when based upon the Developer Approach, it is concluded that there is no potential for an adverse effect on the SPA population as a result of the predicted effects from the Proposed Development in-combination with the other UK North Sea wind farms. It is considered that the level of effects on kittiwakes assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

416. For Troup, Pennan and Lion's Heads SPA, the predicted levels of impact for the Proposed Development in-combination with the other UK North Sea wind farms are inevitably greater for the Scoping Approach than as determined by the Developer Approach. It is considered that these may, potentially, be sufficient to result in an adverse effect on this SPA population. However, it is considered that the level of effects on kittiwakes assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

417. On the basis that the potential for adverse effects arising have been identified on Forth Islands SPA, St Abb's Head to Fast Castle SPA, Fowlsheugh SPA, Buchan Ness to Collieston Coast SPA and Troup Head, Pennan and Lion's Heads SPA, kittiwake populations and these colonies are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA it is concluded that there is potential for an adverse effect on kittiwake at the Outer Firth of Forth and St Andrews Bay Complex SPA from the Proposed Development alone and in-combination.

Assessment for the Black-headed Gull Population

418. Black-headed gulls are distributed throughout Scotland, primarily on the east and south-west coasts (Forrester et al., 2007). As well as birds arriving from elsewhere in the UK, many black-headed gulls migrate from northern and eastern Europe. Relatively large flocks of wintering birds have been observed within the Firth of Forth, such as at Skinflats and the Isle of May, located to the west of the survey area (Forrester et al., 2007).

419. The citation population of 26,835 individuals is based on winter gull surveys undertaken between 2003/04 and 2005/06 (NatureScot 2020) and based on the WeBS counts data the population has remained relatively stable since the last survey was undertaken (BTO 2022).

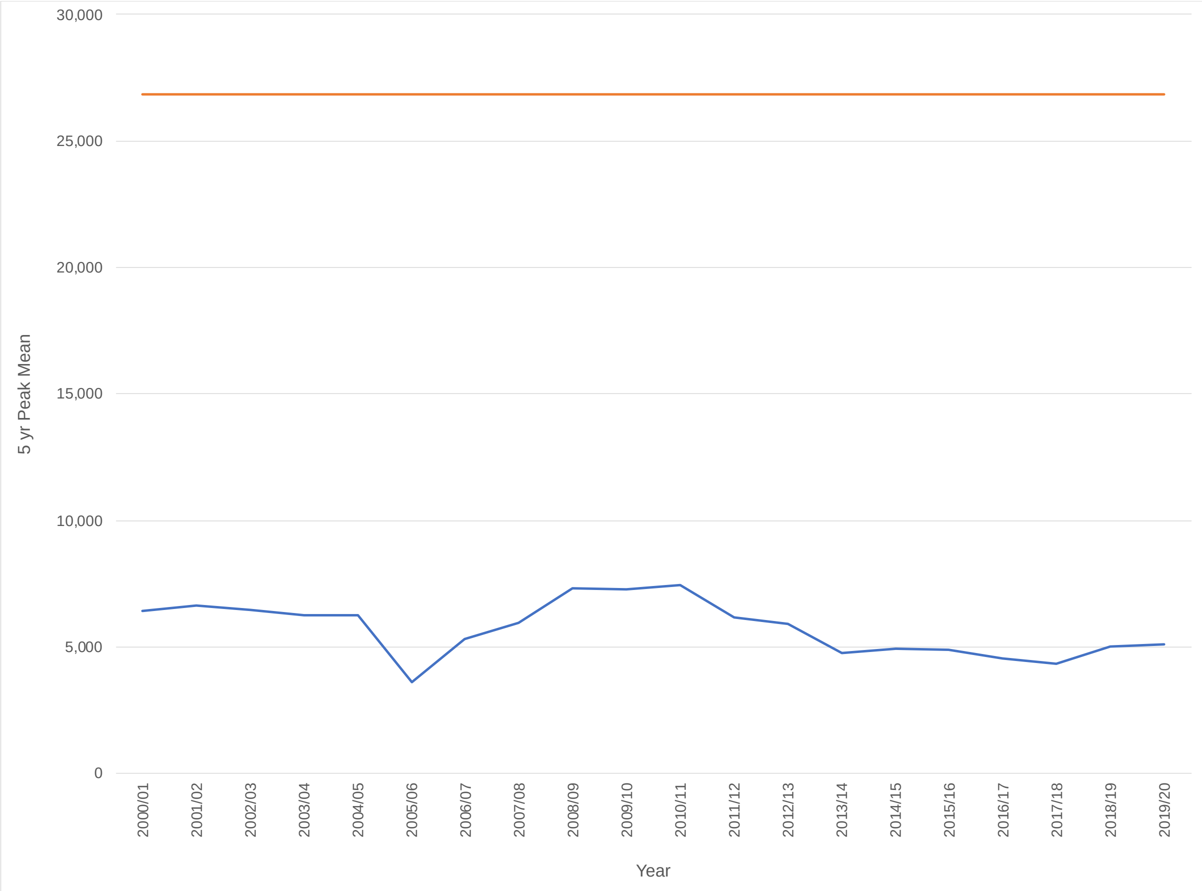

Figure 5.9: Black-headed gull population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the population at the time of site designation peak mean of 26,835 individuals). Data are from the Wetland Bird Survey Database (BTO 2022)

420. Species specific advice for black-headed gull is to:

- *Ensure black-headed gulls within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the non-breeding season.*
- *Ensure black-headed gulls can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Black-headed Gull Population

421. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

422. Black-headed gulls were uncommon in Offshore Ornithology Study Area and were only recorded during the non-breeding season with a mean seasonal peak population estimated at nine birds (95%CI 1 – 24) and a density of <0.001 birds/km^2. During inter-tidal and nearshore surveys black-headed gulls were regularly present throughout the year with a peak count of 265 during October. Birds were mostly recorded out to 1 km from the shore, although were mainly recorded in the shallow nearshore waters between 0-500 m.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

423. Direct disturbance and displacement to black-headed gull during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

424. Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed Black-headed gull as having relatively low sensitivity from disturbance arising from vessels (Furness et al. 2013). Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would be localised and, should it occur, be temporary.

425. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

426. The maximum count of 265 black-headed gulls recorded during nearshore and intertidal surveys is equivalent to 5.2% of the SPA population (based on latest 5 year peak mean) and 0.99% of the citation population. Although birds present could be disturbed and displaced by the presence of vessel activity within the SPA, evidence shows that displacement is temporary and that birds that are displaced will be able to relocate to other locations within the SPA and return shortly after vessel activities cease. On this basis it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Changes to Prey Availability

427. Black-headed gulls are opportunistic feeders and any changes in prey availability will be relatively localised and temporary. Black-headed gull occur widely across the SPA and therefore not restricted by prey availability and will be able to forage elsewhere if needed to. On this basis it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Direct Habitat Loss

428. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on black-headed gull.

429. Black-headed gull feed on the sea surface and there will be no direct impact from the loss of habitat to black-headed gull. On this basis it is considered that there is no potential for construction or decommissioning related habitat loss to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Project Alone: Operation

Disturbance and Displacement

430. On-going routine maintenance could cause disturbance and displacement to black-headed gull during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the maintenance of the export cable.

431. Black-headed gull are recognised to have low sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Project Alone: Conclusion

432. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA black-headed gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

433. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on black-headed gull and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Changes to Prey Availability

434. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of black-headed gull and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where black-headed gull are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Direct Habitat Loss

435. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

436. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to black-headed gull as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where black-headed gull are known to most frequently occur.

437. The potential impacts on black-headed gull will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

In-combination: Conclusion

438. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA black-headed gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Little Gull Population

439. Little gull migrate to UK coastal environments for the non-breeding period. Post-breeding adult birds usually arrive in Scotland from Europe between late July and August, followed by juvenile birds, observed in the highest concentrations along the Angus and Dundee coast (Forrester et al., 2007). A secondary influx generally occurs between October and November, mainly consisting of adult and first-winter birds (Forrester et al., 2007).

440. The citation population of 126 individuals is based on winter gull surveys undertaken between 2001/02 and 2004/05 (NatureScot 2020) and based on WeBS counts data the population has fluctuated since 2001 (BTO 2022) (**Figure 5.10**).

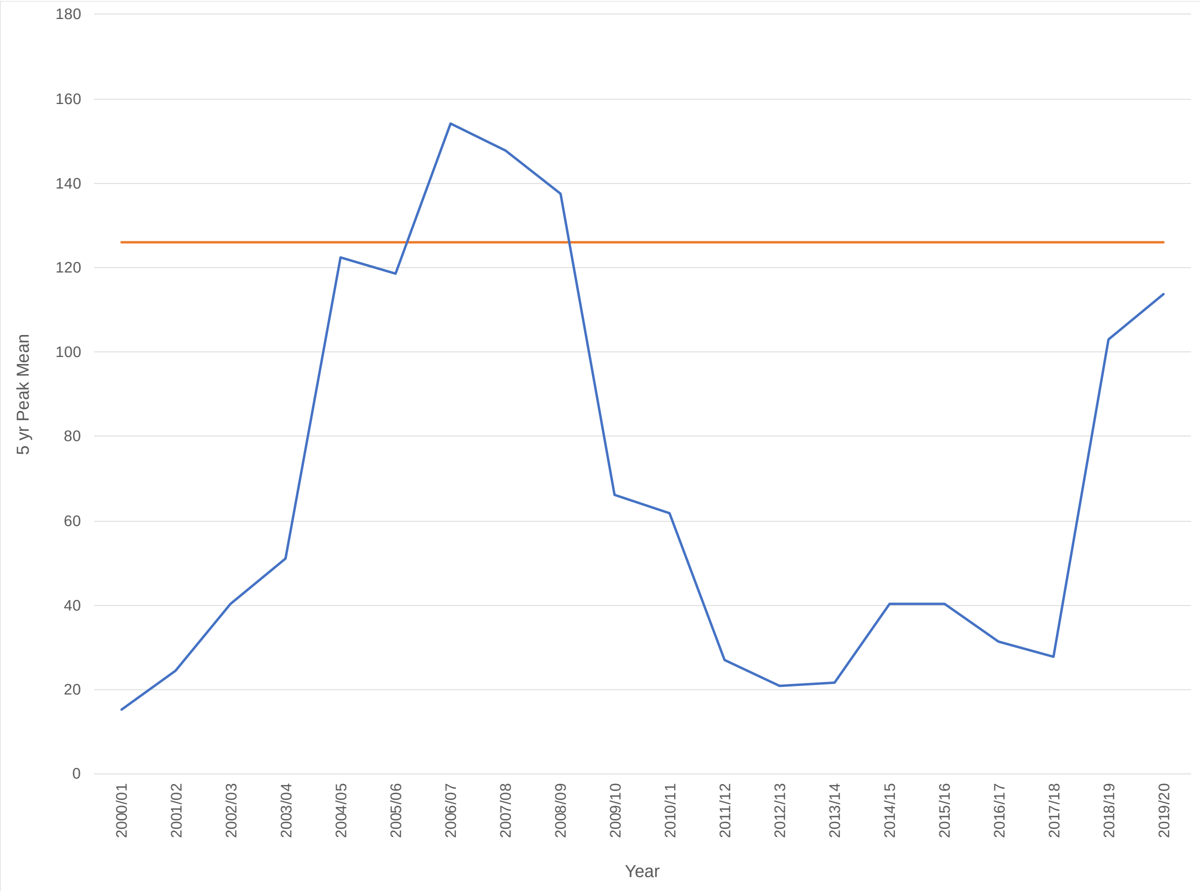

Figure 5.10: Little gull population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the site reference population size for the SPA (2001/02 -2004/05 peak mean of 126 individuals). Data are from the Wetland Bird Survey Database (BTO 2022)

441. Species specific advice for little gull is to:

- *Maintain the extent and distribution of the supporting habitats for little gulls within the site.*
- *Maintain the condition of supporting habitats and associated processes.*
- *Existing water quality should be maintained and any increase in nutrients, turbidity or contaminants where this could reduce supporting habitats should be avoided*

Project Alone: Construction and Decommissioning

Disturbance and Displacement

442. Direct disturbance and displacement to little gull during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

443. Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have not assessed little gull although generally Gulls are considered not to be sensitive to disturbance or displacement by the physical presence of vessels and that is predicted to be the case for little gull (Furness et al. 2013). Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would be localised and, should it occur, be temporary.

444. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

445. Little gulls were regularly recorded in the Offshore Ornithology Study Area with peak population estimates occurring in August with up to 420 birds (95%CI 242 – 629) and a density of 0.11 birds/km2. No little gulls were recorded during nearshore and intertidal surveys. Although birds present could be disturbed and displaced by the presence of vessel activity within the SPA, displacement will be temporary and that birds that are displaced will be able to relocate to other locations within the SPA and return shortly after vessel activities cease. On this basis it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Changes to Prey Availability

446. Little gull are opportunistic feeders and any changes in prey availability will be relatively localised and temporary. Little gull occur widely across the SPA and are therefore not restricted by prey availability and will be able to forage elsewhere if needed to. On this basis it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Direct Habitat Loss

447. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on little gull.

448. Little gull feed on the sea surface and there will be no direct impact from the loss of habitat to little gull. On this basis it is considered that there is no potential for construction or decommissioning related habitat loss to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Project Alone: Operation

Disturbance and Displacement

449. On-going routine maintenance could cause disturbance and displacement to little gull during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities associated with the maintenance of the export cable.

450. Little gull are believed to have low sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Collision Impacts

451. The Proposed Development array area lies outwith the Outer Firth of Forth and St Andrews Bay Complex SPA. However, little gulls originating from the SPA could occur within the Proposed Development array area and be impacted by collision.

452. Collision risk modelling estimate between two and four little gull collisions during the non-breeding period, based on either the Developers Approach or the Scoping Approach (Offshore EIA, volume 3, appendix 11.3). No collisions are predicted to occur during the breeding period (Offshore EIA, volume 3, appendix 11.3).

453. The Outer Firth of Forth and St Andrews Bay Complex SPA citation population is 126 individuals and the regional baseline population is 3,000 adults. Therefore, the SPA holds 4.2% of the regional little gull population. On this basis approximately 4.2% of the little gull collisions could be birds from the SPA. Consequently between 0.08 and 0.17 little gull collisions per year could be from birds associated with the SPA. It is therefore predicted that the annual collision mortality will be very low and that there is no potential for operational related collision impacts to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Project Alone: Conclusion

454. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA little gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

28. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on little gull and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Changes to Prey Availability

455. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of little gull and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where little gull are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Direct Habitat Loss

456. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

457. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown.

458. The potential impacts on little gull will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

Collision Impacts

459. There is potential for an in-combination collision impacts on little gull during the non-breeding period. The estimated densities of little gull recorded at Inch Cape, Seagreen 1 and Seagreen 1a offshore wind farms were low and so few little gulls were recorded at rotor height at these wind farms collision risk modelling was not undertaken. For Neart na Gaoithe offshore wind farm between four and six collisions were estimated per year, depending on the turbine scenarios, with all collisions predicted to occur in the non-breeding period. Consequently, an in-combination collision scenario of approximately ten collision per year is predicted. On the basis that 4.2% of the collisions could be birds from the SPA less than 0.5 collisions per year is predicted to impact on the Outer Firth of Forth and St Andrews Bay Complex SPA.

460. This is equivalent to 0.39% of the Outer Firth of Forth and St Andrews Bay Complex SPA citation population of 126 individuals. This estimated level of impact is not predicted to lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA little gull population.

In-combination: Conclusion

461. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA little gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Common Gull Population

462. Common gull is both a breeding and winter visitor to Scottish coastal waters. Generally, lower numbers of common gulls are present during the breeding period when they are breeding inland. During the non-

breeding period they occur largely within inshore and coastal waters and are infrequent further offshore (Forrester et al. 2007).

463. The citation population of 14,647 individuals is based on winter gull surveys undertaken between 2003/04 and 2005/06 (NatureScot and JNCC 2022). Based on the WeBS counts data the population has remained relatively stable since 2001 (BTO 2022) (**Figure 5.11**).

464. Species specific advice in relation to common gull is to:

- *Ensure common gull continue to have access to and can utilise all optimal habitats suitable for all relevant aspects of their life cycle associated with the site.*
- *Avoid significant disturbance to common gulls and ensure individuals can move safely between these areas within the site.*

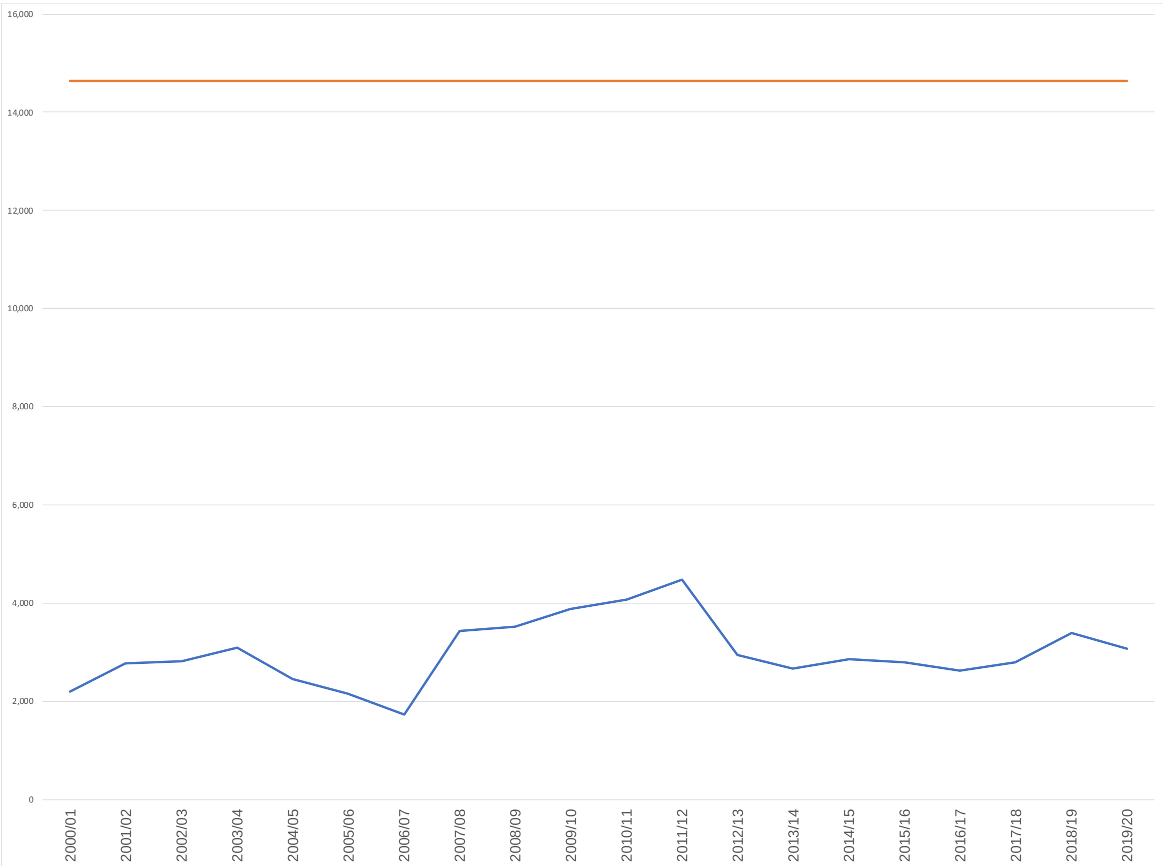

Figure 5.11: Common gull population trend at the Outer Firth of Forth and St Andrews Bay Complex SPA for the period 2001 - 2020. The orange line shows the population at the time of site designation peak mean of 14,647 individuals). Data are from the Wetland Bird Survey Database (BTO 2022).

The Potential for Impacts on the Common Gull Population

465. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

466. Common gulls were primarily recorded in the Offshore Ornithology Study Area during the non-breeding season in both years, with abundance peaking in December 2020 at 982 birds (95CI 232-1934). During inter-tidal and nearshore surveys common gulls were largely absent or recorded in low numbers throughout the year with an exception of 565 during December, the same period that the peak abundance occurred offshore. Birds were mostly recorded out to 1 km from the shore, although were mainly recorded in the shallow nearshore waters between 0-500 m.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

467. Direct disturbance and displacement to common gull during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the export cable.

468. Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed common gull as having relatively low sensitivity from disturbance arising from vessels (Furness et al. 2013). Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would be localised and, should it occur, be temporary.

469. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

470. The maximum count of 565 common gulls recorded during nearshore and intertidal surveys is equivalent to 3.8% of the SPA population (based on winter gull survey population estimate). Although birds present could be disturbed and displaced by the presence of vessel activity within the SPA, evidence shows that displacement is temporary and that birds that are displaced will be able to relocate to other locations within the SPA and return shortly after vessel activities cease. On this basis it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common gull population.

Changes to Prey Availability

471. Common gulls are opportunistic feeders and any changes in prey availability will be relatively localised and temporary. Common gull occur widely in coastal waters across the SPA and therefore not restricted by prey availability and will be able to forage elsewhere if needed to. On this basis it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common gull population.

Direct Habitat Loss

472. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on common gull.

473. Common gull feed on the sea surface and there will be no direct impact from the loss of habitat to common gull. On this basis it is considered that there is no potential for construction or decommissioning related

habitat loss to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common gull population.

Project Alone: Operation

Disturbance and Displacement

474. On-going routine maintenance could cause disturbance and displacement to common gull during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the maintenance of the export cable.

475. Common gull are recognised to have low sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA black-headed gull population.

Project Alone: Conclusion

476. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA common gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

477. During construction, operation and decommissioning phases there is potential existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on common gull and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA common gull population.

Changes to Prey Availability

478. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of common gull and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where common gull are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA common gull population.

Direct Habitat Loss

479. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

480. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown. However, the long-term loss of habitat from cable protection does not equate to loss of habitat to common gull as they do not occur in the area where the majority of impacts on habitat from cable protection are predicted to occur. Furthermore the nearshore trenchless cabling will not impact on the habitats and it is the nearshore areas where common gull are known to most frequently occur.

481. The potential impacts on common gull will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA common gull population

In-combination: Conclusion

482. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA common gull population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Herring Gull Population

483. Herring gull occur widely across the east coast of Scotland both during the breeding and non-breeding periods. Herring gull using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPAs:

- Forth Islands SPA;
- St Abb's Head to Fast Castle SPA; and
- Fowlsheugh SPA.

484. Consequently, these SPA populations are considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

485. No site-reference population is set for herring gull at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of herring gulls within the foraging area. For breeding herring gull, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the above SPAs (NatureScot and JNCC 2022).

486. Species specific advice for herring gull is to:

- *Ensure breeding herring have the ability to recover at the relevant SPA breeding colonies.*
- *Ensure herring gull within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure herring gull can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Herring Gull Population

487. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

488. The potential impacts on herring gull for each of the SPAs that are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed under each relevant SPA. The conclusions for each assessment are presented in **Table 5.6** and apply to both breeding and non-breeding populations during construction, operation and decommissioning phases.

489. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in

490. **Table 5.7** and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.6: Potential for adverse effects on herring gull from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision Impacts
Forth Islands	No adverse effect	No adverse effect	No adverse effect	No adverse effect
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	No adverse effect	No adverse effect
Fowlsheugh	No adverse effect	No adverse effect	No adverse effect	No adverse effect

Table 5.7: Potential for in-combination adverse effects on herring gull from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision Impacts
Forth Islands	No adverse effect	No adverse effect	No adverse effect	No adverse effect
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	No adverse effect	No adverse effect
Fowlsheugh	No adverse effect	No adverse effect	No adverse effect	No adverse effect

491. On the basis that no adverse effects have been identified for Forth Islands SPA, St Abb's Head to Fast Castle SPA and Fowlsheugh SPA and these colonies are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA it is concluded that the effects from the Proposed Development alone and in-combination would not result in an adverse effect on herring gull at the Outer Firth of Forth and St Andrews Bay Complex SPA. This conclusion is supported by the assessments presented in sections 5.7.1 to 5.73 inclusive.

Assessment for the Arctic Tern Population

492. Arctic terns are a summer migrant to Scottish waters with bird arriving in mid-April and departing in early September. The largest colony in the Forth and Tay area is in the Forth Islands SPA with a breeding population of 832 AoN in 2017.

493. The mean seasonal peak density was 0.06 birds/km2, equating to a mean seasonal peak population estimate for the Offshore Ornithology Study Area of 301 birds (95%CI 138 – 524). Peak abundances were recorded in late summer which can likely be attributed to adults and juveniles moving through the study area away from breeding colonies.

494. Arctic tern using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPA:

- Forth Islands SPA

495. Consequently, this SPA population is considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

496. No site-reference population is set for Arctic tern at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of Arctic tern within the foraging area. For breeding Arctic tern, when assessing plans or projects, the population impact should be considered in relation to the site reference population for the Forth Islands SPA (NatureScot and JNCC 2022).

497. Site specific advice for Arctic tern is to:

- Ensure Arctic terns within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding season.
- Ensure Arctic tern can move safely between the site and important areas of functionally linked land outwith the site.

The Potential for Impacts on the Arctic tern Population

498. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

499. The potential impacts on Arctic tern for the Forth Islands SPA the population of which is functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed. The conclusions for each assessment are presented in **Table 5.8** and apply to breeding populations during construction, operation and decommissioning phases.

500. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in **Table 5.9** and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.8: Potential for adverse effects on Arctic tern from SPA functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	No adverse effect

Table 5.9: Potential for in-combination adverse effects on Arctic tern from SPA functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	No adverse effect

501. On the basis that no adverse effects have been identified for Forth Islands SPA, and this colony is functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA it is concluded that the effects from the Proposed Development alone and in-combination would not result in an adverse effect on Arctic tern at the Outer Firth of Forth and St Andrews Bay Complex SPA.

Assessment for the Common Tern Population

502. Common terns are a summer migrant to Scottish waters with bird arriving in April and departing in September. Birds were widespread throughout the Offshore Ornithology Study Area and the mean seasonal peak density was 0.06 birds/km2, equating to a mean seasonal peak population estimate for the Offshore Ornithology Study Area of 301 birds (95%CI 138 – 524). Most sightings occurred during the late breeding season, with peaks occurring in August. These birds can likely be attributed to adults and juveniles moving through the study area away from breeding colonies.

503. Common terns are a qualifying species for the nearby Forth Islands SPA, which is estimated to hold around 3% of the GB population, corresponding to 334 pairs (mean 1997 – 2001; NatureScot, 2020). Leith docks, located in Edinburgh also supports a large breeding population, estimated to be at around 514 and 246 AON in 2018 and 2019 respectively (SMP, 2021), although the Offshore Ornithology Study Area is outwith the mean maximum foraging range (+1S.D) for birds from this colony

504. Common terns using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPAs:

- Forth Islands SPA; and
- Imperial Dock Lock SPA.

505. Consequently, these SPA population are considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

506. No site-reference population is set for common tern at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of common terns within the foraging area. For breeding common tern, when assessing plans or projects, the population impact should be considered in relation to the site reference population for the Forth Islands and Imperial Dock Lock SPAs (NatureScot and JNCC 2022).

507. Species specific advice for comment tern is to:

- *Ensure breeding common tern have the ability to recover at the relevant SPA breeding colonies.*
- *Ensure common terns within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding season.*
- *Ensure common tern can move safely between the site and important areas of functionally linked land outwith the site.*

<u>The Potential for Impacts on the Common Tern Population</u>

508. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

509. As outlined in section 3.1, it is considered that there is no pathway for effect on common terns breeding at Imperial Dock Lock SPA since the Proposed Development is situated well beyond the foraging range of common tern breeding at this SPA (based on colony tracking data and a mean maximum plus 1 SD foraging range of 18.0±8.9 km; Wilson *et al.* 2014; Woodward *et al*. 2019). Therefore, only potential impacts on common tern for the Forth Islands SPA have been assessed. The conclusions for this assessment are presented in **Table 5.10** and apply to the breeding population during construction, operation and decommissioning phases.

510. The conclusions for this assessment for the Proposed Development in-combination with other plans or programmes are presented in **Table 5.11** and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.10: Potential for adverse effects on common tern from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	No adverse effect

Table 5.11: Potential for in-combination adverse effects on common tern from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	No adverse effect

511. On the basis that no adverse effects have been identified for Forth Islands SPA or Leith Docks SPA, and these colonies are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA it is concluded that the effects from the Proposed Development alone or in-combination would not result in an adverse effect on common tern at the Outer Firth of Forth and St Andrews Bay Complex SPA.

Assessment for the Guillemot Population

512. Guillemots were the most abundant species, with peaks present in April, May and August and/or September in both years, coinciding with the start of the breeding season and the post-breeding flightless moult stage. April/May peaks coincide with the onset of egg-laying and incubation (Harris and Wanless, 2004). During this time, most birds were recorded as sitting on the water, which is to be expected

considering their feeding strategy, in which they dive for prey from the water surface. The mean seasonal peak abundances for guillemots in the Offshore Ornithology Study Area during the breeding and non-breeding season, respectively, were 249,682 birds (95%CI 211,155 – 295,561) and 170,982 birds (95%CI 136,779 – 206,729).

513. Large breeding colonies in proximity to the Offshore Ornithology Study Area are present on the Isle of May and St Abb's Head with approximately 18,705 and 42,905 individuals recorded in 2018 respectively (SMP, 2021).

514. Guillemot using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPAs:

- Forth Islands SPA;
- St Abb's Head to Fast Castle SPA;
- Fowlsheugh SPA; and
- Buchan Ness to Collieston SPA.

515. Consequently, these SPA populations are considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

516. No site-reference population is set for guillemot at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of guillemot within the foraging area. For breeding guillemot, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the above SPAs (NatureScot and JNCC 2022).

517. Species specific advice in relation to guillemot is to:

- *Ensure guillemot within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure guillemot can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Guillemot Population

518. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

519. The potential impacts on guillemot for each of the SPAs that are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed under each relevant SPA. The conclusions for each assessment are presented in **Table 5.12** and apply to both breeding and non-breeding populations during construction, operation and decommissioning phases.

520. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in **Table 5.13** and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.12: Potential for adverse effects on guillemot from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.* Adverse effect concluded under on the Scoping Approach only.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	Adverse effect*
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	Adverse effect*
Fowlsheugh	No adverse effect	No adverse effect	Adverse effect*
Buchan Ness to Collieston	No adverse effect	No adverse effect	No adverse effect

Table 5.13: Potential for in-combination adverse effects on guillemot from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA. *Adverse effect concluded under on the Scoping Approach only.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	Adverse effect*
St Abb's Head to Fast Castle	No adverse effect	No adverse effect	Adverse effect*
Fowlsheugh	No adverse effect	No adverse effect	Adverse effect*
Buchan Ness to Collieston	No adverse effect	No adverse effect	No adverse effect

521. The following conclusions are supported by the assessments presented in sections 5.7.1 to 5.73 inclusive, and section 5.7.5.

522. The potential effects from the Proposed Development alone and in-combination with other UK North Sea wind farms on the Forth Islands SPA guillemot population are predicted to be relatively small based on the Developer Approach. Given this, it is concluded that the effects from the Proposed Development alone and in-combination would not result in an adverse effect on this population. The Scoping Approach predicts greater effects from the Proposed Development alone and in-combination. However, it is considered that the level of effects on guillemots assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach, which concluded no adverse effect on the Forth Islands SPA guillemot population as a result of the Proposed Development alone or in-combination with other UK North Sea wind farms.

523. The potential effects from the Proposed Development alone and in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms are predicted to have the potential to result in marked reductions in the size of the St Abb's Head to Fast Castle SPA kittiwake population relative to the population size in the absence of these effects. Although it is considered likely that the assessment is overly precautionary, the level of the predicted impact is such that there is considered to be the potential for an adverse effect on the St Abb's Head to Fast Castle SPA kittiwake population as a result of the predicted Proposed Development alone and in-combination effects. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

524. It is considered that the predicted levels of impact from the Proposed Development alone on the Fowlsheugh SPA kittiwake population are of a small (for the Developer Approach) to, at most, moderate scale (for the upper range of the Scoping Approach). It is therefore concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population. However, for both the Scoping and Developer Approaches, the predicted levels of impact associated with the two in-combination scenarios represent a marked increase compared to those associated with the Proposed

Development alone. Consequently, it is concluded that there is the potential for an adverse effect on the Fowlsheugh kittiwake population as a result of the predicted effects from (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms.

525. On the basis that no adverse effects have been concluded for St Abb's Head to Fast Castle SPA and Fowlsheugh SPA and that these colonies are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA cannot be concluded that the effects from the Proposed Development alone or in-combination would not result in an adverse effect on guillemot at the Outer Firth of Forth and St Andrews Bay Complex SPA.

Assessment for the Razorbill Population

526. Razorbills were present in relatively high abundances in the Offshore Ornithology Study Area, with birds recorded most frequently in October and September, during the non-breeding season. Mean seasonal peaks occurred during the non-breeding period with an estimated population of 48,899 birds (95%CI 32,543 – 68,240). Estimates during the breeding season were lower, calculated at 14,639 birds (95%CI 11,117 – 18,606). Relatively lower abundances recorded during the summer suggests most birds at nearby colonies do not venture into the Offshore Ornithology Study Area to forage during chick-rearing and instead use the Offshore Ornithology Study Area during dispersal post-breeding. This is supported by increases in abundance towards the end of the breeding season.

527. No site-reference population is set for razorbill at the Outer Firth of Forth and St Andrews Bay Complex SPA in the non breeding season and there are no SPAs that are functionally linked with razorbill (NatureScot and JNCC 2022).

528. Site specific advice in relation ro razorbill is to:

- *Ensure razorbill within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the non-breeding season.*
- *Ensure razorbill can move safely between the site and important areas of functionally linked land outwith the site.*

<u>The Potential for Impacts on the Razorbill Population</u>

529. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

<u>Project Alone: Construction and Decommissioning</u>

<u>Disturbance and Displacement</u>

530. Direct disturbance and displacement to razorbill during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements, as well as from other activities directly associated with the installation of the export cable.

531. Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed razorbill as having a relative moderate sensitivity from disturbance arising from vessels (Furness et al. 2013).

532. The Proposed Development offshore export cable encompasses 168km2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

533. Studies undertaken indicate that razorbill may be displaced by vessel traffic with one study reporting individuals being flushed by approaching vessels at distances from between 30 m and 900 m and for flocks a median distance of 280 m (Fliessbach et al. 2019).

534. Consequently, the area of impact from a single vessel at any one time could vary from between 0.003 km2 to 2.55 km2 (based on the minimum and maximum reported disturbance distances), equivalent to between <0.001% and 0.09% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 30.6 km^2 could occur, equivalent to 1.12% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

535. Razorbill that are displaced could return to the area following the departure of the vessel. Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively limited area and would be temporary with no significant changes in the numbers present.

536. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

537. On the basis that the potential disturbance and displacement impacts will be temporary and will not cause change in the abundance within the SPA, it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

<u>Changes to Prey Availability</u>

538. Razorbill prey primarily on sandeels but will also take other species in particular sprats and herring (Harris and Wanless 1986, St. John Glew et al 2019). Any changes in prey availability associated with the construction and decommissioning activities within the SPA will be relatively localised and temporary. Razorbill occur widely across the SPA and are therefore not restricted by prey availability and are adapted to relocating elsewhere during periods of low prey availability (St. John Glew et al 2019). On this basis, although there could be a temporary change in the distribution of razorbills within the SPA it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

<u>Direct Habitat Loss</u>

539. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on non-breeding razorbill.

540. Razorbill typically dive to depths of less than 15 m but can reach up to 47 m during the non-breeding season (Dunn *et al*. 2019). Reviews of the sensitivity of different seabird species to habitat use flexibility assigned razorbill as '3' on a five-scale ranking system. (Furness *et al.* 2013). Suggesting that razorbill are moderately sensitive to the loss of habitat.

541. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA razorbill population

which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of razorbill.

Project Alone: Operation

Disturbance and Displacement

542. On-going routine maintenance could cause disturbance and displacement to razorbill during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the maintenance of the export cable.

543. razorbill are recognised to be moderately sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

Project Alone: Conclusion

544. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA non-breeding razorbill population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

545. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on razorbill and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

Changes to Prey Availability

546. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of razorbill and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where razorbill are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

Direct Habitat Loss

547. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

548. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown.

549. The potential impacts on razorbill will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA razorbill population.

In-combination: Conclusion

550. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA razorbill population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Puffin Population

551. Puffins were relatively abundant throughout the Offshore Ornithology Study Area, with density and population estimates suggesting the species utilises the area most frequently between March and September during the breeding season. Mean seasonal peaks were estimated as 12,290 birds (95%CI 9,857 – 14,997) in the breeding season and 20,667 birds (95%CI 17,298 – 24,031) in the non-breeding season. High abundances between May and August suggest birds at nearby colonies use the Offshore Ornithology Study Area to forage during chick rearing, with widespread dispersal towards the end of this period suggesting movement offshore to at-sea wintering areas

552. A large breeding colony is present on the Isle of May, with the most recent count of 39,200 Apparently Occupied Burrows in 2017 (AOB's; SMP, 2021). Usually only present in coastal areas during the breeding season, puffins generally return to colonies between March and April, with egg laying occurring in April and May (Harris et al., 2010). Typically, adult birds return to the same burrow year-on-year, raising one chick which generally fledges between July and August (Anker-Nilssen and Røstad, 1993; Finney et al., 2003).

553. Typical prey species are small to mid-sized schooling pelagic fish, including sandeels and sprats, supplemented by crustaceans, molluscs and polychaetes during the breeding season (del Hoyo et al., 1996).

554. Puffin using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPA:

- Forth Islands SPA

555. Consequently, this SPA population is considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

556. No site-reference population is set for puffin at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of puffin within the foraging area. For breeding puffin, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the Forth Islands SPA (NatureScot and JNCC 2022).

557. Site specific advice for puffin is to:

- *Ensure puffin within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure puffin can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Puffin Population

558. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

559. The potential impacts on puffin for Forth Islands SPA that is functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed. The conclusions for each assessment are presented in **Table 5.14** and apply to both breeding and non-breeding populations during construction, operation and decommissioning phases.

560. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in **Table 5.15** and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.14: Potential for adverse effects on puffin from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	No adverse effect

Table 5.15: Potential for in-combination adverse effects on puffin from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA. *Adverse effect concluded under the Scoping Approach only.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement
Forth Islands	No adverse effect	No adverse effect	Adverse effect*

561. The following conclusion is supported by the assessment presented in section 5.7.2 to 5.73 inclusive, and section 5.7.5.

562. Based on the Developer Approach, the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms on the Forth Islands SPA puffin population are predicted to be small, as are the resultant population-level impacts. Given this, and the fact that this colony is functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA.

563. As would be expected, the Scoping Approach predicts greater levels of effects and consequent population-level impacts than as predicted by the Developer Approach. Given this, it is concluded that for the Scoping Approach the possibility of an adverse effect on the SPA breeding population (and hence the Outer Firth of Forth and St Andrews Bay Complex SPA) cannot be excluded. This conclusion is considered to apply to the effects from the Proposed Development in-combination with the other Forth and Tay wind farms, as well as to the Proposed Development in-combination with the other UK North Sea wind farms (on the basis of the small difference in the predicted effects).

564. It is considered that the displacement and mortality rates used in the Scoping Approach are overly precautionary and are not supported by the available evidence (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Therefore, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach. On this basis, it is concluded that the effects from the Proposed Development in-combination with other plans or projects would not result in an adverse effect on puffin at the Outer Firth of Forth and St Andrews Bay Complex SPA.

Assessment for the Manx Shearwater Population

565. Manx shearwater densities were generally low with birds primarily observed during the breeding season, peaking in June. In these months, peak densities were 0.04 birds/km^2 (95%CI 0.02 – 0.07) equating to a peak population estimate of 153 birds (95%CI 63 – 268). Mean peak population estimates for both years of surveys were calculated at 113 birds (95%CI 40 – 209) during the breeding season.

566. Although there is no site reference population the population at time of designation was 2,885 individuals (NatureScot 2020, NatureScot and JNCC 2022). There is currently insufficient information on Manx shearwater populations to assess a long-term UK trend, although indications from some of their main breeding colonies suggest an increasing trend (NatureScot and JNCC 2022).

567. The Manx shearwaters within the Outer Firth of Forth and St Andrews Bay Complex SPA may be a mixture of breeding birds from a mixture of colonies, sabbaticals, pre-breeding birds and possibly failed breeders.

The Potential for Impacts on the Manx Shearwater Population

568. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

Disturbance and Displacement

569. Direct disturbance and displacement to Manx shearwater during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel

movements and helicopter activity, as well as from other activities directly associated with the installation of the export cable.

570. Manx shearwater are highly mobile foragers that spend significant proportions of time in flight. Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed Manx shearwater as having very low sensitivity from disturbance arising from vessels (Furness et al. 2013). Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA would be localised and, should it occur, be temporary.

571. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

572. On the basis that Manx shearwater are not sensitive to disturbance or displacement and any impacts would be localised and temporary it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Changes to Prey Availability

573. Manx shearwater are opportunistic feeders and do not entirely rely on fish in their diet and are pursuit-plunging or pursuit-diving specialists and reported to forage to depths of up to 55 m (Shoji *et al*. 2016). They also show flexibility with respect to foraging areas and not restricted to limited areas. Any changes in prey availability caused by construction or decommissioning activities within the SPA will be relatively localised and temporary and Manx shearwater will be able to forage elsewhere over a wide area. On this basis it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Direct Habitat Loss

574. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on Manx shearwater.

575. As there will be no direct impact from the loss of habitat to Manx shearwater it is considered that there is no potential for construction or decommissioning related habitat loss to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Project Alone: Operation

Disturbance and Displacement

576. On-going routine maintenance could cause disturbance and displacement to Manx shearwater during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the maintenance of the export cable.

577. Manx shearwater are recognised to have very low sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Project Alone: Conclusion

578. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA Manx shearwater population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

579. During construction, operation and decommissioning phases there is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on Manx shearwater and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Changes to Prey Availability

580. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of Manx shearwater and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where Manx shearwater are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

Direct Habitat Loss

581. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (see Offshore EIA report volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. It is predicted that all construction activities for other offshore wind farms that could cause an in-combination impact will be completed prior to the commencement of construction for the proposed Development. There will be in-combination impacts during the operation and maintenance phases of the projects.

582. Potential impacts on habitat from the Project Alone has been identified as being temporary during construction and decommissioning and there is little potential for in-combination impacts to arise with other offshore wind farms due to their construction having been completed before construction commences at

the Proposed Development and similarly decommissioning may have been completed by the other projects prior to the start of decommissioning by the proposed Development. There is potential long-term habitat loss throughout the period of operation and maintenance when a potential loss of 0.09% of the SPA could be impacted due to cable protection. The potential long-term loss of habitat associated with the other projects is unknown.

583. The potential impacts on Manx shearwater will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA Manx shearwater population.

In-combination: Conclusion

584. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA Manx shearwater population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Shag Population

585. Shags were only recorded twice in the Offshore Ornithology Study Area, on the June 2019 and December 2020 surveys. Design-based density estimates for June 2019 were 0.01 birds/km^2 (95%CI 0.00 – 0.02), equating to a population estimate of 25 birds (95% CI 0 –72). The mean seasonal peak population estimate for the breeding season was 12 birds (95% CI 0 – 36) compared to the non-breeding season, where 5 birds (95%CI 0 – 12) were estimated to be present.

586. During intertidal and nearshore surveys shags were present in the Survey Area throughout the year, although numbers were generally low. Typically there were no more than eleven individuals recorded and a peak count of 21 in April. The majority of shags were observed within 0-500m from the shore.

587. Shag using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPA:

- Forth Islands SPA.

588. Consequently, this SPA population is considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

589. No site-reference population is set for shag at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of shags within the foraging area. For breeding shag, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the above SPA (NatureScot and JNCC 2022).

590. The population has declined since designation (**Figure 5.12**).

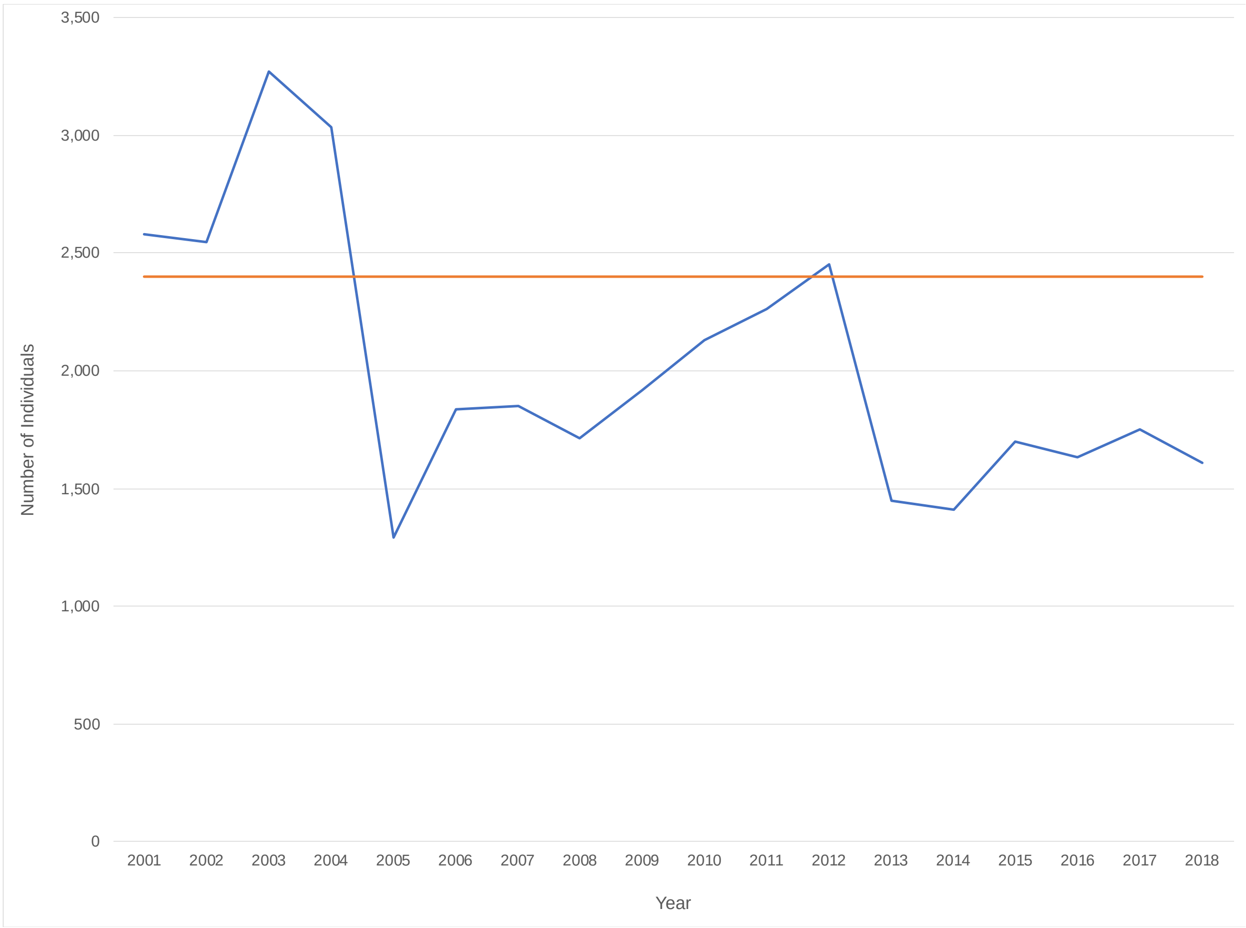

Figure 5.12: Shag population trend at the Forth Islands SPA for the period 2001 - 2020. The orange line shows the population at the time of site designation 2,400 individuals). Data are from the Seabird Monitoring Programme Database (SMP 2022).

591. Species specific advice in relation to shag is to:

- *Ensure breeding European shag have the ability to recover at the relevant SPA breeding colonies.*
- *Ensure European shags within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure European shags can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Shag Population

592. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

Project Alone: Construction and Decommissioning

Disturbance and Displacement

593. Direct disturbance and displacement to shag during the construction phase may arise within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the export cable.

594. Reviews of the sensitivity of different seabird species to disturbance from vessels have assessed shag as having a relative moderate sensitivity from disturbance arising from vessels (Furness et al. 2013).

595. The Proposed Development offshore export cable encompasses 168km2 and the total area of Outer Firth of Forth and St Andrews Complex SPA is 2,720.68 km2. Consequently, no more than 6.2% of the SPA will be affected by disturbance over the whole construction phase. Construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but will be undertaken within discrete areas along the cable route corridor.

596. Studies indicate that shag may be disturbed by motorised craft at a mean distance of 500 m. Although flight responses are typically occur when a vessel is within 200 – 300 m (Goodship and Furness 2019, Jarrett *et al*. 2018).

597. Consequently, the area of impact from a single vessel at any one time is estimated to be 0.78 km^2 (based on the mean reported disturbance distance of 500 m), equivalent to between <0.028% of the SPA. During construction there is potential for up to 12 vessels to occur in the area. On this basis a theoretical maximum area of disturbance of up to 9.36 km^2 could occur, equivalent to 0.34% of the SPA. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller

598. Shags that are displaced could return to the area following the departure of the vessel with one study reporting no significant reduction in the number of birds present within 30 minutes of a vessel disturbance (Jarrett *et al*. 2018). Consequently, it is predicted that any disturbance or displacement impacts arising from the construction activities within the SPA could occur over a relatively limited area and would be temporary with no significant changes in the numbers present.

599. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

600. On the basis that the potential disturbance and displacement impacts will be temporary and will not cause change in the abundance within the SPA, it is considered that there is no potential for construction or decommissioning related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

<u>Changes to Prey Availability</u>

601. Shag prey on a wide variety of fish species in particular sandeels (Wanless *et al* 1997) but are adaptable and opportunistic taking a broad range of prey items (Swan *et al.* 2008, Hillersøy and Lorentsen 2012). Any changes in prey availability associated with the construction and decommissioning activities within the SPA will be relatively localised and temporary. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, shag occur widely across the SPA and are therefore not restricted by prey availability and are adapted to relocating elsewhere during periods of low prey availability. On this basis, although there could be a temporary change in the distribution of shag within the SPA it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

<u>Direct Habitat Loss</u>

602. Construction activities within the Outer Firth of Forth and St Andrews Bay Complex SPA could cause the loss of habitat which could impact on shag.

603. Shag typically occur in water depths of between 10 and 40 m, although can forage in water depths of up to 50 m (Daunt *et al*. 2015). They avoid muddy sediments and reviews of the sensitivity of different seabird species to habitat use flexibility assigned razorbill as '3' on a five-scale ranking system. (Furness *et al.* 2013, Daunt *et al*. 2015), suggesting that shag are moderately sensitive to the loss of habitat.

604. The potential loss of 0.09% of the SPA due to cable protection and the potential temporary habitat loss caused by trenching and burying the cables will impact on a small proportion of the SPA shag population which will be able to relocate to other suitable areas until the habitat and associated prey, return to pre-construction levels. The impact will not lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA populations of shag.

<u>Project Alone: Operation</u>

<u>Disturbance and Displacement</u>

605. On-going routine maintenance could cause disturbance and displacement to shag during the operation phase within the Proposed Development export cable corridor (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the maintenance of the export cable.

606. Shag are recognised to be moderately sensitivity to disturbance and displacement and therefore any impacts will be temporary and birds will be able to relocate to undisturbed areas. On this basis it is considered that there is no potential for operational related disturbance or displacement to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

<u>Changes to Prey Availability</u>

607. As outlined in the section on *project alone: operation and maintenance – changes to prey availability* for eider, there will be no increase in the potential for temporary changes in prey availability caused by impacts during operating and maintenance phases. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

<u>Project Alone: Conclusion</u>

608. The potential effects from the Proposed Development alone on the Outer Firth and Forth and St Andrews Bay Complex SPA non-breeding shag population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects In-Combination: Construction, Operation, Maintenance and Decommissioning

Disturbance and Displacement

609. There is potential for existing marine traffic activity, including fishing and commercial vessels to cause disturbance and displacement impacts on shag and therefore capable of causing an in-combination impact. Marine traffic occurs widely throughout the region, including within the SPA (see Offshore EIA report volume 2, chapter 13) and the additional vessel activity arising during construction, operation and decommissioning will not make any material difference to the level of disturbance and displacement currently present within the SPA. It is predicted that the potential increase in disturbance and displacement will not be detectable against current levels and therefore will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

Changes to Prey Availability

610. There is limited potential for in-combination impacts to affect prey availability within the Outer Firth and Forth and St Andrews Bay Complex SPA. Any impacts will be temporary with recovery following completion of the construction, operation and decommissioning activities. There is limited, if any, potential for in-combination impacts that will cause a measurable effect on the prey of shag and no in-combination impacts that would limit their ability to relocate temporarily to other locations within the SPA where shag are known to occur. Consequently, there will be no in-combination impacts relating to changes in prey availability that would cause an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

Direct Habitat Loss

611. Existing and planned offshore wind farms: Inch Cape, Neart na Gaoithe, Seagreen 1 and Seagreen 1A could all have potential to cause in-combination impacts within the SPA (See Offshore EIA Report, volume 2, chapter 8). During construction and decommissioning these impacts will be temporary and in-combination impacts would only occur if activities were undertaken within the SPA simultaneously or overlapping the recovery period. There is uncertainty on when activities may be undertaken that could cause an in-combination impact but these will occur during the operation and maintenance phases of the projects. Potential loss of habitat from the Project Alone has been identified as being temporary during construction and decommissioning with a potential loss of 0.09% of the SPA due to cable protection throughout the period of operation and maintenance. The potential impacts on shag will likely be undetectable and will not cause an in-combination impact that would lead to an adverse effect on Outer Firth of Forth and St Andrews Bay Complex SPA shag population.

In-combination: Conclusion

612. The potential effects from the Proposed Development in-combination with other plans or programmes on the Outer Firth and Forth and St Andrews Bay Complex SPA shag population are predicted to be small and temporary, impacting on a small proportion of the site population. Given this, it is concluded that the effects from the Proposed Development in-combination would not result in an adverse effect on this population.

Assessment for the Gannet Population

613. Gannets were most abundant in the Offshore Ornithology Study Area in the breeding season. Design-based analysis estimated gannet density to range between 0.00 birds/km^2 (95%CI 0.00 – 0.01; February 2020) and 4.06 birds/km^2 (95%CI 3.42 – 4.79; August 2019) in 2019/20 and 0.05 birds/km^2 (95%CI 0.02 – 0.09; February 2021) and 3.27 birds/km^2 (95%CI 2.88 – 3.68; July 2020) in 2020/21. Densities peaked in July and August.

614. Gannets were regularly present throughout the nearshore an intertidal surveys throughout the year with a peak of 978 birds was recorded in September. The majority of birds were observed in flight between 1km and 1.5km offshore

615. Gannet using the Outer Firth of Forth and St Andrews Bay Complex SPA include those breeding at the following SPAs:

- Forth Islands SPA,

616. Consequently, this SPA population is considered functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

617. No site-reference population is set for gannet at the Outer Firth of Forth and St Andrews Bay Complex SPA due to the turnover of gannet within the foraging area. For breeding gannet, when assessing plans or projects, the population impact should be considered in relation to the site reference populations for the Forth Islands SPA (NatureScot and JNCC 2022).

618. Species specific advice for gannet is to:

- *Ensure gannet within Outer Firth of Forth and St Andrews Bay Complex SPA are not at significant risk from injury or mortality during the breeding and non-breeding seasons.*
- *Ensure gannet can move safely between the site and important areas of functionally linked land outwith the site.*

The Potential for Impacts on the Gannet Population

619. Potential impacts from the Proposed Development could arise during construction, operation and maintenance and decommissioning and could cause direct habitat loss, changes in prey availability and disturbance and displacement and collision impacts. Consequently, the focus of the assessment for this SPA population is concerned with all the Conservation Objectives.

620. The potential impacts on gannet for each of the SPAs that are functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA have been assessed under each relevant SPA. The conclusions for each assessment are presented in Table 5.16 and apply to both breeding and non-breeding populations during construction, operation and decommissioning phases.

621. The conclusions for each assessment for the Proposed Development in-combination with other plans or programmes are presented in Table 5.17 and apply to breeding and non-breeding populations during construction, operation and decommissioning phases.

Table 5.16: Potential for adverse effects on gannet from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision
Forth Islands	No adverse effect	No adverse effect	No adverse effect	No adverse effect

Table 5.17: Potential for adverse in-combination effects on gannet from SPAs functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA.

SPA	Direct Habitat Loss	Changes in Prey Availability	Disturbance and Displacement	Collision
Forth Islands	No adverse effect	No adverse effect	No adverse effect	No adverse effect

622. On the basis that no adverse effects have been identified for Forth Islands SPA and that this colony is functionally linked to the Outer Firth of Forth and St Andrews Bay Complex SPA it is concluded that the effects from the Proposed Development alone and in-combination with other plans or programmes would not result in an adverse effect on gannet at the Outer Firth of Forth and St Andrews Bay Complex SPA.

Assessment for the Non-breeding Waterfowl Assemblage

623. The non-breeding waterfowl assemblage for the Outer Firth of Forth and St Andrews Bay Complex SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual waterbirds. Eider, velvet scoter, common scoter, goldeneye, red-breasted merganser and long-tailed duck are amongst the species identified in the citation as having nationally important populations which contribute to SPA non-breeding waterbird assemblage.

624. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the non-breeding waterfowl assemblage for the SPA could arise via effects on the individual species within the assemblage feature.

625. The assessment undertaken for each qualifying feature identifies no potential adverse effects on any of the component species from the project alone or in-combination. Consequently, it is concluded that there will not be an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA non-breeding waterfowl assemblage, in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms.

Assessment for the Breeding Seabird Assemblage

626. The breeding seabird assemblage for the Outer Firth of Forth and St Andrews Bay Complex SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Puffin, kittiwake, Manx shearwater, guillemot and herring gull are species identified in the citation as having nationally important populations which contribute to the Outer Firth of Forth and St Andrews Bay Complex SPA breeding seabird assemblage.

627. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. The assessments undertaken identify the potential for adverse effects from the Proposed Development alone on the SPA kittiwake population. There is potential for adverse in-combination effects on the SPA kittiwake population and, based on the Scoping approach, also to guillemot, and puffin populations

628. Given the above, it is concluded that there is the potential for an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA breeding seabird assemblage, in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the Non-breeding Seabird Assemblage

629. The non-breeding seabird assemblage for the Outer Firth of Forth and St Andrews Bay Complex SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Black-headed, common and herring gulls, along with kittiwake, guillemot, razorbill and shag are the species identified in the citation as having nationally important populations which contribute to SPA non-breeding seabird assemblage.

630. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the non-breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature.

631. The assessment undertaken for each qualifying feature identifies no potential adverse effects on any of the component species from the project alone or in-combination. Consequently, it is concluded that there will not be an adverse effect on the Outer Firth of Forth and St Andrews Bay Complex SPA non-breeding seabird assemblage, in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms.

Site Conclusion

632. It is concluded that the possibility of adverse effects cannot be discounted for the Outer Firth of Forth and St. Andrews Bay Complex SPA given the potential for impacts on breeding kittiwake, guillemot and puffin at functionally-linked SPAs. For the kittiwake and guillemot populations, the potential for adverse effects arises from the Proposed Development alone and in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. For the puffin population, the potential for an adverse effect is in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms (but not to the effects of the Proposed Development alone). The potential for an adverse effect on Outer Firth of Forth and St. Andrews Bay Complex SPA is a direct consequence of the potential effects on these breeding SPA populations, which are assessed separately below.

633. Consequently, it is concluded that an Adverse Effects on Integrity of the Outer Firth of Forth and St. Andrews Bay Complex SPA cannot be excluded.

5.7. APPROPRIATE ASSESSMENTS: BREEDING SEABIRD COLONY SPAS

5.7.1. ST ABB'S HEAD TO FAST CASTLE SPA

European site information and conservation objectives

634. The St Abb's Head to Fast Castle SPA is located on the Berwickshire coast in southeast Scotland, at approximately 32 km from the Proposed Development array area and 4 km from the Proposed Development export cable corridor. The SPA was designated in 1997 and comprises an area of sea cliffs and coastal strip along which there are multiple seabird colonies, with a seaward extension which extends approximately 1 km into the marine environment.

635. There are no Annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting in excess of 20,000 individual seabirds, with the breeding seabird assemblage feature including five named component species (Table 5.18). The potential for LSE has been identified in relation to four of these five named components (Table 5.18), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

636. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

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

637. Further information on this European site is presented in appendix 3A.

Table 5.18: Details on the Qualifying Features of the St Abb's Head to Castle SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	*Breeding*	*Unfavourable declining*	79,560 individuals	*Yes*
Kittiwake*	Breeding	Unfavourable declining	21,170 pairs	*Yes*
Herring gull*	Breeding	Unfavourable declining	1,160 pairs	*Yes*
Guillemot*	*Breeding*	*Favourable maintained*	31,750 individuals	*Yes*
Razorbill*	Breeding	Favourable maintained	2,180 individuals	*Yes*
Shag*	Breeding	Unfavourable declining	560 pairs	*No*

*Named components of the assemblage only.

Assessment for the kittiwake population

638. The St Abb's Head to Fast Castle SPA kittiwake population is currently estimated to number 5,452 breeding pairs and has been declining since the SPA was designated. The whole SPA has only been counted sporadically since 1985, most recently in 2016 to 2020, but the main colony in the SPA (the St Abb's Head NNR, which comprises approximately 85% of the current SPA population) is counted annually. The population size has been below the citation population size in all years for which count data are available since 1987 (Figure 5.13). The more recent counts provide a tentative indication that there may be some stabilisation in the SPA population size, albeit at a level well below the citation size.

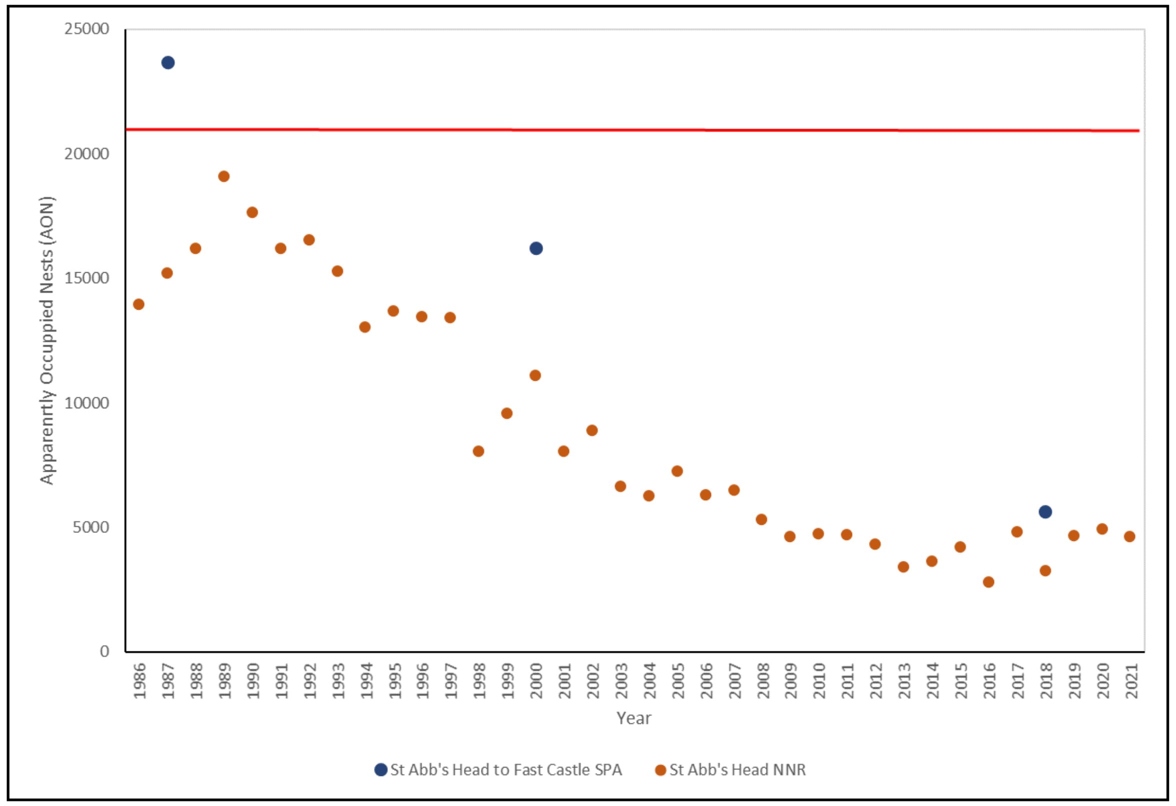

Figure 5.13: Kittiwake Population Trend at the St Abb's Head NNR Between 1986 and 2021, with Three Counts for the Entire St Abb's Head to Fast Castle SPA also Shown (Noting that the Latest SPA Count is Shown for 2018 Because it Spans the Period 2016 – 2020). The Red Line Shows the Citation Population Size for the SPA (21,170 pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org)).

The potential for impacts on the kittiwake population

639. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the St Abb's Head to Fast Castle SPA, so that potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

[7] Displacement / barrier effects are determined in relation to the Proposed Development array area and two kilometre buffer for those species for which this effect pathway is screened in (volume 3, appendix 11.4 of the Offshore EIA Report).

640. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017, Bogdanova *et al.* 2022), it is apparent that during the breeding period kittiwakes from the St Abb's Head to Fast Castle SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development Array area. This is reflected in the findings of the apportioning exercise, which estimates that approximately 52% of the kittiwakes occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

641. In the non-breeding season kittiwakes are largely pelagic, with birds from some UK colonies wintering as far west as the coast of eastern Canada (Frederiksen *et al.* 2012), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the St Abb's Head to Fast Castle SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.4). Given the above, the Proposed Development may have potential effects on the St Abb's Head to Fast Castle SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

642. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

643. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer – Offshore EIA Report, volume 2, chapter 13).

644. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

645. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the St Abb's Head to Fast Castle SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development Array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

646. Tracking data (and associated modelling of foraging distributions) for kittiwake show that the Proposed Development array area and Proposed Development offshore export cable corridor overlap with, or occur close to, waters that are heavily used by birds from the St Abb's Head to Fast Castle SPA during the breeding season (Cleasby *et al.* 2018, Bogdanova *et al.* 2022). However, the degree of overlap is limited and excludes those areas of heaviest usage. For example, based on the data from 37 birds tracked from this SPA population during the 2021 breeding season, there is no overlap between the Proposed Development array area and either the core foraging or 'resting at sea' areas of the tracked birds (as defined by the respective 50% utilisation distributions), whilst only 20% of the wider foraging and 'resting at sea' areas (as defined by the 90% utilisation distribution) overlap with the Proposed Development array area (Bogdanova *et al.* 2022). Furthermore, during the 2021 work, only 11% of the tracked birds and 3% of the total tracks passed through the Proposed Development array area.

647. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015) and the potential for effects of construction-related disturbance is lower than during the breeding season.

648. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

649. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

650. Given the low sensitivity of kittiwake to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the St Abb's to Fast Castle SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

651. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the St Abb's Head to Fast Castle SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given

time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

652. Therefore, based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the St Abb's to Fast Castle SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

653. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the St. Abb's Head to Fast Castle SPA kittiwake population in the short-term.

654. During construction there are a number of ways in which effects on key prey species may occur. The installation of infrastructure within the Proposed Development may lead to temporary subtidal habitat loss/disturbance as a result of a range of activities including use of jack-up vessels during foundation installation, installation of inter-array, interconnector and offshore export cables and associated seabed preparation, and anchor placements associated with these activities. There is the potential for temporary habitat loss/disturbance to affect up to 113,974,700 m^2 of seabed during the construction phase, which equates to 9.7% of the Proposed Development area. Activities will occur intermittently during the construction phase, with only a small proportion of the total footprint affected at any one time. Recovery of seabed habitats will commence immediately following installation of infrastructure allowing key prey species to repopulate the areas of previous disturbance (see volume 2, chapter 9 of the Offshore EIA Report). On this basis, temporary habitat loss/disturbance to key prey species during the construction phase was assessed as being of low magnitude in volume 2, chapter 9 of the Offshore EIA Report.

655. In addition to temporary habitat loss/disturbance for key prey species, construction activities are also predicted to result in long-term subtidal habitat loss through the installation of foundations and associated scour protection, cable protection, OSP/Offshore Convertor Station Platform interconnector and offshore export cables. Up to 7,798,856 m^2 of long-term subtidal habitat loss is predicted. Many species of fish are reliant upon the presence of suitable subtidal habitat for foraging, spawning and nursing. However, these areas of habitat loss will be discrete, either in the immediate vicinity of foundations (i.e. foundations and scour protection), or relatively small isolated stretches of cable within large areas of sediment which characterise the baseline environment (i.e. soft sediments), representing a very low proportion of available habitat (0.7% of the Proposed Development fish and shellfish ecology study area). Long-term subtidal habitat loss to key prey species during the construction phase was therefore assessed as being of low magnitude in volume 2, chapter 9 of the Offshore EIA Report.

656. Increases in SSC and associated sediment deposition may also reduce the abundance and distribution of fish. The installation of all wind turbines and offshore substation foundations and the installation of inter-array, interconnector and offshore export cables may result in short-term avoidance of affected areas by fish. The maximum design scenario assessed in volume 2, chapter 9 of the Offshore EIA Report assumed all wind turbine and offshore substation foundations will be installed by drilling 5.5 m diameter piles and installation of inter-array cables through jet-trenching. Modelling of SSCs showed that the plume directly associated with foundation installation was < 5 mg/l, dropping to lower levels within a very short distance, typically < 500 m. Modelling of SSC for installation of inter-array and offshore export cables indicated concentrations of up to 500 mg/l and between 50 mg/l and 500 mg/l, respectively. Adult fish have high mobility and may show avoidance behaviour in areas of high sedimentation. However, there may be impacts on the hatching success of fish larvae and consequential effects on the viability of spawning stocks due to limited mobility. Spawning grounds for sandeel overlap with the Proposed Development fish and shellfish ecology study area, and their eggs are buried in the seabed for couple of weeks before hatching. Sandeel eggs are known to be tolerant to sediment deposition due to the nature of re-suspension and deposition within their natural high energy environment, and it is therefore very likely that any effect from increased SSC during construction will be limited. Herring spawning grounds are also found within the Proposed Development fish and shellfish ecology study area, with their eggs potentially tolerant of very high levels of SSC (volume 2, chapter 9 of the Offshore EIA Report). Furthermore, deposited sediments are expected to be removed quickly by the currents resulting in small amount of sediment being deposited. Given the small amount of predicted deposition, local spatial extent and relatively short duration of predicted SSC increases, no effect on survival of these key prey species was predicted by volume 2, chapter 9 of the Offshore EIA Report.

657. Increases in SSC and associated reductions in water clarity may also affect the ability of foraging kittiwakes to locate fish at the sea surface, reducing the availability of key prey species. However, it is considered that foraging kittiwakes from the St. Abb's Head to Fast Castle SPA will be largely unaffected by the low-level temporary increases in SSC, as the concentrations are likely to be within the range of natural variability (generally <5 mg/l but can increase to over 100 mg/l during storm events/increased wave heights) and will reduce to background concentrations within a very short period (approximately two tidal cycles).

658. There is the potential for underwater noise and vibration during construction pile-driving to affect the abundance and distribution of kittiwake prey (see volume 2, chapter 9 of the Offshore EIA Report). Injury and/or mortality for all fish species is to be expected for individuals within very close proximity to piling operations. However, this is unlikely to result in significant mortality due to the implementation of soft starts during piling operations which will allow fish to move away from the areas of highest noise levels, before the received noise reaches a level that would cause an injury. Although spawning and nursery habitats for key prey species are present within the zone of influence of underwater noise from piling, these habitats extend over a very wide area across the Proposed Development fish and shellfish ecology study area. The relative proportion of these habitats affected by piling operations at any one time will therefore be small in the context of the wider habitat available. The potential onset of behavioural effects which could affect the distribution of key prey species (such as elicitation of a startle response, disruption of feeding, or avoidance of an area) may occur to ranges of approximately 17 km to 23 km (see volume 2, chapter 9 of the Offshore EIA Report). However, evidence from Beatrice Offshore Wind Farm (BOWL, 2021a, 2021b) has demonstrated that noise impacts on fish behaviour associated with piling are temporary and that fish communities (including sandeel) show a high degree of recoverability following construction (see also RPS, 2019). Furthermore, the Proposed Development array area and export cables corridor represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km; Woodward *et al*., 2019). Non-breeding season effects are considered to be lower than during the breeding season given that birds are no longer constrained by the location of their colonies and are likely to occur across large expanses of sea (Frederiksen *et al*., 2012; Furness 2015).

659. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect kittiwake prey species (Peschko *et al*., 2020; BOWL 2021a, b; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the

marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding kittiwakes forage.

660. Based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on kittiwakes during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

661. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

662. Based on information presented in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. An average of 14 vessels per day were recorded within a 10 nm buffer around the Proposed Development array area (hereinafter Proposed Development shipping and navigation study area) over a 14-day survey period in August 2022. The vessel traffic surveys also showed an average of three to four vessels intersecting the Proposed Development array area per day over summer. Throughout the season, a maximum of 25 vessels were recorded within the Proposed Development array shipping and navigation study area over one day.

663. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the Navigational Safety and Vessel Management Plan (NSVMP; Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance.

664. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often small) parts of these wider areas.

665. Given the low sensitivity of kittiwake to disturbance effects at sea (Garthe and Hüppop 2004; Furness *et al.,* 2013), the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the St Abb's to Fast Castle SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

666. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, volume 3, appendix 11.4 of the Offshore EIA Report). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects.

667. Displacement mortality is calculated using the peak population size (using the counts of birds on the water plus those in flight) for each of the relevant seasonal periods, averaged over the two years of baseline survey, for the Proposed Development array area and two kilometre buffer volume 3, appendix 11.4 of the Offshore EIA Report, Table 5.19). A displacement rate is applied to each of the seasonally specific mean peak population sizes to estimate the numbers of displaced birds in each seasonal period, with an assumed mortality rate applied to those birds estimated to be displaced.

668. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

669. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%; and
- Non-breeding periods: No measurable effects of displacement on mortality.

670. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the St Abb's Head to Fast Castle SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.19). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline

surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table5.19: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer For Each Seasonal Period, Together With The Proportion of Birds Estimated to Belong to The Breeding Adult Age Class And to be From The St Abb's Head To Fast Castle SPA Population in Each Period. The Proportion Of Adults Assumed to be Sabbaticals During The Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	*0.522*	0.522	*0.10*
Autumn migration	*11,190*	*N/A*	*0.005*	*0.003*	*N/A*
Spring migration	*13,766*	*N/A*	*0.007*	*0.003*	*N/A*

671. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as 30 adult and 1 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 88 adult and 3 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.20). As expected on the basis that kittiwakes from this breeding colony SPA use the waters within the vicinity of the Proposed Development array area during the breeding season (and as reflected by the seasonally-specific apportioning rates), the displacement effects predicted by the Scoping Approach are largely attributable to the breeding season (with the potential breeding season mortality accounting for c.97% of the overall annual mortality – Table 5.20).

672. The annual mortality from displacement as determined using the Developer Approach is predicted to be 58 adult and 2 immature birds, so lies approximately midway between the mortality predictions from the Scoping Approach and is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are considered unlikely to result in detectable impacts on the population – volume 3, appendix 11.4, annex G of the Offshore EIA Report).

Table5.20: Estimated Potential Annual Mortality of St Abb's Head to Fast Castle SPA Kittiwakes As a Result of Displacement From The Proposed Development Array Area And 2 km Buffer as Determined by The Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	*Breeding*	*30%*	*1%*	*29.1*	*1.0*
	Autumn migration	*30%*	*1%*	*0.2*	*0.1*
	Spring migration	*30%*	*1%*	*0.3*	*0.1*
	Annual total	*-*	*-*	*29.6*	*1.2*
Scoping B	*Breeding*	*30%*	*3%*	*87.0*	*3.0*
	Autumn migration	*30%*	*3%*	*0.5*	*0.3*
	Spring migration	*30%*	*3%*	*0.9*	*0.4*
	Annual total	*-*	*-*	*88.4*	*3.7*
Developer	*Breeding*	*30%*	*2%*	*57.8*	*2.0*
	Autumn migration	N/A	*N/A*	*N/A*	*N/A*
	Spring migration	N/A	*N/A*	*N/A*	*N/A*
	Annual total	-	-	*57.9*	*1.8*

673. The additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to displacement from the Proposed Development array represents 0.5% of the current adult breeding population at this colony (i.e. 10,904 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.3 – 0.8% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 3.7% for the Developer Approach and of 1.9 – 5.6% for the lower and upper estimates from the Scoping Approach.

674. The potential levels of impact on the St Abb's Head to Fast Castle SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Collision risk</u>

675. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, volume 3, appendix 11.3 of the Offshore EIA Report). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

676. Guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments (i.e. from at least the Round 3 and Scottish territorial waters leasing rounds onwards). Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. In part at least, this advice appeared to derive from a decision that it was not possible to use the stochastic version of the CRM (McGregor *et al.* 2018) due to an absence of recommended avoidance rates, meaning that the resultant collision estimates for the Proposed Development (as generated from the deterministic CRM) would not incorporate measures of associated variability[9]. However, the use of the maximum monthly densities does not actually address this issue, whilst alternative solutions to expressing the associated variability in the collision estimates exist and have been applied in other assessments (Natural England 2022a). Furthermore, it is also the case that guidance from Natural England accepts that option 2 of the stochastic CRM can be used with the same species-specific avoidance rates as for option 2 of the deterministic CRM (Natural England 2022a).

677. Given that the approach advised in the Scoping Opinion for predicting collision mortality was considered overly precautionary (and did not follow previous precedent), the CRMs for kittiwake were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

678. In addition to the above, collision estimates for kittiwakes were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

679. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of volume 3, appendix 11.3 of the Offshore EIA Report).

680. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the St Abb's Head to Fast Castle SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5; Table 5.19). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.19).

681. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the St Abb's Head to Fast Castle SPA is predicted to be 283 adults and 11 immatures as determined by the Scoping Approach, and 196 adults and eight immatures as determined by the Developer Approach (Table 5.21). As for displacement, the vast majority of this mortality (i.e. 99% for adults and 90% for immatures) is predicted to occur during the breeding season.

Table5.21: Predicted Collision Effects from The Proposed Development On The St Abb's Head to Fast Castle SPA Kittiwake Population, As Determined by The Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using A 98.9% Avoidance Rate (See Text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	*Breeding*	*280.9*	*9.6*
	Autumn migration	*0.9*	*0.5*
	Spring migration	*1.3*	*0.6*
	Annual total	*283.1*	*10.7*
Developer	*Breeding*	*193.9*	*6.7*
	Autumn migration	*0.5*	*0.3*
	Spring migration	*1.1*	*0.5*
	Annual total	*195.5*	*7.5*

682. The additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 1.8% of the number of adults currently estimated to breed at this colony (i.e. 10,904 individuals – Table 3.3 in Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 2.6% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 12.4% and 17.9% for the Developer and Scoping Approaches, respectively.

683. The kittiwake collision estimates calculated using alternative assumptions are substantially lower than those on which this assessment is based. Thus, using the site-specific flight height data (as collected during a series of boat-based surveys of the Proposed Development array area) within the CRM gives annual collision estimates for kittiwake that are 8% and 33% of those derived using the generic flight height data of Johnston *et al.* (2014a,b), when using the laser range finder and visual flight height estimates, respectively (volume 3, appendices 11.3 and 11.7 of the Offshore EIA Report). Similarly, estimates derived using options 2 and 3 of the stochastic version of the CRM with the Bowgen and Cook (2018) avoidance rates applied are approximately 50% of the estimates on which the assessment is based (volume 3, appendix 11.3 of the Offshore EIA Report). Given that these differences are consistent across seasonal periods, these scales of reduction can be extrapolated directly to the collision estimates for the SPA population, meaning that the potential impacts (as expressed above in relation to the adult population size

[8] A minimum 24 month programme of baseline offshore ornithology surveys (as undertaken for the Proposed Development) is considered a standard requirements for UK offshore wind farm assessments, providing (at least) two density estimates for each calendar month for use as inputs to the CRM (e.g. Natural England 2022a).

[9] Based on comments from MSS in MS-LOT email response of 2nd March 2022 to the Applicant's ornithology-related concerns with the Scoping Opinion, as issued to MS-LOT on 9th February 2022.

[10] Details on the collection of these data are presented in volume 3, appendix 11.7, and involved flight height estimates collected from the survey vessel using both a laser rangefinder and visual estimation.

and the change to baseline adult mortality) would be reduced by at least 50% compared to those on which the assessment is based (according to either the Developer or Scoping Approaches).

684. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.21 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

685. Potential impacts on key prey species for kittiwakes breeding at St. Abb's Head to Fast Castle SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, electromagnetic fields (EMF) from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the St. Abb's Head to Fast Castle SPA kittiwake population.

686. During the operation and maintenance phase, there is potential for temporary habitat loss/disturbance for up to 989,000 m^2 as a result of the use of jack-up vessels during any component replacement activities and during any cable repair activities. These impacts will be similar to those identified for temporary habitat loss/disturbance during the construction phase (as discussed in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for this SPA population) and will be highly restricted to the immediate vicinity of these operations.

687. As outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* above, the presence of infrastructure within the Proposed Development, will result in long-term habitat loss of up to 7,798,856 m^2 during the operation and maintenance phase. These areas of habitat loss will be discrete, either in the immediate vicinity of foundations, or relatively small, isolated, stretches of cable, representing a very low proportion of available habitat (0.7% of the Proposed Development fish and shellfish ecology study area).

688. Increased SSC could occur as a result of repair or remedial burial activities during the operation and maintenance phase. The maximum design scenario assessed in volume 2, chapter 9 of the Offshore EIA Report for increased SSC and associated deposition is for the repair of cables of up to 30,000 m in length and reburial of cables of up to 10,000 m in length for inter-array cables; and repair of cables of up to 4,000 m in length and reburial of cables of up to 4,000 m in length for offshore export cables, using similar methods as those for cable installation activities, e.g. jet-trenching, undertaken at intervals over the 35 years operation and maintenance phase. The assessment in volume 2, chapter 9 of the Offshore EIA Report considered that any suspended sediments and associated deposition will be of the same magnitude, or lower as for construction.

689. The presence and operation of inter-array, interconnector and offshore export cables will result in emissions of localised EMF, which could potentially affect the sensory mechanisms of some species of fish. However, there is no evidence to suggest that the key prey species of kittiwake (e.g. sandeel, sprat and juvenile herring) are electrosensitive and would respond to electrical and/or magnetic fields (volume 2, chapter 9 of the Offshore EIA Report).

690. Up to 10,198,971 m^2 of habitat may be created due to the installation of jacket foundations and associated scour and cable protection measures. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions, particularly in relation to key prey species for kittiwake, remain largely unknown (Peschko *et al*., 2020; BOWL 2021a, 2021b; Scott, 2022). Overall, any change in prey abundance and/or distribution through the presence of subsea structures of foundations is likely to be very small relative to the area over which breeding and non-breeding SPA kittiwakes forage.

691. It is therefore considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on kittiwakes during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

692. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the St Abb's Head to Fast Castle SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

693. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.20 and 5.21 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report). The starting population size was the 2016 – 2020 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The PVAs used a matched runs approach to compare the un-impacted (i.e. baseline) and impacted populations (such that the stochasticity in the demographic rates was applied to each simulation prior to applying the impacts) and productivity was assumed to be unaffected by the displacement and collision effects on the adult and immature age classes. The PVA modelling was undertaken using the bespoke R-code for the Natural England nepva tools (Searle *et al.* 2019, Mobbs *et al.* 2020), with the code modified to allow a 'burn-in' period for establishing an initial population age structure (volume 3, appendix 11.6 of the Offshore EIA Report).

694. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple

replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table5.22: Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality Adults	Additional Annual Mortality Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
35 years	*Baseline*	*0*	*0*	*2695 (1029 – 6567)*	*1.000*	1.000	*50.0*
	Scoping A	*312.6*	*11.9*	*1181 (437 – 2947)*	*0.438*	*0.977*	*4.7*
	Scoping B	*371.3*	*14.3*	*1011 (372 – 2538)*	*0.375*	*0.973*	*2.2*
	Developer	*253.2*	*9.4*	*1382 (514 – 3432)*	*0.513*	*0.982*	*8.7*

695. The PVA predicted a continuing population decline for the St Abb's Head to Fast Castle SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, under baseline conditions (i.e. no wind farm effects), the population is predicted to decline by 76% after 35 years from the current estimate of 10,904 adult birds (Table 5.22). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted declines are inevitably greater for those scenarios incorporating the effects from the Proposed Development.

696. Considering the PVA metrics, the CPS values indicate that the SPA population size would be reduced by approximately 50% and 56 – 63%, relative to the predicted population size under baseline conditions, after 35 years for the Developer Approach and Scoping Approach, respectively (Table 5.22). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be almost 2% on the basis of the Developer Approach and approximately 2.5% on the basis of the Scoping Approach (Table 5.22). On the basis of the Developer Approach, the centile value is estimated to be less than 10 after 35 years, whilst for the Scoping Approach the equivalent values are less than five (Table 5.22). Thus, the centile metric indicates little overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a high likelihood of the impacted population being smaller than the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

697. Whilst the PVA metrics indicate that the potential effects from the Proposed Development may be substantive at the population level, it is important to consider that the SPA population is predicted to decline irrespective of these effects and that such a trend is broadly consistent with the documented long-term trend for this population, albeit that there are indications of a levelling off in this decline over the past decade (Figure 5.13). Therefore, it seems likely that the SPA population will continue to remain well below the citation size and that the Proposed Development is unlikely to be the critical factor determining this, or indeed the overall population trend and condition status of the feature.

698. The primary reasons for population decline in kittiwakes in the North Sea and the Forth and Tay region (including the St Abb's Head to Fast Castle SPA) are likely to be fisheries management and climate change (Frederiksen *et al.,* 2004). With fisheries now more appropriately managed in the Forth and Tay region (a sandeel fishery ban has been in place since 2000), it is possible that the recent stability in the numbers of breeding kittiwake at the St Abb's Head to Fast Castle SPA may be sustained. However, changes caused by climate change, that are also likely to be affecting the SPA kittiwake population, may still be affecting the population in 35 years. The primary management option to prevent such climate change effects on kittiwake populations will be through global initiatives to mitigate greenhouse gas emissions (e.g. 21st Conference of the Parties of the UNFCCC (COP21)). Therefore, while the conservation status of the SPA population is projected to be in unfavourable condition, the effects of the Proposed Development, may not result in any important change to this, nor prevent recovery in the event of the factors causing population decline being reversed.

699. Interpretation of the PVA metrics, and the implications for effects on the SPA population, should also be considered in the context of the high levels of precaution incorporated in the assessment. Differences between the Developer and Scoping Approaches in this respect have been discussed above (as well as in volume 3, appendices 11.3 and 11.4 of the Offshore EIA Report) but other likely sources of over-precaution in the assessment of the effects of the Proposed Development on this SPA population include:

- Reliance on the seasonal mean peak abundance estimates within the Proposed Development array area and two kilometre buffer in determining displacement effects (with these estimates substantially higher than the seasonal means);
- The assumption that displacement extends out to two kilometres from the Proposed Development Array and occurs at the same rate as within the Array, despite the lack of evidence for displacement of kittiwakes by offshore wind farms (Dierschke *et al.* 2016); and
- Determining breeding season age classes on the basis of plumage characteristics of birds recorded during the baseline surveys, which overestimates the proportion of adults in the population (and hence also the impacts at the population level) because kittiwake may adopt adult plumage from their second year onwards (and certainly by their third year) although they do not start breeding until four years, on average (Coulson 2011).

700. Perhaps most notably, the PVAs are based upon a density independent population model which is biologically implausible because it assumes no population regulation and permits unrealistic predictions of unlimited population growth. Instead, it is likely that compensatory density dependence will operate within the SPA population, so that mortality from the wind farm effects is offset to (at least) some degree by changes in other demographic parameters (e.g. increased rates of breeding productivity or reduced age of first breeding), as opposed to being wholly additive. There is empirical evidence for compensatory density dependence acting on seabird populations generally (Horswill *et al.* 2016), whilst for kittiwakes specifically, evidence supports the occurrence of intra-specific density dependent competition and the operation of compensatory density dependence (based on studies demonstrating, for example, that the numbers breeding at a colony are influenced by those at neighbouring colonies, that birds from larger colonies travel further to forage and that annual rates of increase in colony size are inversely related to the colony size whilst declines at colonies in northern parts of the UK have been greatest at the largest colonies - Furness and Birkhead 1984, Coulson 2011, Furness 2015, Wakefield *et al.* 2017). Although seabird populations may also be subject to depensatory density dependent effects (whereby the rate of decline increases as colony size reduces – e.g. due to increased vulnerability to predation), this is more likely to occur when populations are small and heading towards local extinction (Horswill *et al.* 2016).

Therefore, the underlying basis for predicting the population-level impacts is unrealistic and likely to give overly precautionary outputs.

Project alone: conclusion

701. The potential effects from the Proposed Development alone due to mortality from displacement, barrier effects and collisions during the operation and maintenance phase are predicted to have the potential to result in sizeable reductions in the size of the St Abb's Head to Fast Castle SPA kittiwake population relative to the population size in the absence of these effects. Although it is considered likely that the assessment is overly precautionary, the level of the predicted impact is such that there is considered to be the potential for an adverse effect on the St Abb's Head to Fast Castle SPA kittiwake population as a result of the Proposed Development alone. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Effects in-combination

Effects of relevance to the in-combination assessment

702. As detailed above, any effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

703. Therefore, the potential for effects of the Proposed Development to act on the St Abb's Head to Fast Castle SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for two in-combination scenarios, i.e. (i) the Proposed Development in-combination with the other Forth and Tay offshore wind farms and (ii) the Proposed Development in-combination with the offshore wind farms in the UK North Sea (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

704. As described in volume 3, appendix 11.6, annex E of the Offshore EIA Report, estimates of breeding season displacement mortality which had been attributed to the St Abb's Head to Fast Castle SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development (Table 5.20), the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

705. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, to derive the in-combination estimates, the relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (volume 3, appendix 11.6, annex E of the Offshore EIA Report). The displacement and mortality rates used for the Scoping and Developer Approaches (Table 5.20) were then applied to these estimates to obtain the overall potential kittiwake mortality, with this mortality then apportioned to the adult and immature age classes from the St Abb's Head to Fast Castle SPA population according to the BDMPS approach (Furness 2015). As agreed through the Ornithology Roadmap process (at meeting 6, 10th May 2022), and as detailed in volume 3, appendix 11.6, annex E of the Offshore EIA Report), estimates are derived for projects within the larger North Sea development zones only due to the difficulty of locating the required information. Also, for some projects the baseline data were not presented in a format that allowed calculation of the seasonal mean peak abundance, so that alternative abundance estimates had to be used.

706. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farm scenario and the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.23).

Table5.23 Estimated Annual Mortality of St. Abb's Head to Fast Castle SPA Kittiwakes as a Result of Displacement from The Proposed Development Array Area and 2 km Buffer as Determined by The Scoping Approach and Developer Approach, In-Combination with Other Forth And Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	32.2	1.2	0.4	0.2	0.4	0.2	33.0	1.6
	Scoping B	96.2	3.7	1.2	0.7	1.1	0.5	98.5	4.9
	Developer	64.0	2.5	N/A	N/A	N/A	N/A	64.0	2.5
UK North Sea	Scoping A	32.2	1.2	0.9	0.5	1.4	0.6	34.5	2.4
	Scoping B	96.2	3.7	2.7	1.6	4.1	1.8	103.0	7.1
	Developer	64.0	2.5	N/A	N/A	N/A	N/A	64.0	2.5

707. The potential mortality resulting from the predicted displacement effects associated with other plans and projects is small relative to that predicted for the Proposed Development alone (Tables 5.20 and 5.23). Thus, inclusion of the other Forth and Tay wind farms increases the predicted displacement mortality of adult birds by approximately 10.5% and 11.5% compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively. Considering the Proposed Development in-combination with the other UK North Sea wind farms increases the predicted displacement mortality by approximately 16% compared to the Proposed Development alone for the Scoping Approach but adds no further mortality compared to the in-combination with the Forth and Tay wind farms for the Developer Approach (because the Developer Approach does not attribute mortality to displacement during the non-breeding periods and breeding season effects on the SPA population are limited to the Proposed Development and the other Forth and Tay wind farms – see volume 3, appendix 11.6, annex E of the Offshore EIA Report).

708. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to displacement represents 0.6% of the current adult breeding population at this colony (i.e. 10,904 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the

Developer Approach, and between approximately 0.3 – 0.9% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 4.0% for the Developer Approach and of 2.1 – 6.2% for the lower and upper estimates from the Scoping Approach.

709. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to displacement represents between approximately 0.3 – 0.9% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 2.2 – 6.5% for the lower and upper estimates from the Scoping Approach. The equivalent figures for the predicted additional mortality as determined by the Developer Approach are as for the Proposed Development in-combination with the other Forth and Tay wind farms.

710. The potential levels of impact on the St Abb's Head to Fast Castle SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Collision risk - operation and maintenance</u>

711. As for displacement, breeding season collision estimates attributed to the St Abb's Head to Fast Castle SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (volume 3, appendix 11.6, annex E of the Offshore EIA Report). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (volume 3, appendix 11.6, annex E of the Offshore EIA Report). The non-breeding season collision estimates were apportioned to the St Abb's Head to Fast Castle SPA population according to the BDMPS approach (Furness 2015).

712. Collision estimates based on consented and 'as-built'[11] designs were also considered but for the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms and had minimal effects on those for the other UK North Sea wind farms (with the respective totals differing by approximately one adult bird). Therefore, only the estimates for the consented designs are considered in this case.

713. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

714. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.24).

Table5.24: Predicted Collision Effects on the St Abb's Head to Fast Castle SPA Kittiwake Population Due to the Proposed Development In-Combination with Other Projects in The Forth And Tay and in UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
Forth and Tay	*Scoping*	*Breeding*	*287.3*	*9.8*
		Autumn migration	*1.5*	*0.9*
		Spring migration	*1.6*	*0.7*
		Annual total	*290.4*	*11.4*
	Developer	*Breeding*	*200.3*	*6.8*
		Autumn migration	*1.1*	*0.6*
		Spring migration	*1.4*	*0.6*
		Annual total	*202.8*	*8.1*
UK North Sea	*Scoping*	*Breeding*	*287.3*	*9.8*
		Autumn migration	*5.2*	*3.1*
		Spring migration	*6.9*	*3.0*
		Annual total	*299.5*	*15.9*
	Developer	*Breeding*	*200.3*	*6.8*
		Autumn migration	*4.8*	*2.8*
		Spring migration	*6.7*	*2.9*
		Annual total	*211.8*	*12.6*

715. As with the displacement effects, the potential mortality resulting from the predicted collision effects associated with other plans and projects is small relative to that predicted for the Proposed Development alone (Tables 5.21 and 5.24). Thus, inclusion of the other Forth and Tay wind farms increases the predicted collision mortality of adult birds by approximately 3.6% and 2.5% compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively. Considering the Proposed Development in-combination with the other UK North Sea wind farms increases the predicted collision mortality by approximately 8.3% and 5.8% compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively. As for the displacement effects, predicted collision effects to the SPA population during the breeding season are limited to the Proposed Development and the other Forth and Tay wind farms (see volume 3, appendix 11.6, annex E of the Offshore EIA Report).

[11] 'As-built' designs refers to the wind turbine number and specifications which have been built and which may be associated with lower collision estimates than the maximum design scenario on which the consent is based (MacArthur Green 2017).

716. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to collisions represents 1.9% of the current adult breeding population at this colony (i.e. 10,904 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 2.7% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 12.8% for the Developer Approach and of 18.4% for the Scoping Approach.

717. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the St Abb's Head to Fast Castle SPA population predicted due to collisions represents 1.9% of the current adult breeding population at this colony (i.e. 10,904 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 2.7% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 13.4% for the Developer Approach and of 18.9% for the Scoping Approach.

718. The potential levels of impact on the St Abb's Head to Fast Castle SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-Combination: Population-Level Impacts

719. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.23 and 5.24 above).

720. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table5.25 Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination With the Other Forth and Tay Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	*2695* *(1029 – 6567)*	*1.000*	1.000	*50.0*
	Scoping A	*323.3*	*12.9*	*1146* *(424 – 2866)*	*0.425*	*0.977*	*4.2*
	Scoping B	*388.7*	*16.1*	*964* *(354 – 2422)*	*0.357*	*0.972*	*1.8*
	Developer	*266.6*	*10.5*	*1333* *(496 – 3312)*	*0.494*	*0.981*	*7.6*

Table5.26 Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head To Fast Castle SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination With The Other UK North Sea Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	*2695* *(1029 – 6567)*	*1.000*	1.000	*50.0*
	Scoping A	*333.8*	*18.2*	*1105* *(408 – 2763)*	*0.410*	*0.976*	*3.5*
	Scoping B	*402.2*	*23.0*	*919* *(338 – 2312)*	*0.341*	*0.971*	*1.3*
	Developer	*275.7*	*15.0*	*1291* *(480 – 3210)*	*0.479*	*0.980*	*7.0*

721. As expected on the basis that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggests more marked population-level impacts (Tables 5.25 and 5.26). Focussing on the outputs for the Proposed Development in-combination with the other UK North Sea wind farms, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by approximately 50% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 59 – 66% (Table 5.26). Reductions in the annual population growth rate (relative to that predicted under baseline

conditions) are estimated to be 2% on the basis of the Developer Approach and 2.4 – 2.9% on the basis of the Scoping Approach. On the basis of the Developer Approach, the centile value is estimated to be 7.6 after 35 years, whilst the equivalent values for the Scoping Approach are 1.3 – 3.5 (Table 5.26). Thus, the centile metric indicates very little overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a high likelihood of the impacted population being smaller than the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

722. The PVA metrics suggest slightly lower, but broadly similar, population-level impacts for the Proposed Development in-combination with the other Forth and Tay wind farms (as follows from the smaller level of predicted mortality associated with this in-combination scenario – Table 5.25).

723. As detailed above in the *Project Alone: Population-Level Impacts* section, in considering the level of these potential impacts and their implications for the SPA population, it is important to take account of the fact that the SPA population is predicted to decline irrespective of the in-combination wind farm effects and that these effects are unlikely to be the critical factor determining the overall population trend and condition status of the feature. Also, for the reasons outlined above for the project alone, the in-combination assessment is likely to be highly precautionary but with a likelihood that this issue is compounded further via the summing of effects derived from multiple assessments which incorporate similarly high levels of precaution.

In-Combination: conclusion

724. The potential effects from the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms are predicted to have the potential to result in marked reductions in the size of the St Abb's Head to Fast Castle SPA kittiwake population relative to the population size in the absence of these effects. Although it is considered likely that the assessment is overly precautionary, the level of the predicted impact is such that there is considered to be the potential for an adverse effect on the St Abb's Head to Fast Castle SPA kittiwake population as a result of the predicted in-combination effects. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the herring gull population

725. The St Abb's Head to Fast Castle SPA herring gull population is currently estimated to number 306 breeding pairs, which is considerably lower than the citation population of 1,160 pairs (Figure 5.14). The whole SPA has only been counted sporadically since 1985, but the annual count data from the St Abb's Head NNR (which have comprised the bulk of the SPA population in recent decades) demonstrate a long-term decline between 1986 and 2021. This decline has been relatively gradual, following a marked reduction in numbers in the late 1980s. The population size has been below the citation population size in all years for which count data are available since 1987 (Figure 5.14).

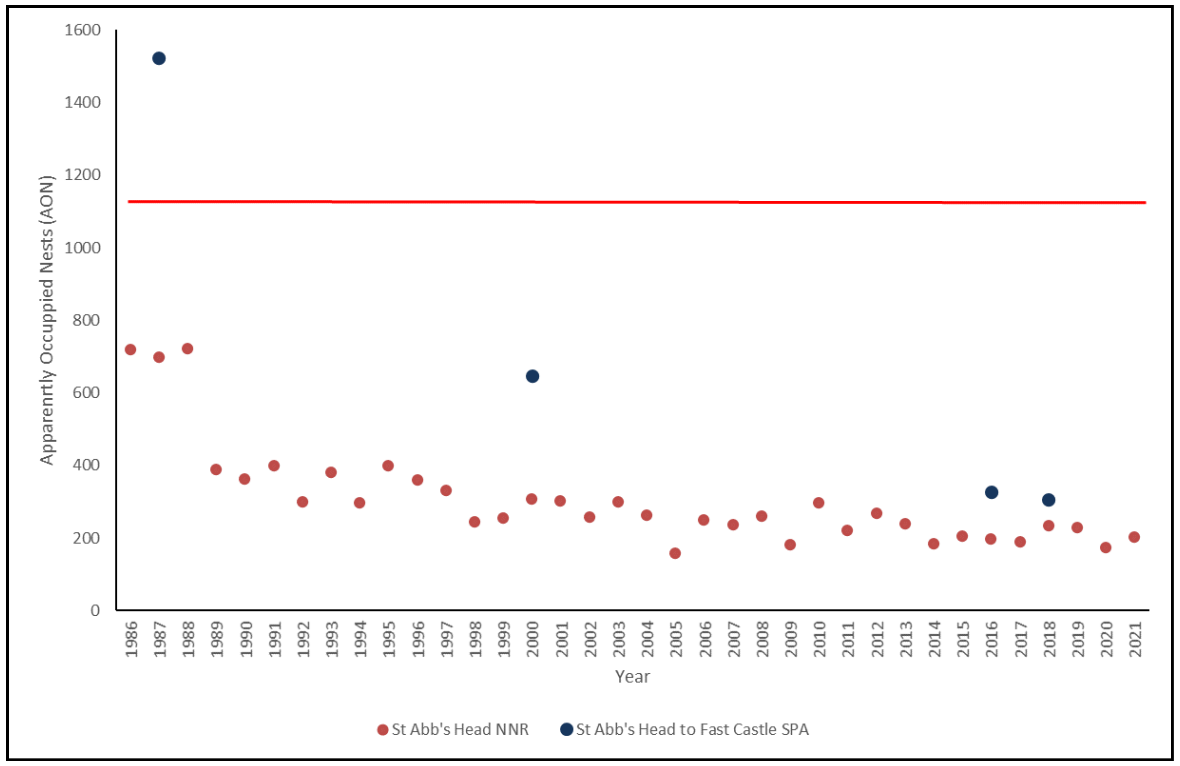

Figure 5.14: Herring Gull Population Trend at the St Abb's Head NNR Between 1986 and 2021, With Four Counts for the Entire St Abb's Head to Fast Castle SPA Also Shown (Noting that the Latest SPA Count is Shown for 2018 Because it Spans The Period 2016 – 2020). The Red Line Shows The Citation Population Size for the SPA (1,160 Pairs). Data are from The Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the herring gull population

726. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the St Abb's Head to Fast Castle SPA, so that potential impacts on its herring gull population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

727. From published information on herring gull foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period herring gulls from the St Abb's Head to Fast Castle SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 3% of the herring gulls occurring on the Proposed Development array area during the breeding season derive from

this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for herring gull is defined as April to August, following NatureScot (2020).

728. In the non-breeding season, herring gulls in Great Britain are largely sedentary with relatively short local movements only (Wernham *et al.* 2002). However, there is an influx of breeding birds of Scandinavian breeding subspecies, *L. argentatus argentatus* (Coulson *et al.,* 1984). On this basis, and following the scoping advice from NatureScot (volume 3, appendix 6.2 of the Offshore EIA Report), it is assumed that during the non-breeding period herring gulls remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Offshore EIA Report, volume 3, appendix 11.5). To account for the influx of birds from other regions to this regional population during the non-breeding period, the regional non-breeding population is assumed to increase (relative to the size of the breeding population) in accordance with the proportion of continental and western UK birds estimated to be present in the UK North Sea and Channel BDMPS (Furness 2015, Offshore EIA Report, volume 3, appendix 11.5).

729. Given the above, there is potential for the Proposed Development to have effects on the St Abb's Head to Fast Castle SPA herring gull population during both the breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

730. Herring gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on herring gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the St. Abb's Head to Fast Castle SPA herring gull population in the short-term.

731. During construction there are a number of ways in which effects on herring gull prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the SPA kittiwake population. However, the total area within which prey could be affected represents a relatively small proportion of the total area of marine habitat available to herring gulls from the St Abb's Head to Fast Castle SPA. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent c. 10% of the total breeding season marine foraging area that is potentially available to the SPA herring gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 58.8±26.8 km; Woodward *et al*., 2019)) and assuming that this range is represented by a semicircle to the seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for herring gulls breeding at the St. Abb's Head to Fast Castle SPA. Non-breeding season effects are expected to similar since herring gulls in Great Britain do not disperse widely during winter (Wernham *et al.* 2002).

732. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect herring gull prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding herring gulls forage.

733. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA herring population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

734. Predictions of the number of herring gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, volume 3, appendix 11.3 of the Offshore EIA Report). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 99.0% were applied to the outputs from option 2 and option 3, respectively.

735. As outlined for kittiwake above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for kittiwake (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for herring gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

736. In addition to the above, collision estimates for herring gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA herring gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of volume 3, appendix 11.3 of the Offshore EIA Report.

737. Herring gull collision estimates are calculated for the breeding and non-breeding periods, with estimates apportioned to the St Abb's Head to Fast Castle SPA population according to the NatureScot (2018) approach but with allowance made for the influx of birds from other regions during the non-breeding period (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes

according to the plumage characteristics of herring gulls recorded during the baseline surveys (EIA Report, volume 3, appendix 11.1), whilst on the basis of advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

738. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of herring gulls from the St Abb's Head to Fast Castle SPA is predicted to be approximately 0.8 adults and 0.1 immatures as determined by the Scoping Approach, and 0.5 adults and 0.1 immatures as determined by the Developer Approach (Table 5.27). The vast majority of this mortality (i.e. approximately 90% for adults and 70% for immatures) is predicted to occur during the breeding season. The collision estimates for option 3 of the deterministic CRM with a 99.0% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.27 below but give outputs that are approximately 40% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA, volume 3, appendix 11.3). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 99.0% avoidance rate, and hence also substantially lower than those presented in Table 5.27 below (see Offshore EIA report, volume 3, appendix 11.3, annex C).

Table5.27 Predicted Collision Effects from the Proposed Development on the St Abb's Head to Fast Castle SPA Herring Gull Population, As Determined by The Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based On Options 2 and 3 of the Deterministic CRM Using 99.5% and 99.0% Avoidance Rates, Respectively (See Text)

Approach	Model Option	Seasonal Period	Estimated Number Of Collisions	
			BREEDING ADULTS	IMMATURES
Scoping	*2*	*Breeding*	*0.67*	*0.09*
		Non-breeding	*0.08*	*0.04*
		Annual total	*0.76*	*0.13*
Developer	*2*	*Breeding*	*0.41*	*0.05*
		Non-breeding	*0.04*	*0.02*
		Annual total	*0.45*	*0.08*

739. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult herring gulls from the St Abb's Head to Fast Castle SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.07% of the number of adults currently estimated to breed at this colony (i.e. 612 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.12% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.6% and 1.0% for the Developer and Scoping Approaches, respectively.

740. The potential levels of impact on the St Abb's Head to Fast Castle SPA herring gull population resulting from the predicted collision mortalities in Table 5.27 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

<u>Changes to prey availability</u>

741. Potential impacts on key prey species for herring gulls breeding at St. Abb's Head to Fast Castle SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect herring gull survival and productivity in the St. Abb's Head to Fast Castle SPA population.

742. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

743. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA herring gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

<u>Project alone: population-level impacts</u>

744. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the St Abb's Head to Fast Castle SPA herring gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

745. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.27 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.27 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.11 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2016 – 2020 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The approach and methods to undertaking the PVA are as described for kittiwake above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

746. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;

- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table5.28: Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	6349 (3564 – 10753)	*1.000*	1.000	*50.0*
Scoping	0.76	0.13	6166 (3461 – 10452)	0.971	0.999	45.9
Developer	0.44	0.07	6243 (3503 – 10573)	*0.983*	*1.000*	*47.5*

747. The PVA predicted that the St Abb's Head to Fast Castle SPA herring gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be 10 times larger than the current estimate of 612 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.28). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted trend does not reflect the documented long-term for this SPA population (Figure 5.14).

748. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the Scoping Approach the CPS value indicates that the collision mortality associated with the Proposed Development alone would result in a reduction of approximately 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.28). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 45.9 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the Developer Approach suggest even smaller levels of impact (Table 5.28). In addition, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that were 40% lower than those used for the PVA.

Project alone: conclusion

749. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA herring gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

750. As detailed above, any effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA herring gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

751. Therefore, the potential for effects of the Proposed Development to act on the St Abb's Head to Fast Castle SPA herring gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Collision risk - operation and maintenance

752. Breeding and non-breeding season collision estimates attributed to the St Abb's Head to Fast Castle SPA herring gull population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (Offshore EIA, volume 3, appendix 11.6, annex D). As for the Proposed Development, the non-breeding season collision estimates for the other plans and projects were adjusted to account for the influx of birds from other regions to this regional population during the non-breeding period, in accordance with the estimates used for the UK North Sea and Channel BDMPS (see above, Offshore EIA Report, volume3, appendix 11.5, Furness 2015).

753. The collision estimates derived for the other plans and projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. However, the potential effects on the SPA population were limited to the other Forth and Tay wind farms, noting that apportioning of the non-breeding season effects for herring gull assumed that birds remain within the waters in the region of the breeding colony (as described above, see also Offshore EIA Report, volume 3, appendix 11.5). Given that these two different in-combination scenarios are equivalent, the predicted effects are reported solely for the UK North Sea wind farms in the tables below (Table 5.29). Options based on

consented and 'as-built'[12] designs did not affect the collision estimates from the other plans and projects, so that estimates are reported for the consented designs only. The collision estimates used for the Proposed Development are those presented in Table 5.29, which derived from the more precautionary of the two different CRM approaches recommended by the Scoping Opinion (see above).

754. The existing collision estimates for the other plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects included with the in-combination scenario having followed the 'standard' approach of using the mean density). As explained for kittiwake above, such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data. Thus, it is only the estimates for the Proposed Development which differentiate the Developer and Scoping Approaches for the in-combination scenarios that are presented below.

Table5.29: Predicted Collision Effects on the St Abb's Head to Fast Castle SPA Herring Gull Population due to The Proposed Development In-Combination With Other Projects in the UK North Sea Waters. Estimates are Presented for Both The Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
UK North Sea1	*Scoping*	*Breeding*	*0.81*	*0.19*
		Non-breeding	*0.21*	*0.13*
		Annual total	*1.06*	*0.33*
	Developer	*Breeding*	*0.55*	*0.15*
		Non-breeding	*0.17*	*0.11*
		Annual total	*0.74*	*0.27*

[1]The Forth and Tay and UK North Sea in-combination effects for the SPA population are equivalent (so that they are reported for the latter scenario only).

755. Incorporating the potential mortality resulting from the predicted collision effects associated with other plans and projects increases the predicted collision mortality of adult birds by 60% and 36% compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively (Tables 5.27 and 5.29). As noted above, the predicted collision effects to the SPA population are limited to the Proposed Development and the other Forth and Tay wind farms (see Offshore EIA Report, volume 3, appendix 11.6, annex D), with the combined collision mortality predicted for the other Forth and Tay wind farms being lower than for the Proposed Development alone during the breeding season but higher than for Proposed Development alone during the non-breeding period.

756. For the Proposed Development in-combination with these other wind farms, the additional annual mortality of adult herring gulls from the St Abb's Head to Fast Castle SPA population predicted due to collisions represents 0.12% of the current adult breeding population at this colony (i.e. 612 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.17% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 1.0% for the Developer Approach and of 1.4% for the Scoping Approach.

757. The potential levels of impact on the St Abb's Head to Fast Castle SPA herring gull population resulting from the predicted collision mortalities in Table 5.29 are considered in more detail below in the *In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

In-combination: population-level impacts

758. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.29 above).

759. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table5.30: Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development In-Combination With the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	6349 *(3564 – 10753)*	*1.000*	1.000	*50.0*
Scoping	1.06	0.33	6075 *(3408 – 10294)*	0.957	0.999	43.9
Developer	0.74	0.27	6148 (3450 – 10417)	0.969	0.999	45.6

760. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.28 with Table 5.30). However, the changes in the values of the PVA metrics are small, with the reduction in the size of the SPA population after 35 years relative to that in the absence of any wind farm effects predicted to be approximately 4% for the Scoping Approach (compared to 3% for the

[12] 'As-built' designs refers to the actual wind turbine number and specifications which have been built at a project site and which may be associated with lower collision estimates than the maximum design scenario on which the consent is based (MacArthur Green 2017).

Proposed Development alone). The equivalent reduction is smaller for the metrics associated with the Developer Approach. For both the Developer and Scoping Approaches, the centile metric continues to indicate a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.30).

761. It is also the case that these predicted levels of impact are derived using the more precautionary of the two CRM approaches recommended by the Scoping Opinion for the Proposed Development (volume 3, appendix 6.2 of the Offshore EIA Report). Reliance on the alternative approach would likely reduce the predicted levels of impact considerably, given that it reduced the collision estimates for the Proposed Development by approximately 40% and that the collision effects for the Proposed Development comprise a substantial part of the overall in-combination effects.

In-combination: conclusion

762. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the St Abb's Head to Fast Castle SPA herring gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the guillemot population

763. The St Abb's Head to Fast Castle SPA guillemot population has shown an overall increase during the last 30 years or so, and relative stability since the late 1990s, based on count data from the St Abb's Head NNR (which holds the vast majority of the SPA population – Figure 5.15). The population size has remained above the citation population size (31,750 individuals) since designation.

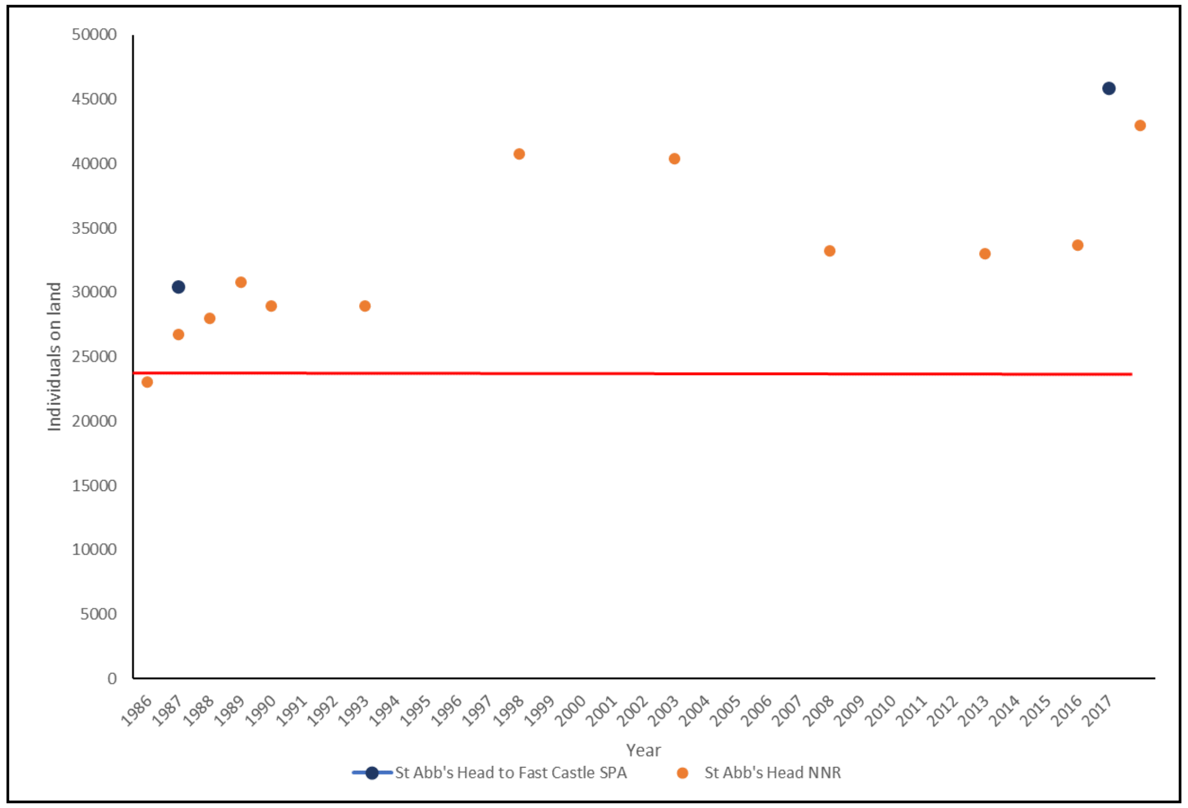

Figure 5.15: Guillemot Population Trend at the St Abb's Head NNR Between 1986 and 2018, With Two Counts for the Entire St Abb's Head to Fast Castle SPA Also Shown (Noting That the Latest SPA Count Is Shown For 2017 Because It Spans The Period 2016 – 2018). The Red Line Shows The Citation Population Size For The SPA (31,750 Individuals) [13]. Data Are From The Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the guillemot population

764. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the St Abb's Head to Fast Castle SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

[13] Data are shown as the count of individuals on land, which needs to be multiplied by 1.34 to give the estimated number of breeding adults (volume3, appendix 11.3) (with the citation population size shown on the amended accordingly to be comparable with the count data).

765. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is highly likely that during the breeding period guillemot from the St Abb's Head to Fast Castle SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 42% of the guillemot occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemot is defined as April to mid-August, following the NatureScot (2020) guidance.

766. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report) and subsequent correspondence (NatureScot email of 20th May 2022), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, volume 3, appendix 11.5 of the Offshore EIA Report). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the St Abb's Head to Fast Castle SPA guillemot population during the non-breeding period as during the breeding season, with 33% of the guillemot occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (volume 3, appendix 11.5 of the Offshore EIA Report).

<u>Project alone: construction and decommissioning</u>

<u>Disturbance</u>

767. As described for kittiwake, direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and it's immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

768. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

769. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

770. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the St Abb's Head to Fast Castle SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development Array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only. Additionally, modelling of guillemot foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area and Proposed Development export cable corridor have minimal overlap with waters that are predicted to be used by birds from the St Abb's Head to Fast Castle SPA and (except for a small part of the Proposed Development export cable corridor) exclude those areas of predicted greatest usage (Cleasby *et al.* 2018).

771. During the non-breeding period, guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD. Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

772. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

773. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

774. Given the moderate sensitivity of guillemot to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the St Abb's to Fast Castle SPA guillemot population.

<u>Displacement</u>

775. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the St Abb's Head to Fast Castle SPA guillemot population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

776. Based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the St Abb's to Fast Castle SPA guillemot population.

Changes to prey availability

777. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the St. Abb's Head to Fast Castle SPA guillemot population in the short-term.

778. During construction and decommissioning there are a number of ways in which effects on key prey species may occur including temporary subtidal habitat loss/disturbance, long-term subtidal habitat loss, increases in SSC and associated sediment deposition, underwater noise and vibration, and colonisation of subsea structures (see section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the SPA kittiwake population and volume 2, chapter 9 of the Offshore EIA Report). Increases in SSC and associated reductions in water clarity may also affect the ability of foraging guillemots to locate fish in the water column, thereby reducing prey availability.

779. It is considered that foraging guillemots from the St. Abb's Head to Fast Castle SPA will be largely unaffected by the low-level temporary increases in SSC, as the concentrations are likely to be within the range of natural variability (generally <5 mg/l but can increase to over 100 mg/l during storm events/increased wave heights) and will reduce to background concentrations within a very short period (approximately two tidal cycles). Furthermore, the Proposed Development array area and export cable corridor represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km; Woodward *et al*., 2019). As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, modelling of guillemot foraging distributions indicates that the Proposed Development array area and export cable corridor have minimal overlap with waters that are predicted to be used by birds from the St Abb's Head to Fast Castle SPA (Cleasby *et al.,* 2018).

780. During the non-breeding period, guillemot distribution is less constrained by the location of breeding colonies (Buckingham *et al*., 2022) but, following the scoping advice from NatureScot (volume 3, appendix 6.2 of the Offshore EIA Report) and subsequent correspondence (NatureScot email of 20th May 2022), it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1 SD. Thus, the potential for effects of construction and decommissioning-related changes to prey availability are assumed to be similar to those during the breeding season.

781. Based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, and with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA guillemot population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on guillemots during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

782. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from the St. Abb's Head to Fast Castle SPA. As described in section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

783. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

784. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

785. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

786. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the St Abb's to Fast Castle SPA guillemot population. This conclusion is consistent with the outcome of the EIA which concluded that effects from disturbance on guillemots during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

787. As outlined above, displacement effects on the St Abb's Head to Fast Castle SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development Array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described for kittiwake above (and in Offshore EIA Report, volume 3, appendix 11.4).

788. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

789. As with kittiwake, the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

790. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

791. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the St Abb's Head to Fast Castle SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.31). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the St Abb's Head to Fast Castle SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.31: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development Array Area And 2 km Buffer for Each Seasonal Period, Together With the Proportion Of Birds Estimated to Belong to the Breeding Adult Age Class and to be from The St Abb's Head to Fast Castle SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During The Breeding Season is Also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.515	0.416	0.416	0.07
Non-breeding	44,171	0.515	0.330	0.330	N/A

792. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as 310 adult and 311 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 576 adult and 574 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.32). The breeding season effects make the greatest contribution to these potential mortalities (comprising 86% and 77% of the total annual mortality for the lower and upper mortality rates, respectively) due to the larger mean peak population size, higher assumed mortality rates and higher proportion of birds assumed to derive from the SPA population (Table 5.32).

793. The annual mortality from displacement as determined using the Developer Approach is predicted to be 111 adult and 110 immature birds, equating to approximately 35% and 20% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.32). As for the Scoping Approach, effects during the breeding season make the greatest contribution (67%) to the predicted annual mortality, although this is less marked because the mortality rates for each seasonal period are assumed to be same under the Developer Approach.

Table 5.32: Estimated Potential Annual Mortality of St Abb's to Fast Castle SPA Guillemots as a Result of Displacement from The Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	265.7	269.1
	Non-breeding	60%	1%	44.5	41.9
	Annual total	-	-	310.2	311.0
Scoping B	Breeding	60%	5%	442.9	448.5
	Non-breeding	60%	3%	133.2	125.5
	Annual total	-	-	576.1	574.0
Developer	Breeding	50%	1%	73.8	74.8
	Non-breeding	50%	1%	37.0	34.8
	Annual total	-	-	110.8	109.6

794. The additional annual mortality of adult guillemot from the St Abb's Head to Fast Castle SPA population predicted due to displacement from the Proposed Development Array represents 0.2% of the current adult breeding population at this colony (i.e. 61,408 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.5 – 0.9% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 2.5% for the Developer Approach and of 6.9 – 12.9% for the lower and upper estimates from the Scoping Approach.

795. The potential levels of impact on the St Abb's Head to Fast Castle SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

796. Potential impacts on key prey species for guillemots breeding at St. Abb's Head to Fast Castle SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the St. Abb's Head to Fast Castle SPA population.

797. During the operation and maintenance phase, there is potential for temporary habitat loss/disturbance for up to 989,000 m^2 as a result of the use of jack-up vessels during any component replacement activities and during any cable repair activities. These impacts will be similar to those identified for temporary habitat loss/disturbance the construction phase (as discussed in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the SPA population) and will be highly restricted to the immediate vicinity of these operations.

798. As outlined in the section on *Project Alone: Operation and Maintenance – Changes to prey availability* for the SPA kittiwake population the presence of infrastructure within the Proposed Development, will result in long-term habitat loss of up to 7,798,856 m^2 during the operation and maintenance phase. These areas of habitat loss will be discrete, either in the immediate vicinity of foundations, or relatively small isolated stretches of cable, representing a very low proportion of available habitat for key prey species (0.7% of the Proposed Development fish and shellfish ecology study area).

799. Increased SSC could occur as a result of repair or remedial burial activities during the operation and maintenance phase, as outlined in the section on *Project Alone: Operation and Maintenance – Changes to prey availability* for the SPA kittiwake. The assessment in volume 2, chapter 9 of the Offshore EIA Report considered that any suspended sediments and associated deposition and water clarity reduction during operation and maintenance will be of the same magnitude, or lower, as for construction.

800. The presence and operation of inter-array, interconnector and offshore export cables will result in emissions of localised EMF, however there is no evidence to suggest that the key prey species of auks (e.g. sandeel and clupeids) are electrosensitive and would respond to electrical and/or magnetic fields (volume 2, chapter 9 of the Offshore EIA Report).

801. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions, particularly in relation to key prey species for guillemot, remain largely unknown (Peschko *et al*., 2020; BOWL 2021a, 2021b; Scott, 2022). Overall, any change in prey abundance and/or distribution through the presence of subsea structures of foundations is likely to be small relative to the area over which breeding and non-breeding SPA guillemots forage.

802. It is therefore considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA guillemot population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on guillemots during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

<u>Project alone: population-level impacts</u>

803. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the St Abb's Head to Fast Castle SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

804. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.32 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of volume 3, appendix 11.6 of the Offshore EIA Report). The starting population size was the 2016 – 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described for kittiwake above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

805. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table5.33: Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	180897 (103494 – 296677)	*1.000*	1.000	*50.0*
Scoping A	*310.3*	*311.8*	*146287* *(83587 – 240251)*	*0.809*	*0.994*	*22.1*
Scoping B	*576.1*	*574.0*	*121918* *(69503 – 200519)*	*0.674*	*0.989*	*7.8*
Developer	*110.8*	*109.6*	*168035* *(96119 – 275714)*	*0.929*	*0.998*	*39.2*

806. The PVA predicted that the St Abb's Head to Fast Castle SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the

population is predicted to be three times larger than the current estimate of 61,408 adult birds under baseline conditions (i.e. no wind farm effects) and twice its current size under the scenario of greatest annual mortality (i.e. Scoping Approach B) (Table 5.33). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). Whilst the predicted levels of increase may be unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the SPA kittiwake population), the prediction for an increasing trend is broadly consistent with the documented, overall, long-term trend for this SPA population (Figure 5.15).

807. The PVA metrics suggest marked differences in the predicted population-level impacts according to the Developer and Scoping Approaches. Thus, for the Developer Approach, the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 7% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.33). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.2%, whilst the centile value of 39.2 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

808. For the Scoping Approach, the CPS values indicate a reduction of 19 – 33% in population size after 35 years, relative to that in the absence of any wind farm effects (Table 5.33). The reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.6 – 1.1%. The centile metric indicates little to, at most, moderate overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting at least a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

809. As for the assessment of the St Abb's Head to Fast Castle SPA kittiwake population, the assessment of the SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Of particular relevance to the guillemot assessment is the reliance on the seasonal mean peak abundances for the prediction of displacement mortality. As would be expected these estimates are considerably higher than the equivalent seasonal mean values (by 44% and 64% for the breeding and non-breeding seasons, respectively – Offshore EIA Report, volume 3, appendix 11.4, annex B), whilst three of the four surveys that contribute to these mean peak values are from months which tend to be associated with pre-breeding concentrations or a pulse of post-breeding dispersal (i.e. March, April and September – see Table 3.3 in the displace tech rept). Thus, the seasonal mean peak values are unlikely to be representative of the usage of the Proposed Development array and two kilometre buffer by birds from nearby breeding colonies, and may grossly overestimate this. This is further supported by modelling of the foraging distributions of SPA guillemots (using data derived from tracking during the chick-rearing period) which indicates that the Proposed Development array area is well beyond core areas of usage (Cleasby *et al.* 2018).

810. The reliance on PVAs which are based upon density independent population models is also likely to cause overestimation of the population-level impacts and give overly precautionary outputs, for the same reasons as outlined above for kittiwake.

Project alone: conclusion

811. Based on the Developer Approach, the potential effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a reasonably high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given that the SPA population has shown an overall, long-term, increase in size and is considered to be in 'favourable maintained' condition, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

812. The Scoping Approach predicts considerably greater effects from the Proposed Development alone, with the potential resultant population-level impacts being relatively large. These potential impacts are of a scale which would be considered likely to result in an adverse effect on the SPA population. However, as has been detailed above (and in Offshore EIA Report, volume 3, appendix 11.4), it is considered that the level of effects on guillemots assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. The potential for gross overestimation of the population-level impacts is further exacerbated by other precautionary elements of the assessment, which have been incorporated irrespective of the Developer or Scoping Approaches. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach, which concluded no adverse effect on the St Abb's Head to Fast Castle SPA guillemot population as a result of the Proposed Development alone.

Effects in-combination

Effects of relevance to the in-combination assessment

813. As detailed above, any effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

814. Therefore, the potential for effects of the Proposed Development to act on the St Abb's Head to Fast Castle SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

815. As described in annex D of Offshore EIA Report, volume 3, appendix 11.6, estimates of displacement mortality during both the breeding and non-breeding periods which had been attributed to the St Abb's Head to Fast Castle SPA guillemot population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development (Table 5.34), the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

816. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. However, the potential effects on the SPA population were limited to the other Forth and Tay wind farms, noting that apportioning of the non-breeding season effects for guillemot did not rely on the BDMPS approach (as stated above, see also Offshore EIA Report, volume 3, appendix 11.5). Given that these two different in-combination scenarios are equivalent, the predicted effects are reported solely for the UK North Sea wind farms in the tables below (Table 5.34).

Table 5.34: Estimated Annual Mortality of St. Abb's Head to Fast Castle SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea[1]	Scoping A	313.1	316.3	58.2	54.1	371.3	370.4
	Scoping B	521.8	527.1	174.4	162.0	696.1	689.1
	Developer	87.0	87.9	48.4	45.0	135.4	132.9

[1]The Forth and Tay and UK North Sea in-combination effects for the SPA population are equivalent (so that they are reported for the latter scenario only).

817. Incorporating the potential mortality resulting from the predicted displacement effects associated with the other UK North Sea wind farms increases the predicted displacement mortality of adult birds by approximately 20% compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.32 and 5.35).

818. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult guillemots from the St Abb's Head to Fast Castle SPA population predicted due to displacement represents between 0.2% of the current adult breeding population at this colony (i.e. 61,408 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between 0.6 – 1.1% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 3.0% for the Developer Approach and of 8.3 – 15.5% for the lower and upper estimates from the Scoping Approach.

819. The potential levels of impact on the St Abb's Head to Fast Castle SPA guillemot population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

820. PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms, as determined by both the Scoping and Developer Approaches (Table 5.35). The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.35: Projected 35 Year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development In-Combination with the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	180897 (103494 – 296677)	*1.000*	1.000	*50.0*
Scoping A	371.1	370.2	140443 (80216 – 230758)	0.776	0.993	18.2
Scoping B	*695.8*	*688.7*	112590 (64146 – 185318)	*0.622*	*0.987*	*4.5*
Developer	131.0	*132.8*	165373 (94593 – 271363)	*0.914*	*0.998*	*37.4*

821. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.32 with Table 5.35). However, the values of the metrics used to quantify the population-level impacts do not represent a marked increase in the impacts compared to those for the Proposed Development alone. Thus, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms indicate slightly greater levels of impact than as described above for the Proposed Development alone.

822. As explained above, the assessment for the Proposed Development in-combination with the other Forth and Tay wind farms is equivalent to that for the Proposed Development in-combination with the other UK North Sea wind farms in the case of this SPA population.

In-Combination: Conclusion

823. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the St Abb's Head to Fast Castle SPA guillemot population. The population-level impacts predicted to

arise from these in-combination effects represent a small increase to those predicted due to the Proposed Development alone. As such, it is considered that the conclusions reached in relation to the Proposed Development alone are also valid for the in-combination scenario.

824. For the Scoping Approach, the conclusions for the Proposed Development alone also apply to the Proposed Development in-combination with the other UK North Sea wind farms, with the predicted population-level impacts being of a scale considered likely to result in an adverse effect on the SPA population. However, the concerns highlighted in the Project Alone conclusions section over the Scoping Approach and its basis are considered to apply equally to the conclusions for the in-combination assessment.

825. The above conclusions in relation to the Proposed Development in-combination with the other UK North Sea wind farms are also taken to apply to the Proposed Development in-combination with the other Forth and Tay wind farms (given that the two scenarios are equivalent for this SPA population).

Assessment for the razorbill population

826. The St Abb's Head to Fast Castle SPA razorbill population has shown an overall increase during the last 30 years or so, and relative stability since the late 1990s, based on count data from the St Abb's Head NNR (which holds the vast majority of the SPA population – Figure 5.16). The population size has remained above the citation population size (2,180 individuals) since designation.

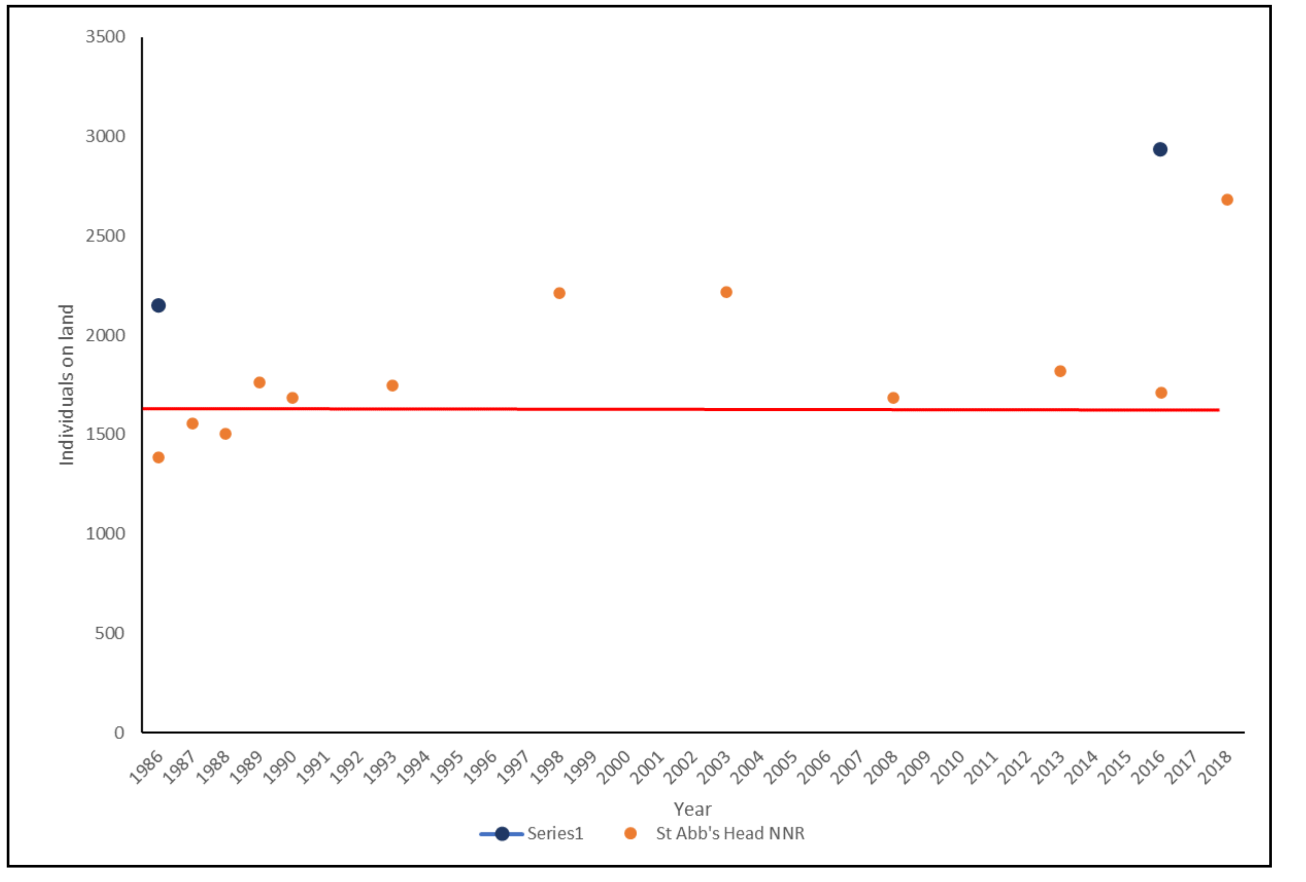

Figure 5.16: Razorbill Population Trend at the St Abb's Head NNR Between 1986 and 2018, With Two Counts For The Entire St Abb's Head to Fast Castle SPA Also Shown (noting that the Latest SPA Count Is Shown for 2017 Because It Spans The Period 2016 – 2018). The Red Line Shows the Citation Population Size for the SPA (2,180 Individuals)[13]. Data are from The Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the razorbill population

827. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the St Abb's Head to Fast Castle SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

828. From published information on razorbill foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is highly likely that during the breeding period razorbill from the St Abb's Head to Fast Castle SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the

apportioning exercise, which estimates that approximately 23% of the razorbill occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

829. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the St Abb's Head to Fast Castle SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the St Abb's Head to Fast Castle SPA razorbill population during breeding and non-breeding periods.

<u>Project alone: construction and decommissioning</u>

<u>Disturbance</u>

830. As described for kittiwake, direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and it's immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

831. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

832. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

833. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to razorbills from the St Abb's Head to Fast Castle SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array area and export cable corridor represent approximately 10% of the breeding season foraging area if considering the mean maximum foraging range only. Modelling of razorbill foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area has minimal overlap with waters that are predicted to be used by birds from the St Abb's Head to Fast Castle SPA and although much of the length of the Proposed Development export cable corridor transits such areas, the overall area of overlap is small (Cleasby *et al.* 2018).

834. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

835. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

836. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

837. Given the moderate sensitivity of razorbill to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the St Abb's to Fast Castle SPA razorbill population.

<u>Displacement</u>

838. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the St Abb's Head to Fast Castle SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

839. Based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the St Abb's to Fast Castle SPA razorbill population.

Changes to prey availability

840. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the St. Abb's Head to Fast Castle SPA razorbill population in the short-term.

841. During construction and decommissioning there are a number of ways in which effects on key prey species may occur including temporary subtidal habitat loss/disturbance, long-term subtidal habitat loss, increases in SSC and associated sediment deposition, underwater noise and vibration, and colonisation of subsea structures (see the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the SPA kittiwake population and volume 2, chapter 9 of the Offshore EIA Report). Increases in SSC and associated reductions in water clarity may also affect the ability of foraging razorbills to locate fish in the water column, thereby reducing prey availability.

842. It is considered that foraging razorbills from the St. Abb's Head to Fast Castle SPA will be largely unaffected by the low-level temporary increases in SSC, as the concentrations are likely to be within the range of natural variability (generally <5 mg/l but can increase to over 100 mg/l during storm events/increased wave heights) and will reduce to background concentrations within a very short period (approximately two tidal cycles). Furthermore, the Proposed Development array area and export cable corridor represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, modelling of razorbill foraging distributions indicates that the Proposed Development array area has minimal overlap with waters that are predicted to be used by birds from the St Abb's Head to Fast Castle SPA and although much of the length of the Proposed Development export cable corridor transits such areas, the overall area of overlap is small (Cleasby *et al.,* 2018). Non-breeding season effects are considered to be lower than during the breeding season given that birds are no longer constrained by the location of their colonies and birds are likely to occur over larger parts of the North Sea (Furness 2015; Buckingham *et al.,* 2022).

843. Based upon the above, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA razorbill population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on razorbills during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

844. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from St. Abb's Head to Fast Castle SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

845. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

846. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the SPA kittiwake population and in Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

847. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

848. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the St Abb's to Fast Castle SPA razorbill population. This conclusion is consistent with the outcome of the EIA which concluded that effects from disturbance on razorbills during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

849. As outlined above, displacement effects on the St Abb's Head to Fast Castle SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described for kittiwake above (and in the Offshore EIA Report, volume 3, appendix 11.4).

850. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

851. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

852. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

853. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the St Abb's Head to Fast Castle SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.36). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the St Abb's Head to Fast Castle SPA razorbill PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table5.36: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the St Abb's Head to Fast Castle SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During The Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*4,040*	*0.501*	*0.231*	*0.231*	*0.07*
Autumn migration	*8,849*	*N/A*	*0.004*	*0.003*	*N/A*
Winter	*1,399*	*N/A*	*0.003*	*0.001*	*N/A*
Spring migration	*7,480*	*N/A*	*0.004*	*0.003*	*N/A*

854. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 8 adult and 9 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 14 adult and 15 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.37). The breeding season effects make the greatest contribution to these potential mortalities (comprising 95% and 92% of the total annual mortality for the lower and upper mortality rates, respectively) due to the higher assumed mortality rates and higher proportion of birds assumed to derive from the SPA population during this period (Table 5.37).

855. The annual mortality from displacement as determined using the Developer Approach is predicted to be 3 adult and 3 immature birds, equating to approximately 31% and 18% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.37). As for the Scoping Approach, effects during the breeding season make the greatest contribution (88%) to the predicted annual mortality, with this being slightly less marked because the mortality rates for each seasonal period are assumed to be same under the Developer Approach.

Table5.37: Estimated Potential Annual Mortality of St. Abb's Head to Fast Castle SPA Razorbills as a Result of Displacement from The Proposed Development Array Area and 2 km Buffer as Determined by The Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	7.9	8.4
	Autumn migration	60%	1%	0.2	0.2
	Winter	60%	1%	0.0	0.0
	Spring migration	60%	1%	0.2	0.1
	Annual total	-	-	8.3	8.7
Scoping B	Breeding	60%	5%	13.1	14.1
	Autumn migration	60%	3%	0.6	0.5
	Winter	60%	3%	0.1	0.0
	Spring migration	60%	3%	0.5	0.4
	Annual total	-	-	14.3	15.0
Developer	Breeding	50%	1%	2.3	2.4
	Autumn migration	50%	1%	0.2	0.1
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	0.1	0.1
	Annual total	-	-	2.6	2.6

856. The additional annual mortality of adult razorbill from the St Abb's Head to Fast Castle SPA population predicted due to displacement from the Proposed Development Array represents 0.07% of the current adult breeding population at this colony (i.e. 3,928 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.2 – 0.4% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.7% for the Developer Approach and of 2.3 – 4.0% for the lower and upper estimates from the Scoping Approach.

857. The potential levels of impact on the St Abb's Head to Fast Castle SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

858. Potential impacts on key prey species for razorbills breeding at St. Abb's Head to Fast Castle SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the St. Abb's Head to Fast Castle SPA population.

859. As for guillemots, it is considered that there is relatively little potential for the St Abb's Head to Fast Castle SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent, and with most effects temporary in nature. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the St. Abb's to Fast Castle SPA razorbill population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on razorbills during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

860. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the St Abb's Head to Fast Castle SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

861. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.37 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2016 – 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described for kittiwake above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

862. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table5.38: Projected 35 Year Population Sizes and Associated PVA Metrics for The St Abb's Head to Fast Castle SPA Razorbill Population Under Different Impact Scenarios for The Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	23085 (12393 - 41063)	*1.000*	1.000	*50.0*
Scoping A	*8.3*	*8.7*	21150 (11333 - 37661)	0.916	0.998	38.6
Scoping B	*14.4*	*14.9*	19840 (10618 – 35354)	0.859	0.996	31.1
Developer	*2.6*	*2.7*	22466 (12054 – 39975)	0.973	0.999	46.2

863. The PVA predicted that the St Abb's Head to Fast Castle SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be six and five times larger than the current estimate of 3,928 adult birds under baseline conditions (i.e. no wind farm effects) and under the scenario of greatest annual mortality (i.e. Scoping Approach B), respectively (Table 5.38). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). Whilst the predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the SPA kittiwake population), the prediction for an increasing trend is broadly consistent with the documented, overall, long-term trend for this SPA population (Figure 5.16).

864. The PVA metrics suggest moderate differences in the predicted population-level impacts according to the Developer and Scoping Approaches. Thus, for the Developer Approach, the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of approximately 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.38). The associated reduction in annual population growth rate (relative to that predicted under

baseline conditions) is estimated to be 0.1%, whilst the centile value of 46.2 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

865. For the Scoping Approach, the CPS values indicates a reduction of 8 – 14% in population size after 35 years, relative to that in the absence of any wind farm effects (Table 5.38). The reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.2 – 0.4%. The centile metric indicates moderate to considerable overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

866. As for the assessment of the St Abb's Head to Fast Castle SPA kittiwake population, the assessment of the SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). In the same way as for guillemot, of particular relevance to the razorbill assessment is the reliance on the seasonal mean peak abundances for the prediction of displacement mortality. For each of the defined seasonal periods, these estimates are 40 – 48% higher than the equivalent seasonal mean values (annex B of Offshore EIA Report, volume 3, appendix 11.4), whilst both of the breeding season peak counts coincide with the latter part of this period (i.e. July and August) and may be affected by post-breeding dispersal. Thus, the seasonal mean peak values are unlikely to be representative of the usage of the Proposed Development Array and two kilometre buffer by birds from nearby breeding colonies, and may grossly overestimate this. This is further supported by modelling of the foraging distributions of SPA razorbills (using data derived from tracking during the chick-rearing period) which indicates that the Proposed Development array area is beyond core areas of usage (Cleasby *et al*. 2018).

867. The reliance on PVAs which are based upon density independent populations models is also likely to cause overestimation of the population-level impacts and give overly precautionary outputs, for the same reasons as outlined above for kittiwake.

Project alone: conclusion

868. Based on the Developer Approach, the potential effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA razorbill population are predicted to be small, as are the resultant population-level impacts. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given that the SPA population has shown an overall, long-term, increase in size and is considered to be in 'favourable maintained' condition, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

869. As would be expected, the Scoping Approach predicts greater levels of effects and consequent population-level impacts than as predicted by the Developer Approach. However, the predicted levels of impact remain relatively small, with the PVA metrics for the Scoping Approach also indicating that there remains a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. When this is considered within the context of the current and longer-term status of this SPA population, as well as the highly precautionary basis for the assessment, it is concluded that the effects from the Proposed Development alone (as determined by the Scoping Approach) would not result in adverse effect on the population.

Effects in-combination

Effects of relevance to the in-combination assessment

870. As detailed above, any effects from the Proposed Development alone on the St Abb's Head to Fast Castle SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

871. Therefore, the potential for effects of the Proposed Development to act on the St Abb's Head to Fast Castle SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

872. As described in volume 3, appendix 11.6, annex E of the Offshore EIA Report estimates of breeding season displacement mortality which had been attributed to the St Abb's Head to Fast Castle SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

873. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021; see volume 3, appendix 11.6, annex E of the Offshore EIA Report for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the St Abb's Head to Fast Castle SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.37). This was done separately for all of the other UK North Sea wind farms and for the subset represented by the other Forth and Tay wind farms.

Table5.39: Estimated Annual Mortality of St. Abb's Head to Fast Castle SPA Razorbills as a result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with Other Forth and Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period									
		Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES
Forth and Tay	Scoping A	8.8	9.1	0.4	0.3	0.1	0.0	0.2	0.1	9.5	9.6
	Scoping B	14.7	15.3	1.2	0.9	0.3	0.1	0.5	0.4	16.7	16.7
	Developer	2.5	2.6	0.4	0.2	0.1	0.0	0.1	0.1	3.1	2.9
UK North Sea	Scoping A	8.8	9.2	1.1	0.9	0.5	0.1	1.0	0.7	11.5	10.9
	Scoping B	14.7	15.3	4.0	2.7	1.6	0.4	3.1	2.1	23.5	20.6
	Developer	2.5	2.6	1.1	0.8	0.4	0.1	0.9	0.6	4.9	4.1

874. The potential mortality resulting from the predicted displacement effects associated with the other plans and projects is smaller than that predicted for the Proposed Development alone but, nonetheless, represents a notable increase to the project alone estimates (Tables 5.37 and 5.39). Thus, inclusion of the other Forth and Tay wind farms increases the predicted displacement mortality of adult birds by approximately 17% for the Developer Approach and 20 - 23% for the Scoping Approach compared to the Proposed Development alone. The analogous increases for the Proposed Development in-combination with the other UK North Sea wind farms, relative to the Proposed Development alone, are 42% for the Developer Approach and 63 – 88% for the Scoping Approach.

875. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult razorbills from the St Abb's Head to Fast Castle SPA population predicted due to displacement represents 0.08% of the current adult breeding population at this colony (i.e. 3,928 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.2 – 0.4% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 0.9% for the Developer Approach and of 2.7 – 5.0% for the lower and upper estimates from the Scoping Approach.

876. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult razorbills from the St Abb's Head to Fast Castle SPA population predicted due to displacement represents 0.1% of the current adult breeding population at this colony as determined by the Developer Approach, and between approximately 0.3 – 0.6% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 1.4% for the Developer Approach and of 3.3 – 6.6% for the lower and upper estimates from the Scoping Approach.

877. The potential levels of impact on the St Abb's Head to Fast Castle SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

878. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.39 above).

879. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table5.40: Projected 35 year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development In-Combination with the Other Forth and Tay Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	23085 (12393 - 41063)	*1.000*	1.000	*50.0*
Scoping A	9.7	9.7	20883 (11188 – 37188)	0.904	0.997	37.1
Scoping B	17.3	16.9	19326 (10339 – 34451)	0.837	0.995	27.9
Developer	3.2	3.1	22346 (11989 – 39764)	0.968	0.999	45.5

Table5.41: Projected 35 year Population Sizes and Associated PVA Metrics for the St Abb's Head to Fast Castle SPA Razorbill Population Under Different Impact Scenarios for The Proposed Development In-Combination with the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	23085 (12393 - 41063)	*1.000*	1.000	*50.0*
Scoping A	11.8	10.9	20512 (10986 - 36537)	0.889	0.997	35.0
Scoping B	23.5	20.5	18327 (9795 – 32688)	0.794	0.994	22.4
Developer	4.9	4.1	*22023 (11814 – 39196)*	0.954	0.999	43.8

880. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.38 with Tables 5.40 and 5.41). However, for the Proposed Development in-combination with the other Forth and Tay wind farms the changes in the values of the PVA metrics are small and it is considered that the conclusions reached for the Proposed Development alone are also applicable to this in-combination scenario.

881. For the Proposed Development in-combination with the other UK North Sea wind farms, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by approximately 5% relative to that in the absence of any wind farm effects (Table 5.41). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small, whilst the centile value continues to indicate a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

882. The metrics associated with the Scoping Approach for the Proposed Development in-combination with the other UK North Sea wind farms inevitably suggest greater levels of effect. However, at the lower range of effects (i.e. Scoping Approach A) they continue to indicate a relatively small effect and a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. At the upper range of effects (i.e. Scoping Approach B), the CPS value indicates that the SPA population size would be reduced by approximately 21% relative to that in the absence of any wind farm effects (Table 5.41), whilst the reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated as 0.6%. The centile value of 22.4 suggests a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

<u>In-combination: conclusion</u>

883. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other Forth and Tay wind farms or the other UK North Sea wind farms would not result in an adverse effect on the St Abb's Head to Fast Castle SPA razorbill population. The population-level impacts predicted to arise from these in-combination effects represent a small increase to those predicted due to the Proposed Development alone. As such, it is considered that the conclusions reached in relation to the Proposed Development alone are also valid for the in-combination scenarios.

884. For the Scoping Approach, the above conclusion is also considered to be valid for the Proposed Development in-combination with the other Forth and Tay wind farms. In terms of the Proposed Development in-combination with the other UK North Sea wind farms, it is considered that the lower range of the predicted impacts would not represent an adverse effect on the SPA population but that it is possible the upper range would. Consequently, it is concluded that the effects of the Proposed Development in-combination with the other UK North Sea wind farms could result in an adverse effect on the St Abb's Head to Fast Castle SPA razorbill population.

Assessment for the breeding seabird assemblage

885. The breeding seabird assemblage for the St Abb's Head to Fast Castle SPA is a qualifying feature on the basis of the SPA supporting 79,560 individual seabirds, including guillemot, razorbill, shag, kittiwake and herring gull.

886. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach, the assessments undertaken above identify the potential for an adverse effect on the SPA kittiwake population in relation to both the project alone and in-combination scenarios. For the Scoping Approach, the assessments undertaken above identify the potential for adverse effects on the SPA kittiwake and guillemot populations in relation to both the project alone and in-combination scenarios, and on the SPA razorbill population in relation to the Proposed Development in-combination with the other UK North Sea wind farms.

887. It is considered that the predicted impacts on the SPA kittiwake population (for both the Developer and Scoping Approaches) are sufficient to represent an increased risk of this population being lost from the breeding seabird assemblage. This is due to the relatively small size of this population combined with its long-term decline. For the Scoping Approach (but not the Developer Approach), it is also considered to be conceivable that the scale of the predicted impacts on the SPA kittiwake, guillemot and razorbill populations are such as to represent a risk of reducing the total number of individual seabirds present in the assemblage to a level that could represent an adverse effect on this qualifying feature. This is particularly relevant to the predicted impacts on the guillemot population because of the large size of this population (and hence its importance to maintaining the breeding seabird assemblage qualifying feature). This conclusion should be considered within the context of the high levels of precaution incorporated within the assessment, with these being outlined above in the sections on each of the named components of the St Abb's Head to Fast Castle SPA breeding seabird assemblage.

888. Given the above, it is concluded that there is the potential for an adverse effect on the St Abb's Head to Fast Castle SPA breeding seabird assemblage, both in relation to the Proposed Development alone and in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

Developer approach

889. It is concluded that the possibility of an adverse effect cannot be discounted for the St Abb's Head to Fast Castle SPA population of breeding kittiwake (noting this species is a named component of the seabird assemblage feature only), as well as the breeding seabird assemblage qualifying feature (due to the impacts on the kittiwake component only). For the kittiwake population, the potential for an adverse effect arises from the Proposed Development alone and the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. The potential for an adverse effect on the breeding seabird assemblage is a direct consequence of the potential effects on the SPA kittiwake population, which is a named component of this assemblage.

890. Consequently, it is concluded that an Adverse Effects on Integrity of the St Abb's Head to Fast Castle SPA cannot be excluded.

Scoping approach

891. It is concluded that the possibility of adverse effects cannot be discounted for the St Abb's Head to Fast Castle SPA populations of breeding kittiwake, guillemot and razorbill (noting these species are named components of the seabird assemblage feature only), as well as the breeding seabird assemblage qualifying feature (due to the impacts on kittiwake, guillemot and razorbill components only). For the kittiwake and guillemot populations, the potential for adverse effects arises from the Proposed Development alone and the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. For the razorbill population, the potential for an adverse effect is in relation to the effects of the Proposed Development in-combination with the other UK North Sea wind farms (but not to the effects of the Proposed Development alone or the Proposed Development in-combination with the other Forth and Tay wind farms). The potential for an adverse effect on the seabird assemblage is a direct consequence of the potential effects on these SPA populations, all of which are named components of this assemblage.

892. Consequently, it is concluded that an Adverse Effects on Integrity of the St Abb's Head to Fast Castle SPA cannot be excluded.

5.7.2. FORTH ISLANDS SPA

European site information and conservation objectives

893. The Forth Islands SPA comprises seabird colonies on multiple islands in the Firth of Forth, southeast Scotland. The SPA is approximately 36 km from the Proposed Development array area and 14 km from the Proposed Development export cable corridor. The Isle of May is the closest of the islands within the SPA to the Proposed Development, with the other islands in the SPA being Inchmickery, Fidra, The Lamb, Craigleith, Bass Rock (all of which were classified in April 1990) and Long Craig (which was an extension to the site and was classified in February 2004). The SPA is underpinned by the following Sites of Special Scientific Interest (SSSIs): Long Craig, Inchmickery, Forth Islands, Bass Rock and the Isle of May. There is a seaward extension from each island of the SPA extending approximately 2 km into the marine environment.

894. There are four Annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting four migratory seabird species and in excess of 20,000 breeding seabirds, including five named component species (Table 5.42). The potential for LSE has been identified in relation to nine of these 13 species, with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

895. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

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

896. Further information on this European site is presented in appendix 3A.

Table5.42: Details on the Qualifying Features of the Forth Islands SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Favourable declining	90,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	8,400 pairs	Yes
Herring gull*	Breeding	Favourable maintained	6,600 pairs	Yes
Lesser black-backed gull	Breeding	Favourable maintained	1,500 pairs	Yes
Sandwich tern	Breeding	Unfavourable declining	440 pairs	No
Roseate tern	Breeding	Unfavourable declining	8 pairs	No
Common tern	Breeding	Unfavourable declining	334 pairs	Yes
Arctic tern	Breeding	Favourable declining	540 pairs	Yes
Guillemot*	Breeding	Favourable maintained	16,000 pairs	Yes
Razorbill*	Breeding	Favourable maintained	1,400 pairs	Yes
Puffin	Breeding	Favourable declining	14,000 pairs	Yes
Gannet	Breeding	Favourable maintained	21,600 pairs	Yes
Cormorant*	Breeding	Unfavourable declining	200 pairs	No
Shag	Breeding	Unfavourable declining	2,400 pairs	No

*Named components of the assemblage only.

Assessment for the gannet population

897. Gannets only occur in the North Atlantic, nesting at relatively high latitudes and wintering south of their breeding sites. Most gannets nest in the eastern Atlantic, with the majority (60 – 70 per cent) of birds breeding in colonies around Great Britain. Other gannet colonies occur in France, Ireland, Norway, Faroe Islands and Iceland. Gannets forage entirely at sea on fish, including discards from fishing boats, and have large foraging ranges when breeding (Woodward *et al.* 2019). Gannets from the Forth Islands SPA forage across a large portion of the North Sea (Lane *et al*. 2020), though their foraging range shows little overlap with those of other colonies (Wakefield *et al.* 2013).

898. The largest gannet colony in the world occurs on Bass Rock, in the Forth Islands SPA (Murray *et al.* 2014). Gannet populations, including on the Bass Rock, have increased substantially through the 20th and 21st centuries, with expansion at existing colonies and the development of new colonies occurring (Mitchell *et*

al. 2004, Murray *et al*. 2015). There are indications that the colony on Bass Rock is close to carrying capacity, with substantive increases having occurred over the last few decades and further increase likely limited by the availability of suitable nesting areas on the island (Figure 5.17, Murray *et al.* 2015). The population size has remained above the citation population size since designation.

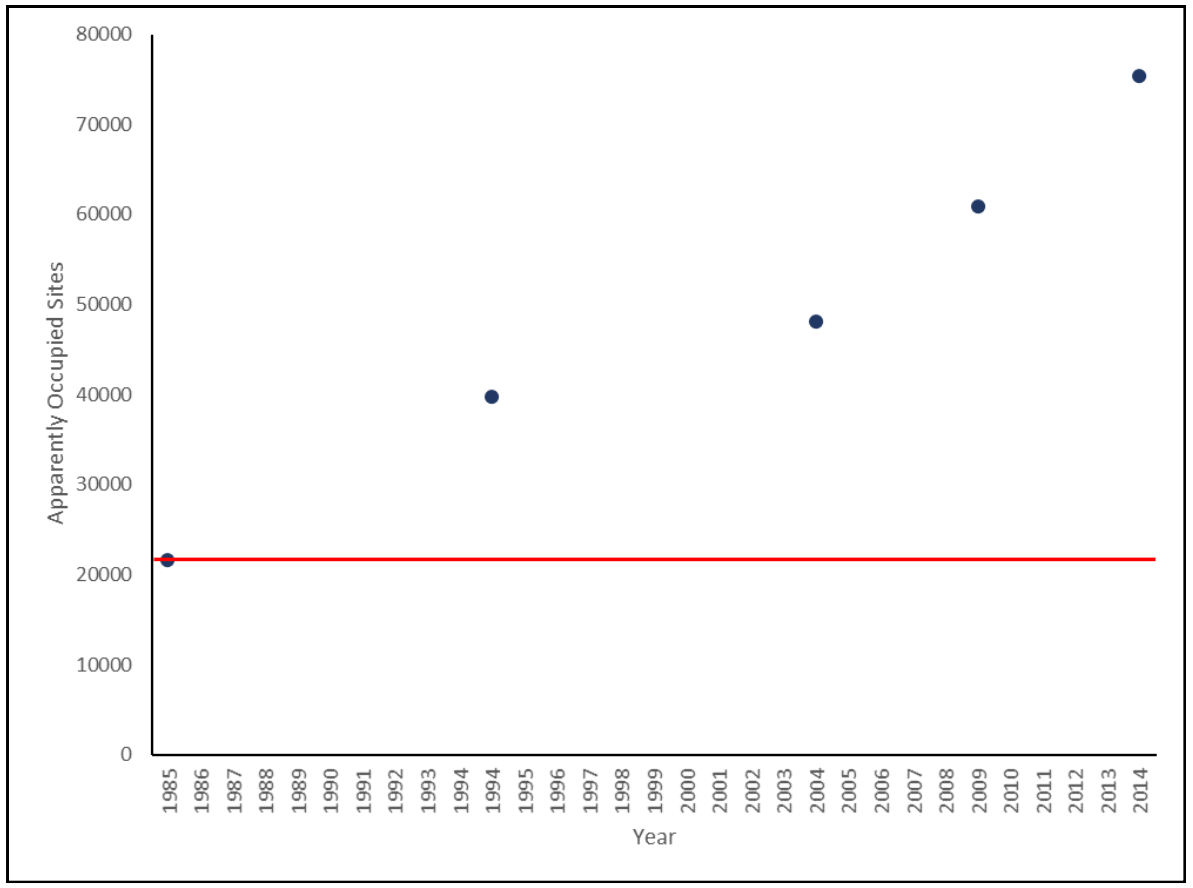

Figure 5.17: Gannet Population Trend at the Forth Islands SPA for the Period 1985 - 2014. The Red Line Shows the Citation Population Size for the SPA (21,600 pairs). Data are from The Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the gannet population

899. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

900. From published information on gannet foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2013, Lane *et al.* 2020, volume 3, appendix 11.4, annex E of the Offshore EIA Report), it is apparent that during the breeding period gannets from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is reflected in the findings of the apportioning exercise, which estimates that 97% of the gannets occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance.

901. Gannets from the Forth Islands SPA move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, volume 3, appendix 11.5 of the Offshore EIA Report). Given the above, the Proposed Development may have potential effects on the Forth Islands SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

902. Direct disturbance to gannets during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

903. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

904. When using the marine environment (and not at the breeding colony), gannets are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign gannet as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

905. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to gannets from the Forth Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km², whilst the Proposed Development export cable corridor encompasses 168 km². Together these areas represent less than 0.5% of the total breeding season foraging area that is potentially available to the SPA gannet population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 309.2±194.2 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development Array and export cable

corridor represent less than 1% of the breeding season foraging area if considering the mean maximum foraging range only. More detailed analyses based on the available tracking data for the Forth Islands SPA gannet population demonstrate that during the incubation and chick-rearing periods, the Proposed Development Array represents only 0.7% of the full home range used by the tracked birds, whilst only 26% of all tracks entered the Proposed Development array area (volume 3, appendix 11.4, annex E of the Offshore EIA Report).

906. During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located.

907. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

908. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

909. Given the low sensitivity of gannet to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA gannet population.

Displacement

910. As detailed above, gannet is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Forth Islands SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

911. Therefore, based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA gannet population.

Changes to prey availability

912. Gannets predominantly prey upon fish including herring, mackerel, sprat and sandeel, as well as fishery discards (del Hoyo *et al*., 1996). Indirect effects on gannets may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA gannet population in the short-term.

913. During construction there are a number of ways in which effects on gannet prey species could occur, which are for the same reasons as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 9 of the Offshore EIA Report. However, the Proposed Development array area and export cable corridor represent less than 0.5% of the total breeding season foraging area that is potentially available to the SPA gannet population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 309.2±194.2 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Effects during the autumn and spring passage periods are considered to be lower than during the breeding season given that birds disperse widely through UK waters to their wintering grounds (Kubetski *et al*., 2009; Furness 2015).

914. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect gannet prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding gannets forage.

915. Given their wide-ranging foraging behaviour and degree of plasticity in diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA gannet population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on gannets during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

916. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project (Table 4.1).

917. Based on information presented in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high (see section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population). In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance.

918. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower than during the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but intermittently within discrete (often small) parts of these wider areas.

919. Given the low sensitivity of gannet to disturbance effects at sea (Garthe and Hüppop 2004; Furness *et al.*, 2013), the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

920. As outlined above, displacement effects on the Forth Islands SPA gannet population are estimated using the SNCB matrix approach, as applied to the Proposed Development Array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

921. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on gannet are estimated for the breeding period and each of the autumn and spring passage periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for gannet are:

- Breeding period: 70% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 70% displacement with lower and upper mortality rates of 1% and 3%.

922. As with other species for which displacement effects are assessed (see above), the approach to estimating gannet displacement effects advocated by the Scoping Opinion was considered overly precautionary. For gannet, this was specifically concerned with the upper range of the proposed mortality rates, and the evidence available to support this (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for gannet displacement, the extent of the species' ranging behaviour, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach (for both displacement and consequent mortality) are as for the lower range of the Scoping Approach (i.e. 70% displacement and 1% mortality in for all seasonal periods).

923. Estimates of gannet mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Forth Islands SPA gannet population during the breeding and non-breeding periods according to the NatureScot (2018) approach and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.43). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of gannets recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table5.43: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Forth Islands SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,735	0.99	0.971	0.971	0.10
Autumn migration	1,500	N/A	0.178	0.145	N/A
Spring migration	269	N/A	0.328	0.099	N/A

924. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 32 adult and two immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 94 adult and six immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.44). As expected on the basis that gannets from this breeding colony SPA use the waters within the vicinity of the Proposed Development array area during the breeding season (and as reflected by the seasonally-specific apportioning rates), the predicted displacement effects are largely attributable to the breeding season (with the potential breeding season mortality accounting for almost 90% of the overall annual mortality, irrespective of whether this is determined by the Developer or Scoping Approach – Table 5.44).

Table5.44: Estimated Potential Annual Mortality of Forth Islands SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	29.4	0.3
	Autumn migration	70%	1%	2.0	1.6
	Spring migration	70%	1%	0.7	0.2
	Annual total	-	-	32.1	2.1
Scoping B	Breeding	70%	3%	86.5	1.0
	Autumn migration	70%	3%	5.7	4.7
	Spring migration	70%	3%	2.0	0.6

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
	Annual total	-	-	94.2	6.3
Developer	Breeding	70%	1%	29.4	0.3
	Autumn migration	70%	1%	2.0	1.6
	Spring migration	70%	1%	0.7	0.2
	Annual total	-	-	32.1	2.1

925. The additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to displacement as a result of the Proposed Development array represents 0.02% of the current adult breeding population at this colony (i.e. 150,518 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.02 – 0.06% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.5% for the Developer Approach and of 0.5 – 1.4% for the lower and upper estimates from the Scoping Approach.

926. The potential levels of impact on the Forth Islands SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

927. Predictions of the number of gannets at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for gannet (SNCBs 2014) and as advised by the Scoping Opinion.

928. As outlined for St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for St Abb's Head to Fast Castle SPA kittiwakes and in volume 3. appendix 11.3 of the Offshore EIA Report, but as a result of this overly precautionary approach (which does not follow previous precedent) the CRMs for gannet were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

929. In addition to the above, collision estimates for gannets were also calculated using option 2 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA gannet populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of the Offshore EIA Report, volume 3, appendix 11.3.

930. As for the predicted displacement effects, gannet collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the gannet SPA population during the breeding and non-breeding periods according to the NatureScot (2018) approach and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.43). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.43).

931. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of gannets from the Forth Islands SPA is predicted to be 151 adults and 5 immatures as determined by the Scoping Approach, and 123 adults and 3 immatures as determined by the Developer Approach (Table 5.45). As for displacement, the vast majority of this mortality (i.e. 95% overall) is predicted to occur during the breeding season.

Table 5.45: Predicted Collision Effects from the Proposed Development on the Forth Islands SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
	Breeding	*146.8*	*1.6*
Scoping	*Autumn migration*	*3.2*	*2.6*
	Spring migration	*1.0*	*0.3*
	Annual total	*151.1*	*4.6*
	Breeding	*119.7*	*1.3*
Developer	*Autumn migration*	*2.3*	*1.9*
	Spring migration	*0.8*	*0.2*
	Annual total	*122.8*	*3.4*

932. The additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.08% of the number of adults currently estimated to breed at this colony (i.e. 150,518 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.10% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 1.8% and 2.2% for the Developer and Scoping Approaches, respectively.

933. The collision estimates produced using option 2 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied are 54% lower than those presented in Table 5.45 (for both the Scoping and Developer Approaches).

934. The potential levels of impact on the Forth Islands SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance

phase are considered in more below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Changes to prey availability</u>

935. Potential impacts on key prey species for gannets breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect gannet survival and productivity in the Forth Islands SPA population.

936. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

937. Given their wide-ranging foraging behaviour and degree of plasticity in diet (del Hoyo *et al*., 1996), together with any effects being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA gannet population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on gannets during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

<u>Project alone: population-level impacts</u>

938. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA gannet population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

939. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.44 and 5.45 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2014 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA kittiwake above (with further details provided in the the Offshore EIA Report, volume 3, appendix 11.6).

940. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table5.46: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands Gannet Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	1057020 *(*592306 – 1771243)	*1.000*	1.000	*50.0*
Scoping A	182	*6.7*	1023133 *(*573331 – 1714865)	0.968	0.999	45.6
Scoping B	243	*10.8*	1011584 *(*566890 – 1695683)	0.957	0.999	44.0
Developer	154.1	5.6	1028218 *(*576163 – 1723310)	0.973	0.999	46.2

941. The PVA predicted that the Forth Islands SPA gannet population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be seven times larger than the current estimate of 150,518 adult birds under all scenarios, including baseline conditions which assume no wind farm effects (Table 5.46). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small.

942. The levels of increase in population size predicted by the PVA are highly unlikely to occur in reality and are, in part, a consequence of the absence of any compensatory density dependence within the population model (as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population). The prediction of a strongly increasing trend is consistent with the documented long-term trend for this SPA population (Figure 5.17) and, more widely, for breeding gannet populations across Scotland and the rest of the UK (Mitchell *et al.* 2004, Murray *et al.* 2015). However, it is likely that the availability of resources (possibly nesting sites on the Bass Rock – Murray *et al.* 2015) will limit further growth of the SPA population at some point within the next few years (and almost certainly within the 35 year timescale of the PVA projections). If this occurs, it is likely that there would remain

considerable capacity for population regulation via the operation of compensatory density dependence, making it likely that the SPA population would remain stable despite increased levels of mortality.

943. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 4% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.46). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 44.0 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.46).

Project alone: conclusion

944. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Forth Islands SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

945. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA gannet population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

946. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA gannet population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for the (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms in (noting that scenario (i) represents a 'regional' subset of (ii)).

Displacement/barrier effects – operation and maintenance

947. As described in volume 3, appendix 11.6, annex E of the Offshore EIA Report estimates of displacement mortality were not available for gannet from other Scottish offshore wind farm projects because displacement has not been considered to be an important source of potential mortality in the assessments for the more recent submissions of Scottish projects (e.g. Marine Scotland 2017a,b,c). Thus, to obtain breeding season estimates for projects in Scottish waters, the mean peak breeding season population sizes were extracted for the array areas plus 2 km buffers of the offshore wind farms in the Forth and Tay and Moray Firth development zones which were identified in the relevant assessments as having connectivity with the Forth Islands SPA population (as agreed through the Ornithology Roadmap process at meeting 6, 18th May 2022). Gannets from the Forth Islands SPA may also use the waters in and around the Dogger Bank wind farms during the breeding season (Wakefield *et al.* 2013, Lane *et al.* 2020), with the breeding season numbers for those sites extracted from MacArthur Green and Royal HaskoningDHV (2021) and an assumption made that 10% of these birds derive from the Forth Islands SPA population. Displacement mortality estimates for the breeding season were then calculated for each of these projects using the displacement and mortality rates appropriate to the Scoping and Developer Approaches (Table 5.44).

948. For the non-breeding periods, gannet numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see volume 3, appendix 11.6, annex E of the Offshore EIA Report for more details). The cumulative numbers for each of the autumn and spring passage periods were apportioned to the Forth Islands SPA gannet population according to the BDMPS approach as detailed in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015, Royal HaskoningDHV *et al.* 2015). The subsequent displacement mortality was calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.44). This was done separately for all of the other UK North Sea wind farms and for the subset represented by the other Forth and Tay wind farms.

Table 5.47: Estimated Annual Mortality of Forth Islands SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination With Other Forth and Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES
Forth and Tay	Scoping A	100.1	2.6	6.1	1.9	0.7	0.2	107.0	4.7
	Scoping B	298.7	7.8	18.3	5.5	2.2	0.6	319.2	13.9
	Developer	100.1	2.6	6.1	1.9	0.7	0.2	107.0	4.7
UK North Sea	Scoping A	102.5	2.7	33.9	24.6	7.4	5.7	143.7	32.9
	Scoping B	305.6	8.0	101.4	73.5	22.3	17.0	429.3	98.5
	Developer	102.5	2.7	33.9	24.6	7.4	5.7	143.7	32.9

949. The incorporation of the potential mortality associated with the other plans and projects results in substantive increases in the mortality predicted due to displacement effects relative to that from the Proposed Development alone. Thus, the potential mortality of adult birds from the Proposed Development in-combination with the other Forth and Tay wind farms is more than three times greater than for the Proposed Development alone, whilst that from the in-combination with the other UK North Sea wind farms is approximately four and a half times greater than for the Proposed Development alone (Tables 5.44 and 5.47). Increases in the potential mortality amongst the immature age class (relative to that from the Proposed Development alone) for the in-combination with the Forth and Tay wind farms are of similar magnitude to that of the adults but are approximately 15 times greater for the in-combination with the other

UK North Sea wind farms (although predicted mortality of immature birds remains low compared to that of adults). These levels of increase apply equally to the Scoping and Developer Approaches.

950. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to displacement represents 0.07% of the current adult breeding population at this colony (i.e. 150,518 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.07 – 0.21% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 1.5% for the Developer Approach and of 1.5 – 4.6% for the lower and upper estimates from the Scoping Approach.

951. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to displacement represents 0.09% of the current adult breeding population at this colony as determined by the Developer Approach, and between approximately 0.09 – 0.29% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 2.1% for the Developer Approach and of 2.1 – 6.2% for the lower and upper estimates from the Scoping Approach.

952. The potential levels of impact on the Forth Islands SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In-combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

953. Breeding season collision estimates attributed to the Forth Islands SPA gannet population were extracted from existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (volume 3, appendix 11.6, annex E of the Offshore EIA Report). As stated above, gannets from the Forth Islands SPA may also use the waters in and around the Dogger Bank wind farms during the breeding season (Wakefield *et al.* 2013, Lane *et al.* 2020), with the breeding season numbers for those sites extracted from MacArthur Green and Royal HaskoningDHV (2021) and an assumption made that 10% of these birds derive from the Forth Islands SPA population.

954. For the non-breeding periods, collision estimates for other offshore wind farms that are in planning, consented, under construction or in operation were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (volume 3, appendix 11.6, annex E of the Offshore EIA Report). These collision estimates were apportioned to the SPA population according to the BDMPS approach as detailed in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015, Royal HaskoningDHV *et al.* 2015).

955. Collision estimates based on consented and 'as-built'[11] designs were also considered but for the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms and had minimal effects on those for the other UK North Sea wind farms (with the respective totals differing by approximately four adult birds, representing less than 1% of the in-combination totals). Therefore, only the estimates for the consented designs are considered in this case.

956. In contrast to the displacement estimates derived for the other plans and projects, existing collision estimates for these plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

957. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.48).

Table 5.48 Predicted Collision Effects on the Forth Islands SPA Gannet Population due to the Proposed Development In-Combination with Other Wind Farms in the Forth and Tay and in UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
Forth and Tay	Scoping	Breeding	482.7	10.6
		Autumn migration	9.4	0.4
		Spring migration	13.2	0.2
		Annual total	505.3	11.2
	Developer	Breeding	455.7	10.3
		Autumn migration	8.5	0.4
		Spring migration	12.9	0.2
		Annual total	477.1	10.9
UK North Sea	Scoping	Breeding	508.8	11.5
		Autumn migration	122.0	92.6
		Spring migration	54.7	34.2
		Annual total	685.5	138.3
	Developer	Breeding	481.8	11.2
		Autumn migration	121.1	92.6
		Spring migration	54.4	34.2
		Annual total	657.3	138.0

958. As with the displacement effects, the incorporation of the potential collisions associated with the other plans and projects results in substantive increases in the predicted collision mortality relative to that from the Proposed Development alone. Thus, the potential mortality of adult birds from the Proposed Development in-combination with the other Forth and Tay wind farms is three to four times greater than for the Proposed Development alone (depending on whether the Scoping or Developer Approaches are considered), whilst that from the in-combination with the other UK North Sea wind farms is approximately five times greater than for the Proposed Development alone for both the Scoping and Developer Approaches (Tables 5.45 and 5.48). The predicted mortality amongst the immature age class also increases markedly compared to that for the Proposed Development alone (for both the Scoping and Developer Approaches), with this increase particularly marked for the UK North Sea in-combination scenario (due to the higher levels of mortality apportioned to this age class during the passage periods).

959. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to collisions represents 0.32% of the current adult breeding population at this colony (i.e. 150,518 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.34% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 6.9% for the Developer Approach and of 7.3% for the estimates from the Scoping Approach.

960. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Forth Islands SPA population predicted due to collisions represents 0.43% of the current adult breeding population at this colony (i.e. 150,518 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.46% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 9.5% for the Developer Approach and of 9.9% for the estimates from the Scoping Approach.

961. The potential levels of impact on the Forth Islands SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In- combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

962. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.47 and 5.48 above).

963. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.49: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with the Other Forth and Tay Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	1057020 (592306 – 1771243)	*1.000*	1.000	*50.0*
Scoping A	610.7	18.9	947664 (531089 – 1588915)	0.897	0.997	34.9
Scoping B	822.4	28.1	912148 (511212 – 1529872)	0.863	0.996	30.6
Developer	583.3	*17.8*	952367 (533712 – 1596707)	0.901	*0.997*	*35.0*

Table 5.50: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	1057020 (592306 – 1771243)	*1.000*	1.000	*50.0*
Scoping A	827.7	174.0	895868 (501617 – 1503157)	0.848	0.995	28.5
Scoping B	1112.8	239.7	845416 (473322 – 1419587)	0.800	0.994	21.9
Developer	800.3	167.9	900857 (504410 – 1511404)	0.853	*0.996*	*29.0*

964. Given the increase in the scale of the effects (from both displacement and collisions) for the in-combination scenarios compared to the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest substantially greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.46 with Tables 5.49 and 5.50). However, the PVAs continue to predict a strongly increasing population trend, despite this substantive increase in the scale of the effects.

965. For the Proposed Development in-combination with the other Forth and Tay wind farms, the CPS value for the upper range of the Scoping Approach (i.e. B) indicates that the SPA population size would be reduced

by almost 14% relative to that in the absence of any wind farm effects (Table 5.49). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small (at 0.4%), whilst the centile value of 30.6 suggests a moderate degree of overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. The levels of impact on the population predicted by the Developer Approach (and also the lower range of the Scoping Approach) are smaller than this.

966. For the Proposed Development in-combination with the other UK North Sea wind farms, the PVA metrics associated with the Developer Approach are similar in value to those described above for the upper range of the Scoping Approach as derived from the Forth and Tay in-combination scenario (Table 5.50). The values for the metrics obtained on the basis of the Scoping Approach indicate reductions of 15 – 20% in population size after 35 years relative to that in the absence of any wind farm effects, with slightly greater reductions in the annual population growth rates (relative to the baseline situation) than predicted for the Forth and Tay in-combination scenario. The centile values (21.9 – 28.5) suggest low to moderate overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonably high chance of the impacted population being smaller than the un-impacted population after 35 years.

967. As detailed above, the Forth Islands SPA gannet population has shown a marked, and consistent, long-term increase in size (Figure 5.17). This reflects the wider trend in gannet populations across Scotland and the rest of the UK, whilst earlier count data indicate that the period of rapid increase in the Forth Islands SPA population extends back to the 1950s or 1960s (Mitchell et al. 2004, Murray *et al.* 2015, Natural England 2020). Based on the data in Figure 5.17, the annual growth rate of the Forth Islands SPA population averaged approximately 4.4% between 1985 and 2014. If this growth rate was to be maintained over the 35 year operation and maintenance period for the Proposed Development, the Forth Islands SPA population would still be more than three and half times larger than currently even when accounting for the 0.6% reduction in annual growth rate, as predicted by the upper range of the Scoping Approach for the Proposed Development in-combination with the other UK North Sea wind farms (Table 5.50). The mean annual growth rate for the SPA population under baseline conditions (i.e without any wind farm effects) would have to decrease to below 0.6% for this predicted impact to result in the population declining below its current level over the 35 year operation and maintenance period.

968. As already discussed in the section on *Project Alone: Population-Level Impacts* for this SPA population, it seems likely that the availability of resources will limit further growth of this SPA population at some point within the 35 year operation and maintenance period for the Proposed Development. If this occurs, it is likely that there would remain a considerable capacity for population regulation via the operation of compensatory density dependence, particularly given the evidence for environmental conditions remaining highly suitable for the SPA (and other gannet) population(s) over the long term. Thus, it is likely that the SPA population would remain stable despite increased levels of mortality (at least of a scale which could potentially occur as a result of the effects from the Proposed Development in-combination with the other UK North Sea wind farms).

969. As for the assessments of the St Abb's Head to Fast Castle SPA populations presented above, the assessment of the Forth Islands SPA gannet population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendices 11.3 and 11.4). This includes the reliance on PVAs which are based on density independent population models, as already considered in relation to the expectation that compensatory density dependence would offset increased mortality resulting from the predicted effects. In addition, and of particular relevance to the gannet assessment, the avoidance rate used with the CRM relates to behaviour within the wind farm array only and excludes consideration of macro-avoidance, which is likely to be high for gannet (Cook *et al.* 2014, Cook 2021, Peschko *et al.* 2021). This issue is now recognised in recent advice from Natural England, which recommends the application of a macro-avoidance correction for gannet (ranging from 65 – 85%) to reduce the estimated density of birds in flight within the array area (Natural England 2022b)[14]. This would (obviously) substantially reduce the collision estimates and, hence, the scale of the predicted population-level impacts. In relation to the estimation of displacement effects, as for other species, these are based upon the seasonal mean peak abundance estimates (which are substantially higher than the seasonal mean values).

In-combination: conclusion

970. On the basis of the Developer Approach, the potential effects from the Proposed Development in-combination with the other Forth and Tay wind farms or the other UK North Sea wind farms on the Forth Islands SPA gannet population are predicted to be relatively small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is at least reasonably likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Considering this within the context of a highly precautionary assessment and a population that has shown a strongly increasing trend over the long term, it is concluded that these in-combination scenarios would not result in adverse effect on the Forth Islands gannet population.

971. The above conclusion is also considered to apply to the levels of impact as determined by the Scoping Approach. For the Scoping Approach, the predicted reductions in population size are greater, whilst it is also likely that the impacted population will be smaller than the un-impacted population after 35 years (for the UK North Sea in-combination scenario). However, when these predicted levels of impacts are considered within the context of the precaution incorporated within the assessment and the status and long-term, strongly increasing, trend of the SPA population, as well as the consequences in terms of population growth rates, it is concluded that they would not lead to an adverse effect.

Assessment for the kittiwake population

972. The Forth Islands SPA kittiwake population is distributed across several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony holds approximately 75% of the total SPA population. The kittiwake population has declined in number since the SPA was designated (Figure 5.18), with the SPA counts being below the citation population size in all but two years since the mid-1980s. Counts from 2013 provide a tentative indication of some stabilisation in the SPA population size, albeit at a level well below the citation size.

[14] Noting that this advice also recommends the use of a higher avoidance rate of 0.992 (as opposed to 0.989) for gannet for use with the deterministic version of the CRM, which would reduce the collision estimates presented in this assessment by a further 27%.

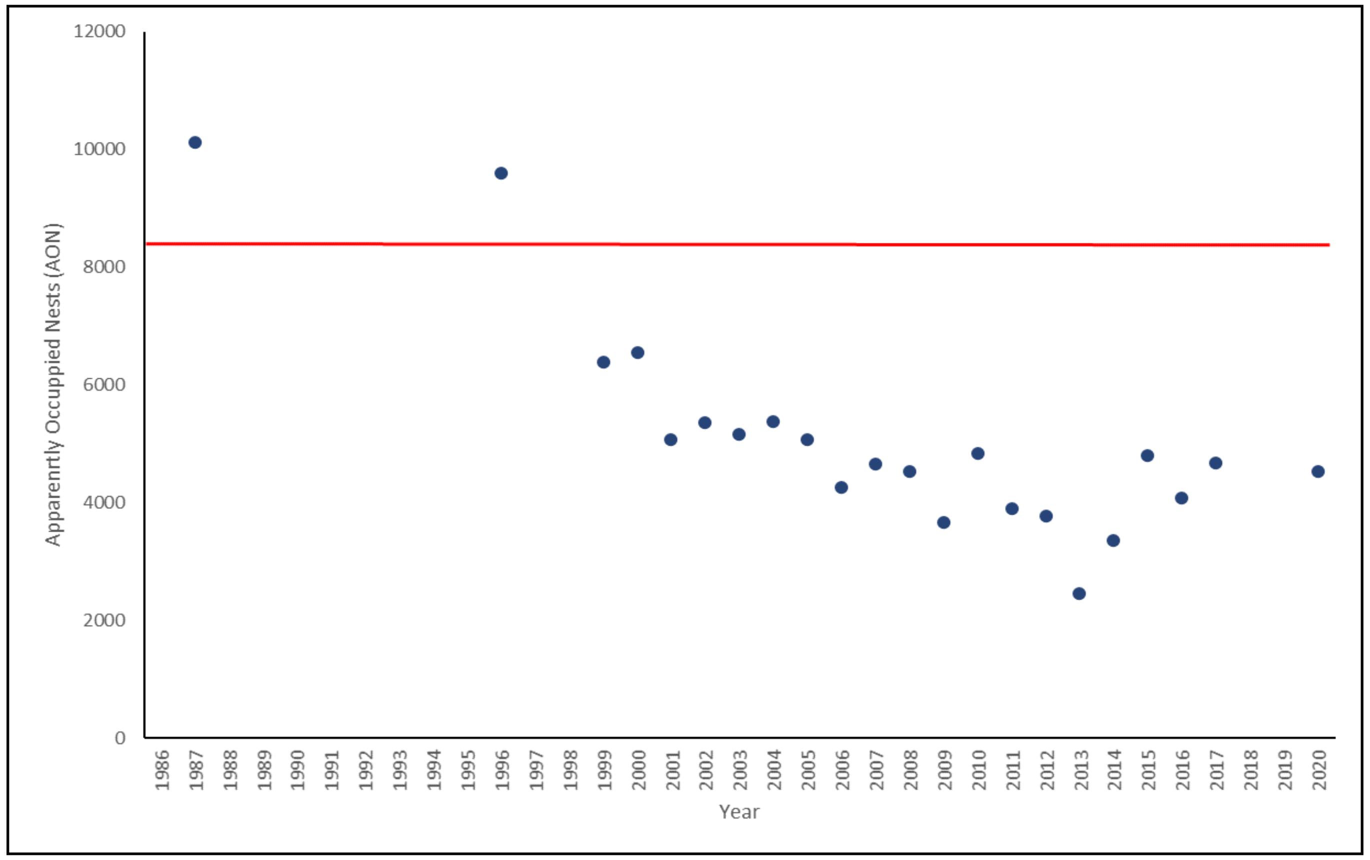

Figure 5.18: Kittiwake Population Trend at the Forth Islands SPA Between 1986 and 2020 (noting that the Latest SPA Count is Shown for 2020 because it spans the period 2018 – 2021). The Red Line Shows the Citation Population Size for the SPA (6,600 pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the kittiwake population

973. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

974. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017, Bogdanova *et al.* 2022), it is apparent that during the breeding period kittiwakes from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is reflected in the findings of the apportioning exercise, which estimates that approximately 6% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

975. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Forth Islands SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Forth Islands SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

976. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

977. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

978. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

979. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Forth Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the (main) seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

980. Tracking data (and associated modelling of foraging distributions) for kittiwake show that the Proposed Development array area and Proposed Development export cable corridor overlap with, or occur close to, waters that are heavily used by birds from the Forth Islands SPA during the breeding season (Cleasby *et al.* 2018, Bogdanova *et al.* 2022). However, the degree of overlap is limited and excludes those areas of heaviest usage. For example, based on the data from 50 birds tracked from this SPA population during the 2021 breeding season, the Proposed Development array area does not overlap with the core foraging area of the tracked birds (as defined by the 50% utilisation distribution), and overlaps with only 0.4% of the core 'resting at sea' area (Bogdanova *et al.* 2022). The overlaps between the Proposed Development array area and the wider foraging and 'resting at sea' areas of these tracked birds (as defined by the respective 90% utilisation distributions) represented 13% and 17% of these wider areas, respectively. Although a high proportion of these 50 birds (i.e. 72%) were recorded in flight through the Proposed Development array area at some point during the tracking period, only 8% of the 2,271 fight tracks were recorded doing so (Bogdanova *et al.* 2022).

981. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015) and the potential for effects of construction-related disturbance is lower than during the breeding season.

982. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

983. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

984. Given the low sensitivity of kittiwake to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

<u>Displacement</u>

985. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Forth Islands SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

986. Therefore, based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

<u>Changes to prey availability</u>

987. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA kittiwake population in the short-term.

988. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Forth Islands SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

989. Given this, it is considered that there is relatively little potential for the Forth Islands SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA kittiwake population.

<u>Project alone: operation and maintenance</u>

<u>Disturbance</u>

990. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Forth Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

991. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

992. Based on information presented in the *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the

operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

993. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

994. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA kittiwake population.

Displacement/barrier effects

995. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

996. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

997. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

998. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Forth Islands SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.51). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.51: The Mean Peak Abundance Estimates Of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Forth Islands SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	*0.057*	0.057	*0.10*
Autumn migration	*11,190*	*N/A*	*0.004*	*0.003*	*N/A*
Spring migration	*13,766*	*N/A*	*0.006*	*0.003*	*N/A*

999. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as four adult and 0.3 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 11 adult and one immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.52). As expected on the basis that kittiwakes from this breeding colony SPA use the waters within the vicinity of the Proposed Development array area during the breeding season (and as reflected by the seasonally-specific apportioning rates), the displacement effects predicted by the Scoping Approach are largely attributable to the breeding season (with the potential breeding season mortality accounting for almost 85% of the overall annual mortality – Table 5.52).

1000. The annual mortality from displacement as determined using the Developer Approach is predicted to be approximately six adult and 0.2 immature birds, so lies midway between the mortality predictions from the Scoping Approach and is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are considered unlikely to result in detectable impacts on the population – volume 3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.52: Estimated Potential Annual Mortality of Forth Islands SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	3.2	0.1
	Autumn migration	30%	1%	0.1	0.1
	Spring migration	30%	1%	0.2	0.1
	Annual total	-	-	3.6	0.3
Scoping B	Breeding	30%	3%	9.5	0.3
	Autumn migration	30%	3%	0.4	0.3
	Spring migration	30%	3%	0.7	0.4
	Annual total	-	-	10.7	1.0
Developer	Breeding	30%	2%	6.3	0.2
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	6.3	0.2

1001. The additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to displacement from the Proposed Development array represents 0.07% of the current adult breeding population at this colony (i.e. 9,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.04 – 0.12% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.5% for the Developer Approach and of 0.27 – 0.82% for the lower and upper estimates from the Scoping Approach.

1002. The potential levels of impact on the Forth Islands SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

1003. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

1004. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes and in volume 3, appendix 11.3 of the Offshore EIA Report, but as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Forth Islands SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1005. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

1006. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of the Offshore EIA Report, volume 3, appendix 11.3.

1007. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the Forth Islands SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.51). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.51).

1008. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Forth Islands SPA is predicted to be approximately 33 adults and two immatures as determined by the Scoping Approach, and approximately 23 adults and two immatures as determined by the Developer Approach (Table 5.53). As for displacement, the vast majority of this mortality (i.e. over 90%) is predicted to occur during the breeding season.

Table 5.53: Predicted Collision Effects from the Proposed Development on the Forth Islands SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for The Maximum Design Scenario and are Based on option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Scoping	Breeding	30.7	1.1
	Autumn migration	0.7	0.5
	Spring migration	1.1	0.6
	Annual total	32.5	2.2
Developer	Breeding	21.2	0.7
	Autumn migration	0.4	0.3
	Spring migration	0.9	0.5
	Annual total	22.5	1.5

1009. The additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.25% of the number of adults currently estimated to breed at this colony (i.e. 9,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.36% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 1.7% and 2.5% for the Developer and Scoping Approaches, respectively.

1010. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Forth Islands SPA kittiwake population that are at least 50% lower than those presented in Table 5.53 above (and on which the assessment is based).

1011. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.53 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

1012. Potential impacts on key prey species for kittiwakes breeding at the Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Forth Islands SPA kittiwake population.

1013. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Forth Islands SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1014. Given this, it is considered that there is relatively little potential for the Forth Islands SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA kittiwake population.

Project alone: population-level impacts

1015. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1016. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.52 and 5.53 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 – 2021 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1017. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.54: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	2423 *(897 – 5771)*	*1.000*	1.000	*50.0*
	Scoping A	36.21	2.32	2156 *(794 – 5145)*	0.890	0.997	40.7
	Scoping B	43.32	2.94	*2106* *(775 – 5033)*	0.869	0.996	39.0
	Developer	28.82	1.63	*2208* *(814 – 5266)*	0.912	0.997	42.8

1018. The PVA predicted a continuing population decline for the Forth Islands SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, under baseline conditions (i.e. no wind farm effects), the population is predicted to decline by 73% after 35 years from the current estimate of 9,034 adult birds (Table 5.54). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted declines are inevitably greater for those scenarios incorporating the effects from the Proposed Development.

1019. Considering the PVA metrics, the CPS values indicate that the SPA population size would be reduced by approximately 9% and 11 – 13%, relative to the predicted population size under baseline conditions, after 35 years for the Developer Approach and Scoping Approach, respectively (Table 5.54). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be approximately 0.3% on the basis of the Developer Approach and 0.3 – 0.4% on the basis of the Scoping Approach (Table 5.54). On the basis of the Developer Approach, the centile value is estimated to be almost 43 after 35 years, whilst for the Scoping Approach the equivalent values are 39.0 – 40.7 (Table 5.54). Thus, overall, the centile metric indicates considerable overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

1020. The PVA outputs described above, and detailed in Table 5.54, need to be considered within the context of the fact that the SPA population is predicted to decline irrespective of the wind farm effects and that such a trend is broadly consistent with the documented long-term trend for this population, albeit that there is some suggestion of a levelling off in this decline over the past decade (Figure 5.18). As described in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population, the available evidence suggests that the long-term decline of kittiwake populations in the North Sea and the Forth and Tay region (including the Forth Islands SPA) is associated with fisheries management and climate change (Frederiksen *et al.* 2004). Therefore, without appropriate management to mitigate these effects, it is likely that the Forth Islands SPA population will remain in unfavourable condition and that the predicted effects from the Proposed Development may be unimportant in this regard. Furthermore, it is also relevant to consider the high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach (with this also detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

Project alone: conclusion

1021. Overall, it is considered that the predicted levels of impact from the Proposed Development alone on the Forth Islands SPA kittiwake population are of a small (for the Developer Approach) to, at most, moderate scale (for the upper range of the Scoping Approach). For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. Given this is within the context of a population which (consistent with the documented long-term trend) is predicted to decline irrespective of the effects from the Proposed Development, and for which the assessment incorporates high levels of precaution (particularly as determined by the Scoping Approach), it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1022. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1023. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for two in-combination scenarios, i.e. (i) the Proposed Development in-combination with the other Forth and Tay offshore wind farms and (ii) the Proposed Development in-combination with the offshore wind farms in the UK North Sea (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1024. As described in annex D of Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Forth Islands SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development (Table 5.52), the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1025. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (Offshore EIA Report, volume 3, appendix 11.6, annex E), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in-combination *Displacement/Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

1026. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farm scenario and the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.55).

Table 5.55: Estimated Annual Mortality of Forth Islands SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and UK North Sea Wind Farms.

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	8.9	0.6	0.3	0.2	0.3	0.2	9.5	1.0
	Scoping B	26.6	1.7	1.0	0.7	1.0	0.5	28.6	2.9
	Developer	17.7	1.2	N/A	N/A	N/A	N/A	17.7	1.2
UK North Sea	Scoping A	8.9	0.6	0.8	0.5	1.2	0.6	10.9	1.6
	Scoping B	26.6	1.7	2.4	1.5	3.7	1.7	32.7	4.9
	Developer	17.7	1.2	N/A	N/A	N/A	N/A	17.7	1.2

1027. The potential mortality resulting from the predicted displacement effects associated with other plans and projects increases the levels predicted for the Proposed Development alone by factors of two and half to three (Tables 5.52 and 5.55). For the Scoping Approach, these increases are slightly greater for the other UK North Sea wind farms in-combination scenario than for the other Forth and Tay wind farms scenario (due to the incorporation of effects from a greater number of wind farms during the passage periods in the former scenario). However, for the Developer Approach, the increases are the same for both scenarios (because no mortality is attributed to displacement during the non-breeding periods, whilst displacement effects during the breeding season on the SPA population are limited to the Proposed Development and the other Forth and Tay wind farms – see Offshore EIA Report, volume 3, appendix 11.6, annex D). As for the Proposed Development alone, the vast majority (i.e. 75 – 100%) of the predicted mortality from displacement is attributed to effects during the breeding season (Table 5.55).

1028. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to displacement represents 0.20% of the current adult breeding population at this colony (i.e. 9,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.11 – 0.32% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 1.4% for the Developer Approach and of 0.7 – 2.2% for the lower and upper estimates from the Scoping Approach.

1029. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to displacement represents between approximately 0.12 – 0.36% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.8 – 2.5% for the lower and upper estimates from the Scoping Approach. The equivalent figures for the predicted additional mortality as determined by the Developer Approach are as for the Proposed Development in-combination with the other Forth and Tay wind farms.

1030. The potential levels of impact on the Forth Islands SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

1031. As for displacement, breeding season collision estimates attributed to the Forth Islands SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (annex D of Offshore EIA Report, volume 3, appendix 11.6). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (annex E of Offshore EIA Report, volume 3, appendix 11.6). The non-breeding season collision estimates were apportioned to the Forth Islands SPA population according to the BDMPS approach (Furness 2015).

1032. Collision estimates based on consented and 'as-built'[11] designs were also considered but for the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms and had minimal effects on those for the other UK North Sea wind farms (with the respective totals differing by approximately one adult bird). Therefore, only the estimates for the consented designs are considered in this case.

1033. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

1034. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.56).

Table 5.56 Predicted Collision Effects on the Forth Islands SPA Kittiwake Population Due to the Proposed Development In-Combination with Other Projects in the Forth and Tay and in UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
Forth and Tay	Scoping	Breeding	45.9	2.3
		Autumn migration	1.2	0.8
		Spring migration	1.4	0.7
		Annual total	48.5	3.8
	Developer	Breeding	36.4	1.9
		Autumn migration	0.9	0.6
		Spring migration	1.2	0.6
		Annual total	38.5	3.1
UK North Sea	Scoping	Breeding	46.3	2.3
		Autumn migration	4.6	2.8
		Spring migration	6.3	2.8
		Annual total	57.2	7.9
	Developer	Breeding	36.8	2.0
		Autumn migration	4.3	2.6
		Spring migration	6.0	2.7
		Annual total	47.1	7.3

1035. The potential mortality resulting from the predicted collision effects associated with other plans and projects increases that predicted for the Proposed Development alone by approximately 50 – 75% for the other Forth and Tay wind farms in-combination scenario and by approximately 75 – 125% for the other UK North Sea wind farms in-combination scenario (with the greater increases associated with the Developer Approach in each case - Tables 5.53 and 5.56). The vast majority of the collision mortality predicted on the SPA population (i.e. approximately 70 – 90%) is again attributable to the breeding season effects (Table 5.56), with the breeding season effects essentially limited to the Proposed Development and the other Forth and Tay wind farms (see annex D to the Offshore EIA Report, volume 3, appendix 11.6).

1036. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to collisions represents 0.43% of the current adult breeding population at this colony (i.e. 9,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.54% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 2.9% for the Developer Approach and of 3.7% for the Scoping Approach.

1037. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Forth Islands SPA population predicted due to collisions represents 0.52% of the current adult breeding population at this colony (i.e. 9,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.63% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 3.6% for the Developer Approach and of 4.4% for the Scoping Approach.

1038. The potential levels of impact on the Forth Islands SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

1039. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.55 and 5.56 above).

1040. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.57: Projected 35 Year Population Sizes And Associated PVA metrics for the Forth Islands SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other Forth and Tay Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	2423 *(897 – 5771)*	*1.000*	1.000	*50.0*
	Scoping A	58.21	4.52	*2004* *(737 – 4800)*	0.827	0.995	35.7
	Scoping B	77.22	6.44	*1881* *(690 – 4513)*	0.777	0.993	31.2
	Developer	*56.22*	*4.23*	*2018* *(742 – 4831)*	0.833	0.995	36.1

Table 5.58 Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development in-Combination with the other UK North Sea Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	2423 *(897 – 5771)*	*1.000*	1.000	*50.0*
	Scoping A	68.21	9.42	*1923* *(706 – 4610)*	0.794	0.994	32.8
	Scoping B	89.92	12.54	*1785* *(654 – 4289)*	0.737	0.992	27.5
	Developer	64.82	8.33	*1948* *(716 – 4667)*	0.804	0.994	33.7

1041. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Tables 5.57 and 5.58 with Table 5.54). Focussing on the outputs for the Proposed Development in-combination with the other UK North Sea wind farms, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by almost 20% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 21 – 26% (Table 5.58). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.6% for the Developer Approach and 0.6 – 0.8% for the Scoping Approach. The values for the centile metric are estimated as 33.7 after 35 years for the Developer Approach and as 27.5 – 32.8 for the Scoping Approach, suggesting moderate levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate slightly lower levels of impact, being closer to those for the UK North Sea in-combination scenario than to those for the Proposed Development alone.

1042. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

<u>In-combination: conclusion</u>

1043. For both the Scoping and Developer Approaches, the predicted levels of impact associated with the two in-combination scenarios represent a marked increase compared to those associated with the Proposed Development alone. These levels of impact suggest the potential for the in-combination effects to lead to a marked reduction in the size of the Forth Islands SPA population after 35 years relative to that which would occur in the absence of these effects. The predicted levels of impact are such that for the Developer Approach (which predicts lower levels of impact than the Scoping Approach), this potential reduction in population size is almost 20% for the Proposed Development in-combination with the other UK North Sea wind farms.

1044. The centile values continue to indicate a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years, whilst the context that has been outlined above (in relation to (i) the high levels of precaution incorporated in the assessment and (ii) the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population) remains highly relevant. However, despite this, it is considered that the scale of the potential reduction in the size of the SPA population associated with the in-combination effects means that the possibility of an adverse effect on the SPA population cannot be excluded.

1045. Consequently, it is concluded that there is the potential for an adverse effect on the Forth Islands kittiwake population as a result of the predicted effects from (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the herring gull population

1046. The Forth Islands SPA herring gull population is currently estimated to number 5,934 breeding pairs, which is slightly below the citation population of 6,600 pairs (Figure 5.19). The available count data for the population suggest that it has remained relatively stable and close to the citation size since the late 1980s at least.

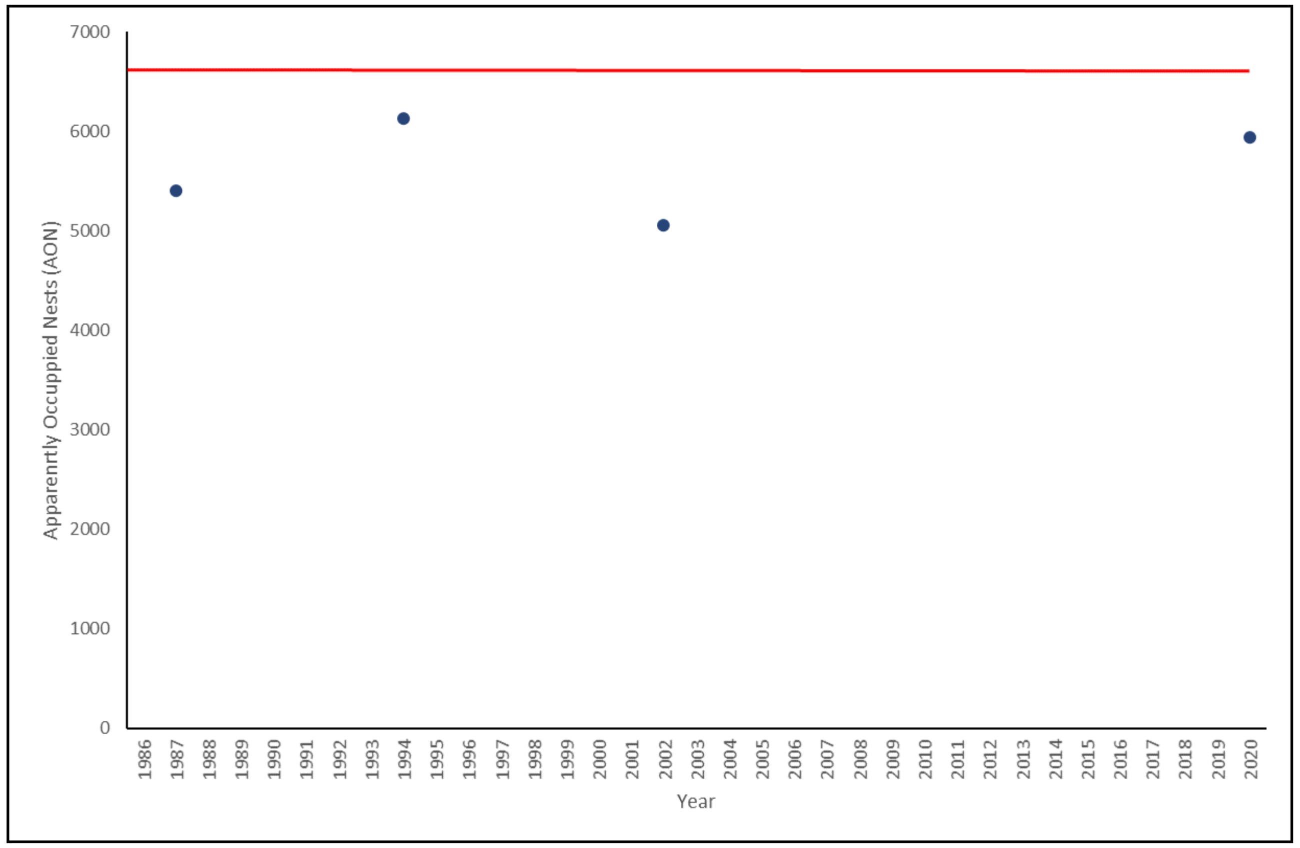

Figure 5.19: Herring Gull Population Trend at the Forth Islands SPA Between 1987 and 2020 (Noting That The Latest SPA Count is Shown for 2020 because it Spans the period 2019 – 2021). The Red Line Shows the Citation Population Size for the SPA (6,600 pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org)).

The potential for impacts on the herring gull population

1047. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its herring gull population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1048. From published information on herring gull foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period herring gulls from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is supported by the findings of the apportioning exercise, which estimates that almost 60% of the herring gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for herring gull is defined as April to August, following NatureScot (2020).

1049. In the non-breeding season, herring gulls in Great Britain are largely sedentary with relatively short local movements only (Wernham *et al.* 2002). However, there is an influx of breeding birds of Scandinavian breeding subspecies, *L. argentatus argentatus* (Coulson *et al.,* 1984). On this basis, and following the scoping advice from NatureScot (volume 3, appendix 6.2 of the Offshore EIA Report), it is assumed that during the non-breeding period herring gulls remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Offshore EIA Report, volume 3, appendix 11.5). To account for the influx of birds from other regions to this regional population during the non-breeding period, the regional non-breeding population is assumed to increase (relative to the size of the breeding population) in accordance with the proportion of continental and western UK birds estimated to be present in the UK North Sea and Channel BDMPS (Furness 2015, volume 3, appendix 11.5 of the Offshore EIA Report).

1050. Given the above, there is potential for the Proposed Development to have effects on the Forth Islands SPA herring gull population during both the breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

1051. Herring gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on herring gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA herring gull population in the short-term.

1052. During construction there are a number of ways in which effects on herring gull prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The Proposed Development array area encompasses 1,010 km², whilst the Proposed Development export cable corridor encompasses 168 km². Together these areas represent c. 10% of the total breeding season foraging area that is potentially available to the SPA herring gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 58.8±26.8 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for herring gulls breeding at the Forth Islands SPA. Non-breeding season effects are expected to similar since herring gulls in Great Britain do not disperse widely during winter (Wernham *et al.* 2002).

1053. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect herring gull prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding herring gulls forage.

1054. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA herring population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

1055. Predictions of the number of herring gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 99.0% were applied to the outputs from option 2 and option 3, respectively.

1056. As outlined for the St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes population (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for herring gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1057. In addition to the above, collision estimates for herring gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA herring gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of Offshore EIA Report, volume 3, appendix 11.3.

1058. Herring gull collision estimates are calculated for the breeding and non-breeding periods, with estimates apportioned to the Forth Islands SPA population according to the NatureScot (2018) approach but with allowance made for the influx of birds from other regions during the non-breeding period (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes according to the plumage characteristics of herring gulls recorded during the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst on the basis advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

1059. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of herring gulls from the Forth Islands SPA is predicted to be 17 adults and three immatures as determined by the Scoping Approach, and approximately 10 adults and two immatures as determined by the Developer Approach (Table 5.59). The vast majority of this mortality (i.e. approximately 90% for adults and 70% for immatures) is predicted to occur during the breeding season. The collision estimates for option 3 of the deterministic CRM with a 99.0% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.59 but give outputs that are approximately 40% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA Report, volume 3, appendix 11.3). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 99.0% avoidance rate, and hence also substantially lower than those presented in Table 5.59 below (see annex C of the Offshore EIA Report, volume 3, appendix 11.3).

Table 5.59: Predicted Collision Effects from the Proposed Development on the Forth Islands SPA Herring Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	15.2	2.0
	Non-breeding	1.9	1.0
	Annual total	17.1	3.0
Developer	Breeding	9.2	1.2
	Non-breeding	1.0	0.5
	Annual total	10.2	1.7

1060. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult herring gulls from the Forth Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.09% of the number of adults currently estimated to breed at this colony (i.e. 11,868 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.14% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.7% and 1.2% for the Developer and Scoping Approaches, respectively.

1061. The potential levels of impact on the Forth Islands SPA herring gull population resulting from the predicted collision mortalities in Table 5.59 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

Changes to prey availability

1062. Potential impacts on key prey species for herring gulls breeding at the Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect herring gull survival and productivity in the Forth Islands SPA population.

1063. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1064. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA herring gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

1065. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA herring gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1066. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.59 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.59 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.11 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2016 – 2020 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle kittiwake above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1067. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.60: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	116788 (66486 – 200969)	*1.000*	1.000	*50.0*
Scoping	*17.10*	*3.00*	112888 (64237 – 194434)	0.967	0.999	45.6
Developer	*10.17*	*1.74*	114459 (65143 – 197071)	0.980	0.999	47.3

1068. The PVA predicted that the Forth Islands SPA herring gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost 10 times larger than the current estimate of 11,868 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.60). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented long-term trend of relative stability for this SPA population (Figure 5.19).

1069. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the Scoping Approach, the CPS value indicates that the collision mortality associated with the Proposed Development alone would result in a reduction of approximately 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.60). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 45.6 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the Developer Approach suggest even smaller levels of impact (Table 5.60). In addition, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that are 40% lower than those used for the PVA.

Project alone: conclusion

1070. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Forth Islands SPA herring gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

1071. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA herring gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1072. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA herring gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Collision risk - operation and maintenance

1073. Breeding and non-breeding season collision estimates attributed to the Forth Islands SPA herring gull population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (annex E of Offshore EIA Report, volume 3, appendix 11.6). As for the Proposed Development, the non-breeding season collision estimates for the other plans and projects were adjusted to account for the influx of birds from other regions to this regional population during the non-breeding period, in accordance with the estimates used for the UK North Sea and Channel BDMPS (see above, Offshore EIA Report, volume 3, appendix 11.5, Furness 2015).

1074. The collision estimates derived for the other plans and projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. However, the potential effects on the SPA population were limited to the other Forth and Tay wind farms, noting that apportioning of the non-breeding season effects for herring gull assumed that birds remain within the waters in the region of the breeding colony (as described above, see also the Offshore EIA Report, volume 3, appendix 11.5). Given that these two different in-combination scenarios are equivalent, the predicted effects are reported solely for the UK North Sea wind farms in the tables below (Table 5.61). Options based on consented and 'as-built'[12] designs did not affect the collision estimates from the other plans and projects, so that estimates are reported for the consented designs only. The collision estimates used for the Proposed Development are those presented in Table 5.59, which derived from the more precautionary of the two different CRM approaches recommended by the Scoping Opinion (see above).

1075. The existing collision estimates for the other plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects included with the in-combination scenario having followed the 'standard' approach of using the mean density). As explained for St Abb's Head to Fast Castle SPA kittiwake above, such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data. Thus, it is only the estimates for the Proposed Development which differentiate the Developer and Scoping Approaches for the in-combination scenarios that are presented below.

Table 5.61: Predicted Collision Effects on the Forth Islands SPA Herring Gull Population Due to the Proposed Development in-combination with Other Projects in the UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
UK North Sea[1]	*Scoping*	*Breeding*	*17.8*	*2.5*
		Non-breeding	*4.3*	*2.7*
		Annual total	*22.1*	*5.2*
	Developer	*Breeding*	*11.7*	*1.7*
		Non-breeding	*3.4*	*2.3*
		Annual total	*15.1*	*4.0*

[1]The Forth and Tay and UK North Sea in-combination effects for the SPA population are equivalent (so that they are reported for the latter scenario only).

1076. Incorporating the potential mortality resulting from the predicted collision effects associated with other plans and projects increases the predicted annual collision mortality of adult birds by approximately 50% and 30% compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively (Tables 5.59 and 5.61). The increase in the predicted collision mortality amongst the immature age class when compared to the Proposed Development alone is of a similar or greater extent (depending on whether the Developer or Scoping Approaches are considered), although the level of mortality predicted amongst this age class remains small relative to the predicted adult mortality. As noted above, the predicted collision effects to the SPA population are limited to the Proposed Development and the other Forth and Tay wind farms (see annex D of the Offshore EIA Report, volume 3, appendix 11.6).

1077. For the Proposed Development in-combination with these other wind farms, the additional annual mortality of adult herring gull from the Forth Islands SPA population predicted due to collisions represents 0.13% of the current adult breeding population at this colony (i.e. 11,868 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Repor) as determined by the Developer Approach, and 0.19% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 1.0% for the Developer Approach and of 1.5% for the Scoping Approach.

1078. The potential levels of impact on the Forth Islands SPA herring gull population resulting from the predicted collision mortalities in Table 5.61 are considered in more detail below in the *In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

In-combination: population-level impacts

1079. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.61 above).

1080. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.62: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	116788 (66486 – 200969)	*1.000*	1.000	*50.0*
Scoping	*22.11*	*5.30*	111573 (63478 – 192206)	0.955	0.999	44.0
Developer	*15.17*	*4.04*	113124 (64376 – 194811)	0.969	0.999	45.8

1081. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.62 with Table 5.60). However, the changes in the values of the PVA metrics are small, with the reduction in the size of the SPA population after 35 years relative to that in the absence of any wind farm effects predicted to be approximately 5% for the Scoping Approach (compared to 3% for the Proposed Development alone). The equivalent reduction is smaller for the metrics associated with the Developer Approach. For both the Developer and Scoping Approaches, the centile metric continues to indicate a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.62).

1082. It is also the case that these predicted levels of impact are derived using the more precautionary of the two CRM approaches recommended by the Scoping Opinion for the Proposed Development. Reliance on the alternative approach would likely reduce the predicted levels of impact considerably, given that it reduces the collision estimates for the Proposed Development by approximately 40% and that the collision effects for the Proposed Development comprise a substantial part of the overall in-combination effects.

In-combination: conclusion

1083. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Forth Islands SPA herring gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the Lesser Black-Backed Gull Population

1084. The Forth Islands SPA lesser black-backed gull population is currently estimated to number 2,003 breeding pairs, which is above the citation population of 1,500 pairs (Figure 5.20). Based on those years for which full count data are available for the SPA, numbers have remained above the citation level since designation and appear relatively stable (albeit with indications of some fluctuations).

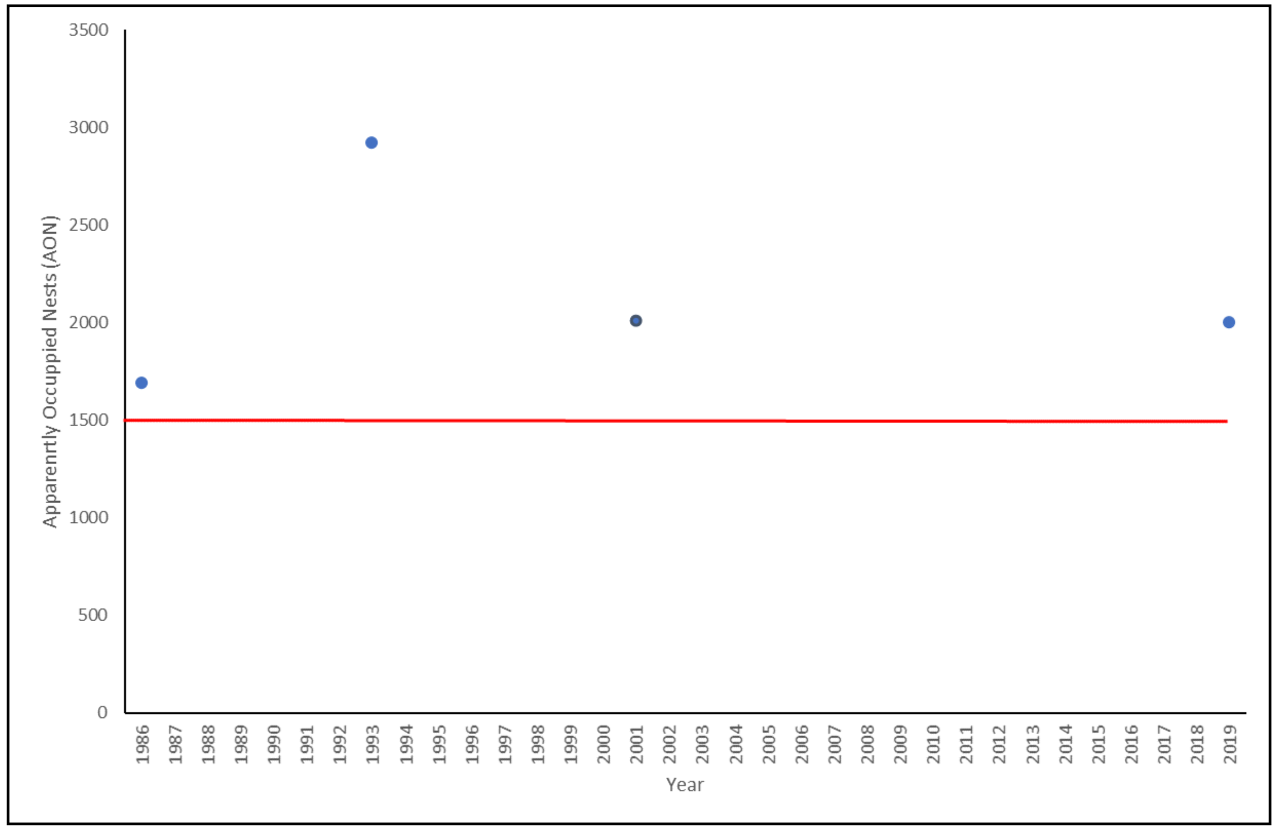

Figure 5.20: Lesser Black-Backed Gull Population Trend at the Forth Islands SPA Between 1987 and 2020 (Noting that the Latest SPA Count is Shown for 2020 because it Spans the Period 2018 – 2021). The Red Line Shows the Citation Population Size for the SPA (1,500 pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the lesser black-backed gull population

1085. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its lesser black-backed gull population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1086. From published information on lesser black-backed gull foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period lesser black-backed gulls from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that almost 53% of the lesser black-backed gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for lesser black-backed gull is defined as mid-March to August, following NatureScot (2020).

1087. In the non-breeding season lesser black-backed gulls from the Forth Islands SPA migrate south through the southern North Sea, undertaking the return journey in spring. It is likely that they winter predominantly in Iberia or on the coast of northwest Africa although a proportion may remain within the North Sea and Channel (Wernham *et al.* 2002, Furness 2015). Therefore, it is likely that there is the potential for birds from the Forth Islands SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to October and the first half of March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5), and to a lesser extent in winter as well (defined as November to February – Furness 2015). Given the above, the Proposed Development may have potential effects on the Forth Islands SPA lesser black-backed gull population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

1088. Lesser black-backed gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on lesser black-backed gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA lesser black-backed gull population in the short-term.

1089. During construction there are a number of ways in which effects on lesser black-backed prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The Proposed Development array area encompasses 1,010 km², whilst the Proposed Development export cable corrirdor encompasses 168 km². Together these areas represent c. 1% of the total breeding season foraging area that is potentially available to the SPA lesser black-backed gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 127±109 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for lesser black-backed gulls breeding at the Forth Islands SPA. Effects during the non-breeding season are considered to be lower than during the breeding season given that birds migrate south through UK waters to their wintering grounds (Wernham *et al*., 2002; Furness 2015).

1090. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect the prey species of lesser black-backed gull (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which lesser-black-backed gulls forage.

1091. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA lesser-back-backed gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on lesser black-backed gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

1092. Predictions of the number of lesser black-backed gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.6). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 98.9% were applied to the outputs from option 2 and option 3, respectively.

1093. As outlined for the St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes population (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for lesser black-backed gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1094. In addition to the above, collision estimates for lesser black-backed gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA lesser black-backed gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of Offshore EIA Report, volume 3, appendix 11.3.

1095. Lesser black-backed gull collision estimates are calculated for the defined breeding period, with estimates apportioned to the Forth Islands SPA population according to the NatureScot (2018) approach (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes according to the plumage characteristics of lesser black-backed gulls recorded during the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst on the basis of advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

1096. No lesser black-backed gull collisions were estimated for the non-breeding periods (Offshore EIA Report, volume 3, appendix 11.3).

1097. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of lesser black-backed gulls from the Forth Islands SPA is predicted to be three adults and 0.4 immatures as determined by the Scoping Approach, and two adults and 0.3 immatures as determined by the Developer Approach (Table 5.63). The collision estimates for option 3 of the deterministic CRM with a 98.9% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.63 but give outputs that are 33 - 44% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA Report, volume 3, appendix 11.6). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 98.9% avoidance rate, and hence also substantially lower than those presented in Table 5.63 below (see annex C of the Offshore EIA Report, volume 3, appendix 11.6).

Table 5.63: Predicted Collision Effects from the Proposed Development on the Forth Islands SPA Lesser Black-Backed Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	2.8	0.4
	Autumn migration	0.0	0.0
	Winter	0.0	0.0
	Spring migration	0.0	0.0
	Annual total	2.8	0.4
Developer	Breeding	2.0	0.3
	Autumn migration	0.0	0.0
	Winter	0.0	0.0
	Spring migration	0.0	0.0
	Annual total	2.0	0.3

1098. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult lesser black-backed gulls from the Forth Islands SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.05% of the number of adults currently estimated to breed at this colony (i.e. 4,006 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.06% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.087 – see Table 2.15 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.6% and 0.8% for the Developer and Scoping Approaches, respectively.

1099. The potential levels of impact on the Forth Islands SPA lesser black-backed gull population resulting from the predicted collision mortalities in Table 5.63 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

Changes to prey availability

1100. Potential impacts on key prey species for lesser black-backed gulls breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect lesser black-backed gull survival and productivity in the Forth Islands SPA population.

1101. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1102. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA lesser black-backed gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on lesser black-backed gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

1103. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA lesser black-backed gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1104. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.63 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.63 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.15 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 – 2021 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described for the St Abb's Head to Fast Castle kittiwake above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1105. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.64 Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Lesser Black-Backed Gull Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	18768 (11852 – 29401)	*1.000*	1.000	*50.0*
Scoping	*2.76*	*0.42*	18431 (11635 – 28885)	0.982	0.999	46.7
Developer	*1.97*	*0.30*	18527 (11697 – 29032)	0.987	1.000	47.7

1106. The PVA predicted that the Forth Islands SPA lesser black-backed gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost five times larger than the current estimate of 4,006 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.64). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented long-term trend of relative stability for this SPA population (Figure 5.20).

1107. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the Scoping Approach the CPS value indicates that the collision mortality associated with the Proposed Development alone would result in a reduction of approximately 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.64). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 46.7 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the Developer Approach suggest even smaller levels of impact (Table 5.64). In addition, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that are 33 - 44% lower than those used for the PVA.

Project alone: conclusion

1108. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Forth Islands SPA lesser black-backed gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

1109. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA lesser black-backed gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1110. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA lesser black-backed gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Collision risk - operation and maintenance

1111. Existing assessments for offshore wind farms that are in planning, consented, under construction or in operation were checked to determine the collision estimates to be attributed to the Forth Islands SPA lesser black-backed gull population during the breeding and non-breeding periods (annex E of Offshore EIA Report, volume 3, appendix 11.6).

1112. None of these assessments identified breeding season effects on the SPA population, noting that the Scoping Opinion for the revised designs of the three Forth and Tay projects (which are in closest proximity to the SPA) did not require this SPA population to be assessed (Marine Scotland 2017a,b,c). Additionally, the Appropriate Assessment for the original consents of the Forth and Tay projects predicted a reduction in adult survival rate of less than 0.1% as a result of the Neart na Gaoithe wind farm and concluded no adverse effect on the SPA population (Marine Scotland 2014).

1113. Cumulative collisions of lesser black-backed gulls for UK North Sea wind farms during the non-breeding periods have been estimated recently as approximately 365, of which nine are attributed to the Forth and Tay wind farms (MacArthur Green and Royal HaskoningDHV 2021). During the non-breeding periods, adult lesser black-backed gulls from the Forth Islands SPA are estimated to comprise approximately 1.5% of the autumn and spring passage populations in the North Sea and Channel BDMPS (each of which number approximately 200,000 birds) and approximately 4% of the smaller winter population in this BDMPS (which numbers approximately 39,000 birds) (Furness 2015). Given this, it is unlikely that more than 2% of the total collisions during the non-breeding periods (i.e. approximately 0.18 and 7 birds for the Forth and Tay in-combination scenario and UK North Sea in-combination scenario, respectively) would be adults from the Forth Islands SPA population. Immatures associated with the Forth Islands SPA population are estimated to represent approximately 0.8% of the passage populations and 0.3% of the winter population (Furness 2015), suggesting that approximately three of the total 365 non-breeding season collisions may be attributable to immatures from this SPA population.

1114. For the Proposed Development in-combination with the other Forth and Tay wind farms, the non-breeding season collisions would not add to the effects associated with the Proposed Development in any meaningful way. For the Proposed Development in-combination with the other UK North Sea wind farms, the addition of the non-breeding season collisions would give a total annual mortality of approximately nine adults and three immatures for the Developer Approach and 10 adults and three immatures for the Scoping Approach.

1115. The PVA undertaken for the Forth Islands SPA lesser black-backed gull population using incremental mortalities gives a CPS value of 0.901 and a CPGR value of 0.987 for a mortality of 10 adult birds per year (see Table 3.153 in volume 3, appendix 11.6 of the Offshore EIA Report). This suggests a reduction in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, of approximately 10% as determined by the Scoping Approach (whilst the predicted impact would be slightly lower as determined by the Developer Approach – e.g. for an annual mortality of eight adult birds the reduction in population size after 35 years is 8%). The centile values associated with this level of mortality are 32.4 – 35.6, which suggest a reasonable likelihood that the impacted population will be similar in size to the un-impacted population after 35 years (see Table 3.153 in volume 3, appendix 11.6 of the Offshore EIA Report).

1116. However, the PVA for the incremental mortalities assumes that mortality across age classes occurs in proportion to the asymptotic age distribution (as calculated by the population model). Given that adults are estimated to comprise just 45% of the population, this means that the PVA grossly overestimates the level of immature mortality (relative to that estimated from the in-combination collision effects), meaning that the above metrics represent an overestimation of the population-level impacts.

In-combination: conclusion

1117. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms would not produce an adverse effect on the Forth Islands SPA lesser black-backed gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the common tern population

1118. The Forth Islands SPA common tern population is largely restricted to the Isle of May, with few pairs occurring elsewhere in SPA and with the most recent count data available on the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org)) giving an estimate of 30 Apparently Occupied Nests (AON) for 2017 - 2019. This represents a marked decline from the citation population size of 334 breeding pairs, which was determined for the period from 1997 – 2001. The SPA population is considered to be in 'unfavourable declining' condition.

The potential for impacts on the common tern population

1119. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its common tern population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features.

1120. Based on the estimated foraging range, it is unlikely that common terns from the Forth Islands SPA will occur within the Proposed Development array to any extent during the breeding period. This is because the Proposed Development array is 41 km from the Isle of May (where almost all of the SPA common terns nest) at its closest point, which is considerably beyond the mean maximum breeding season foraging range plus 1 SD for the species (i.e. 26.9 km – Woodward *et al.* 2019). Thus, there is little, or no, potential for connectivity with the Proposed Development array (HRA Stage One Screening Report). The Proposed Development export cable corridor is 21.4 km from the Isle of May at its closest point, so this will transit waters on the periphery of the potential breeding season foraging range. The breeding period for common tern is defined as May to mid-September, following the NatureScot (2020) guidance.

1121. During the non-breeding season, the SPA common tern population contributes to the wider BDMPS spring and autumn passage populations in the UK North Sea and Channel waters (Furness 2015), so there is potential for birds from this SPA population to pass through offshore wind farms in the North Sea at these times (including the Proposed Development).

Project alone: construction and decommissioning

Disturbance

1122. Direct disturbance to common terns during the construction phase may arise as a result of increased vessel movements and helicopter activity, as well as from other activities associated with the installation of infrastructure associated with the Proposed Development. However, in large part, this will be limited to the increased vessel activity along the Proposed Development export cable corridor associated with the cable laying activities. This is because the Proposed Development array is beyond the likely foraging range of the SPA common terns during the breeding season. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1123. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1124. When using the marine environment (and not at the breeding colony), common terns are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign common tern as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1125. The area of the potential breeding season foraging range (as defined by the mean maximum value plus 1SD) that would be affected by such disturbance is small because (as described above) the Proposed Development export cable corridor will only overlap with a small area near the limits of this range. Furthermore, it is likely that most of the 'at-sea' activity from the SPA common terns will occur within the mean maximum foraging range, which at 18.0 km (Woodward *et al.* 2019) does not encompass the Proposed Development export cable corridor (as measured from the Isle of May).

1126. During the non-breeding passage periods, common tern distribution is not constrained by the location of the breeding colonies and birds from the SPA population are unlikely to make extensive, or protracted, use of the waters encompassed by the Proposed Development given that they migrate from, or to, their breeding areas during these periods. The breeding adult birds from the Forth Islands SPA population comprise only 0.7% of the passage period BDMPS for the UK North Sea and Channel waters (Furness 2015).

1127. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1128. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1129. Given the relatively low sensitivity of common tern to disturbance effects, the small area of their foraging range that is likely to be affected by activities with the potential to cause disturbance, the low levels of potential disturbance associated with the construction of the Proposed Development export cable corridor, and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA common tern population.

Displacement

1130. As detailed above, common tern is considered to have a relatively low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Forth Islands SPA population and be limited to the activities associated with the Proposed Development export cable corridor. Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of common terns from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1131. Given the above, it is considered that there is little potential for the Forth Islands SPA common tern population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across small areas and being temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA common tern population.

Changes to prey availability

1132. Key prey species for common terns include small forage fish such as sandeel (del Hoyo *et al*., 1996). Indirect effects on common terns may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA common tern population in the short-term.

1133. During construction there are a number of ways in which effects on common tern prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 9 of the Offshore EIA Report. However, as described above, it is unlikely that common terns from the Forth Islands SPA will occur within the Proposed Development array area to any extent during the breeding period given their foraging range (as defined by the mean maximum value plus 1 SD). Furthermore, it is likely that most of the 'at-sea' activity from the SPA common terns will occur within the mean maximum foraging range, which does not encompass the Proposed Development export cable corridor (as measured from the Isle of May; see above). Thus, there is no potential for connectivity with the Proposed Development array area during the breeding season, and very little with the Proposed Development export cable corridor. Effects during the non-breeding passage periods are considered to be further reduced given that breeding adults from the Forth Islands SPA comprise only 0.7% of the passage period BDMPS for the UK North Sea and Channel waters (Furness 2015).

1134. Given the limited potential for connectivity between the Proposed Development and the breeding common tern population of the Forth Islands SPA, together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA common tern population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on common terns during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

1135. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of foraging common terns (see section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population and Table 4.1).

1136. However, given the limited potential for connectivity between the Proposed Development and the breeding common tern population of the Forth Islands SPA (see section *The Potential for Impacts on the Common Tern Population*), the low sensitivity of common terns to disturbance effects at sea (Garthe and Hüppop 2004; Furness *et al*., 2013), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA common tern population. This conclusion is consistent with the outcome of the EIA which 'screened' out common tern as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

1137. Given that the Proposed Development array is beyond the likely breeding season foraging range of the Forth Islands SPA common tern population, it is considered that there is little, or no, potential for effects of displacement or barrier effects to result. As such, it is considered that there is no potential for an adverse effect on this SPA population as a result of displacement/barrier effects.

Collision risk

1138. Given that the Proposed Development array is beyond the likely breeding season foraging range of the Forth Islands SPA common tern population, it is considered that there is little, or no, potential for effects of collision mortality to result.

1139. Collision estimates for common terns during the non-breeding period totalled just 0.50 birds (as determined by the Scoping Approach - Offshore EIA Report, volume 3, appendix 11.3), whilst the adult birds from the SPA population represent only 0.7% of the UK North Sea and Channel waters BDMPS (Furness 2015).

1140. As such, it is considered that there is no potential for an adverse effect on this SPA population as a result of collision mortality.

Changes to prey availability

1141. Potential impacts on key prey species for common terns breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition (which may also affect the ability of common terns to detect prey at the sea surface), EMF from subsea electrical cabling could affect common tern survival and productivity in the Forth Islands SPA population.

1142. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1143. Given the limited potential for connectivity between the Proposed Development and the breeding common tern population of the Forth Islands SPA (see above), together with any effects being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA common tern population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on common terns during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: conclusion

1144. Based upon the above, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on the Forth Islands SPA common tern population.

Effects in-combination

1145. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA common tern population during construction and decommissioning and during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for effects from the Proposed Development to add to impacts at the population-level from the effects due to other plans and projects and, therefore, no potential for the Proposed Development to contribute to the in-combination effects associated with other plans and projects.

Assessment for the arctic tern population

1146. The Forth Islands SPA Arctic tern population occurs on the Isle of May, with the most recent count data available on the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org)) giving an estimate of 832 (AON) in 2017. This is higher than the citation population size of 540 breeding pairs but represents a decline from previous counts (e.g. 908 AON were estimated in 2000). The SPA population is considered to be in 'favourable declining' condition.

The potential for impacts on the arctic tern population

1147. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its Arctic tern population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1148. Based on the estimated foraging range, it is unlikely that Arctic terns from the Forth Islands SPA will occur within the Proposed Development array to any extent during the breeding period, although they are likely to occur in waters through which the Proposed Development export cable corridor transits. This is because the Proposed Development array is 41 km from the Isle of May (where the Arctic tern colony is located) at its closest point, which is just beyond the mean maximum breeding season foraging range plus 1 SD for Arctic tern (i.e. 40.5 km – Woodward *et al.* 2019). This would suggest that there is little, or no, potential for the connectivity with the Proposed Development array. The Proposed Development export cable corridor is 21.4 km from the Isle of May at its closest point. The breeding period for Arctic tern is defined as May to August, following the NatureScot (2020) guidance.

1149. During the non-breeding season, the SPA Arctic tern population contributes to the wider BDMPS spring and autumn passage populations in the UK North Sea and Channel waters (Furness 2015), so there is potential for birds from this SPA population to pass through offshore wind farms in the North Sea at these times (including the Proposed Development).

Project alone: construction and decommissioning

Disturbance

1150. Direct disturbance to Arctic terns during the construction phase may arise as a result of increased vessel movements and helicopter activity, as well as from other activities associated with the installation of infrastructure associated with the Proposed Development. However, in large part, this will be limited to the increased vessel activity along the Proposed Development export cable corridor associated with the cable laying activities. This is because the Proposed Development array is beyond the likely foraging range of the SPA Arctic terns during the breeding season. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1151. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1152. When using the marine environment (and not at the breeding colony), Arctic terns are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign Arctic tern as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1153. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to Arctic terns from the Forth Islands SPA. Given that the Proposed Development array is beyond the likely breeding season foraging range of the SPA population, it is only the Proposed Development export cable corridor which is relevant in this regard. The total area encompassed by the Proposed Development offshore export cable is 168 km^2. This represents 6.5% of the total breeding season foraging area that is potentially available to the SPA Arctic tern population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 25.7±14.8 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the (main) seaward side of the colony. If the breeding season foraging range is defined as above but based on the mean maximum value instead, the Proposed Development export cable corridor only encroaches on the edge of this range (because it is 21.4 km from the Isle of May at its closest point).

1154. During the non-breeding passage periods, Arctic tern distribution is not constrained by the location of the breeding colonies and birds from the SPA population are unlikely to make extensive, or protracted, use of the waters encompassed by the Proposed Development given that they migrate from, or to, their breeding areas during these periods. The breeding adult birds from the Forth Islands SPA population comprise only 1% of the passage period BDMPS for the UK North Sea and Channel waters (Furness 2015).

1155. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1156. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1157. Given the relatively low sensitivity of Arctic tern to disturbance effects, the low levels of potential disturbance associated with the construction of the Proposed Development export cable corridor and the small areas subject to such activities at any given time during the construction period, and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA Arctic tern population.

Displacement

1158. As detailed above, Arctic tern is considered to have a relatively low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Forth Islands SPA population and be limited to the activities associated with the Proposed Development export cable corridor. Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of Arctic terns from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1159. Given the above, it is considered that there is little potential for the Forth Islands SPA Arctic tern population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and being temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA Arctic tern population.

Changes to prey availability

1160. Key prey species for Arctic terns include small forage fish such as sandeel (del Hoyo *et al*., 1996). Indirect effects on Arctic terns may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA Arctic tern population in the short-term.

1161. During construction there are a number of ways in which effects on Arctic tern prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 9 of the Offshore EIA Report. However, as described above, the Proposed Development array is beyond the likely breeding season foraging range of the SPA population. Therefore, it is only the Proposed Development export cable corridor which are relevant in relation to potential changes in prey availability. As described above, the Proposed Development export cable corridor represents 6.5% of the total foraging area (25.7±14.8 km - Woodward *et al*., 2019), assuming that this range is represented by a semicircle to the (main) seaward side of the colony, although it is likely that most of the 'at-sea' foraging activity will occur within the smaller mean maximum foraging range (25.7 km - Woodward *et al*., 2019) which reaches the very edges of the Proposed Development export cable corridor . Effects during the non-breeding passage periods are considered to be further reduced given that breeding adults from the Forth Islands SPA comprise only 1% of the passage period BDMPS for the UK North Sea and Channel waters (Furness 2015).

1162. Given the relatively small degree of overlap between the Proposed Development and the potential foraging range of breeding Arctic terns from the Forth Islands SPA, together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA Arctic tern population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on Arctic terns during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

1163. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of foraging Arctic terns (see section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population and Table 4.1).

1164. However, given the relatively small degree of overlap between the Proposed Development and the potential foraging range of breeding Arctic terns from the Forth Islands SPA (see section on *The Potential for Impacts on the Arctic Tern Population*), the low sensitivity of Arctic terns to disturbance effects at sea (Garthe and Hüppop 2004; Furness *et al*., 2013), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA Arctic tern population. This conclusion is consistent with the outcome of the EIA which 'screened' out Arctic tern as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

1165. Given that the Proposed Development array is beyond the likely breeding season foraging range of the Forth Islands SPA Arctic tern population, it is considered that there is little, or no, potential for effects of displacement or barrier effects to result. As such, it is considered that there is no potential for an adverse effect on this SPA population as a result of displacement/barrier effects.

Collision Risk

1166. Given that the Proposed Development array is beyond the likely breeding season foraging range of the Forth Islands SPA Arctic tern population, it is considered that there is little, or no, potential for effects of collision mortality to result.

1167. Collision estimates for Arctic terns during the non-breeding period totalled just 0.13 birds (as determined by the Scoping Approach - Offshore EIA Report, volume 3, appendix 11.3), whilst the adult birds from the SPA population represent only 1% of the UK North Sea and Channel waters BDMPS (Furness 2015).

1168. As such, it is considered that there is no potential for an adverse effect on this SPA population as a result of collision mortality.

Changes to prey availability

1169. Potential impacts on key prey species for Arctic terns breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition (which may also affect the ability of Arctic terns to detect prey at the sea surface), EMF from subsea electrical cabling could affect Arctic tern survival and productivity in the Forth Islands SPA population.

1170. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1171. Given the relatively small degree of overlap between the Proposed Development and the potential foraging range of breeding Arctic terns from the Forth Islands SPA (see above), together with any effects being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA Arctic tern population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on Arctic terns during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: conclusion

1172. Based upon the above, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on the Forth Islands SPA Arctic tern population.

Effects in-combination

1173. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA Arctic tern population during construction and decommissioning and during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for effects from the Proposed Development to add to impacts at the population-level from the effects due to other plans and projects and, therefore, no potential for the Proposed Development to contribute to the in-combination effects associated with other plans and projects.

Assessment for the guillemot population

1174. The Forth Islands SPA guillemot population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony represents approximately 68% of the SPA total. The guillemot population size in the SPA declined during the early to late 2000's, but has shown limited signs of recovery in more recent years and remains close to the citation population size of 32,000 breeding adult birds (Figure 5.21).

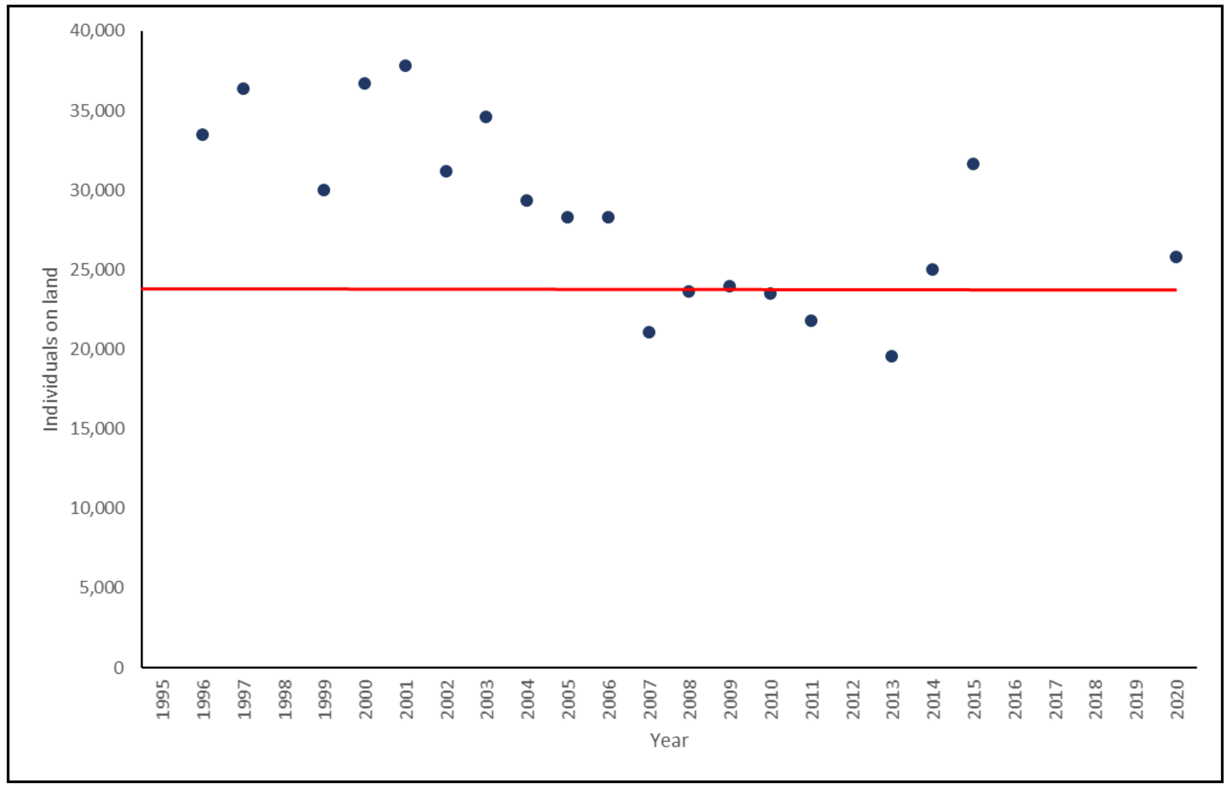

Figure 5.21: Guillemot Population Trend at the Forth Islands SPA Between 1996 and 2020 (Noting that the Latest SPA Count is shown for 2020 because it Spans the Period 2018 – 2021). The Red Line Shows the Citation Population Size for the SPA (32,000 Individuals)[13]. Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the guillemot population

1175. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1176. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017, Bogdanova *et al.* 2022), it is highly likely that during the breeding period guillemots from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 11% of the guillemot occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemots is defined as April to mid-August, following the NatureScot (2020) guidance.

1177. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, Offshore EIA Report, volume 3, appendix 11.5). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the Forth Islands SPA guillemot population during the non-breeding period as during the breeding season, with 16% of the guillemots occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

1178. Direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1179. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - volume 2, chapter 13 of the Offshore EIA Report).

1180. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1181. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the Forth Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km², whilst the Proposed Development export cable corridor encompasses 168 km². Together these areas represent approximately

3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only.

1182. Tracking data (and associated modelling of foraging distributions) for guillemot suggest that the Proposed Development array area and Proposed Development export cable corridor have little overlap with waters that are heavily used by birds from the Forth Islands SPA during the breeding season (Cleasby *et al.* 2018, Bogdanova *et al.* 2022). For example, based on the data from 23 birds tracked from this SPA population during the 2021 breeding season, there is no overlap between the wider foraging and 'resting at sea' areas used by these birds (as defined by the respective 90% utilisation distributions) and either the Proposed Development array area or the Proposed Development export cable corridor, whilst none of the 278 individual flight tracks that were recorded from these birds passed through the Proposed Development array area (Bogdanova *et al.* 2022). Evidence from other tracking data collected during earlier studies also indicates minimal overlap between the areas of sea that are used by this SPA population and the Proposed Development (Cleasby *et al.* 2018).

1183. During the non-breeding period guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD). Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

1184. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1185. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1186. Given the moderate sensitivity of guillemot to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA guillemot population.

Displacement

1187. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Forth Islands SPA guillemot population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1188. Based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA guillemot population.

Changes to prey availability

1189. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA guillemot population in the short-term.

1190. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Forth Islands SPA guillemot population are as for the St Abb's Head to Fast Castle SPA guillemot population (and are detailed above in the equivalent section for that SPA population).

1191. Given this, it is considered that there is relatively little potential for the Forth Islands SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA guillemot population.

Project alone: Operation and Maintenance

Disturbance

1192. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from Forth Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1193. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1194. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 13 of the Offshore EIA Report, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1195. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1196. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA guillemot population.

Displacement/barrier effects

1197. As outlined above, displacement effects on the Forth Islands SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1198. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1199. As with other species for which displacement effects are assessed (see above), the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1200. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1201. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Forth Islands SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.65). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Forth Islands SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.65: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Forth Islands SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.515	0.109	0.109	0.07
Non-breeding	44,171	0.515	0.158	0.158	N/A

1202. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as 91 adult and 91 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 181 adult and 178 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.66). The breeding season effects make the greatest contribution to these potential mortalities (comprising 77% and 65% of the total annual mortality for the lower and upper ranges, respectively) due to the larger mean peak population size and higher assumed mortality rates during this period (although the proportion of birds assumed to derive from the SPA population is greater during the non-breeding period) (Table 5.66).

1203. The annual mortality from displacement as determined using the Developer Approach is predicted to be 37 adult and 36 immature birds, equating to approximately 52% and 31% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.66). In contrast to the Scoping Approach, the levels of predicted mortality are broadly similar for the breeding and non-breeding periods, with the difference between the Developer and Scoping Approaches in this respect being due to the fact that the Developer Approach assumes the same mortality rates in each seasonal period.

Table 5.66: Estimated Potential Annual Mortality of Forth Islands SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	69.9	70.8
	Non-breeding	60%	1%	21.4	20.1
	Annual total	-	-	91.3	90.9
Scoping B	Breeding	60%	5%	116.6	118.0
	Non-breeding	60%	3%	64.0	60.2
	Annual total	-	-	180.6	178.2
Developer	Breeding	50%	1%	19.4	19.7
	Non-breeding	50%	1%	17.8	16.7
	Annual total	-	-	37.2	36.4

1204. The additional annual mortality of adult guillemot from the Forth Islands SPA population predicted due to displacement from the Proposed Development array represents 0.11% of the current adult breeding population at this colony (i.e. 34,580 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.26 – 0.52% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report,), the estimates of adult mortality equate to an increase of 1.5% for the Developer Approach and of 3.6 – 7.2% for the lower and upper estimates from the Scoping Approach.

1205. The potential levels of impact on the Forth Islands SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

1206. Potential impacts on key prey species for guillemots breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the Forth Islands SPA population.

1207. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Forth Islands SPA guillemot population as to the St Abb's Head to Fast Castle SPA guillemot population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1208. Given this, it is considered that there is relatively little potential for the Forth Islands SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA guillemot population.

Project alone: population-level impacts

1209. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1210. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.66 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 – 2021 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1211. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.67: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	94669 (56296 – 155126)	*1.000*	1.000	*50.0*
Scoping A	91.58	91.20	84774	0.895	0.997	33.8

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
			(50333 – 139040)			
Scoping B	180.51	178.26	76174 (45167 – 125045)	0.804	0.994	20.6
Developer	37.42	36.62	90522 (53799 – 148393)	0.956	0.999	43.3

1212. The PVA predicted that the Forth Islands SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost three times larger than the current estimate of 34,580 adult birds under baseline conditions (i.e. no wind farm effects) and approximately twice its current size under the scenario of greatest annual mortality (i.e. Scoping Approach B) (Table 5.67). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted trend does not reflect the documented long-term for this SPA population (Figure 5.21)

1213. The PVA metrics suggest relatively marked differences in the predicted population-level impacts according to the Developer and Scoping Approaches. Thus, for the Developer Approach, the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 4% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.67). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 43.3 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

1214. For the Scoping Approach, the CPS values indicate a reduction of 11 – 20% in population size after 35 years, relative to that in the absence of any wind farm effects (Table 5.67). The reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.3 – 0.6%. The centile metric indicates low to moderate overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

1215. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA guillemot population, the assessment of the Forth Islands SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by guillemot are equally relevant to the Forth Islands SPA population as to the St Abb's Head to Fast Castle SPA population. As for the St Abb's Head to Fast Castle SPA population, the evidence available from tracking data suggests low levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by guillemots from the Forth Islands SPA, as outlined above (Cleasby *et al.* 2018, Bogdanova *et al.* 2022).

<u>Project alone: conclusion</u>

1216. Based on the Developer Approach, the potential effects from the Proposed Development alone on the Forth Islands SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a reasonably high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Although the SPA population has shown an overall decline in size since the early 2000's there are suggestions from the recent count data of a reversal in this trend, and the population remains above the citation level and is considered to be in 'favourable maintained' condition. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

1217. The Scoping Approach predicts greater effects from the Proposed Development alone, with the potential resultant population-level impacts being relatively large when considering the upper range of the effects. These potential impacts are of a scale which would be considered likely to result in an adverse effect on the SPA population. However, as has been detailed above (and in Offshore EIA Report, volume 3, appendix 11.4), it is considered that the level of effects on guillemots assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. The potential for gross overestimation of the population-level impacts is further exacerbated by other precautionary elements of the assessment, which have been incorporated irrespective of the Developer or Scoping Approaches. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach, which concluded no adverse effect on the Forth Islands SPA guillemot population as a result of the Proposed Development alone.

<u>Effects in-combination</u>

<u>*Effects of relevance to the in-combination assessment*</u>

1218. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1219. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and

Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1220. As described in annex E of Offshore EIA Report, volume 3, appendix 11.6, estimates of displacement mortality during both the breeding and non-breeding periods which had been attributed to the Forth Islands SPA guillemot population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1221. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. However, the potential effects on the SPA population were limited to the other Forth and Tay wind farms, noting that apportioning of the non-breeding season effects for guillemot did not rely on the BDMPS approach (as stated above, see also volume 3, appendix 11.5 of the Offshore EIA Report). Given that these two different in-combination scenarios are equivalent, the predicted effects are reported solely for the UK North Sea wind farms in the tables below (Table 5.68).

Table 5.68: Estimated Annual Mortality of Forth Islands SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea[1]	Scoping A	151.9	156.4	48.8	44.0	200.7	200.4
	Scoping B	253.2	260.6	146.2	131.8	399.3	392.4
	Developer	42.2	43.4	40.6	36.6	82.8	80.0

[1]The Forth and Tay and UK North Sea in-combination effects for the SPA population are equivalent (so that they are reported for the latter scenario only).

1222. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to an approximate doubling in the predicted displacement mortality of adult birds compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.66 and 5.68). As for the Proposed Development alone, the breeding season effects make the greatest contribution to the potential mortality as determined by the Scoping Approach (comprising 77% and 65% of the total annual mortality for the lower and upper ranges, respectively), whilst for the Developer Approach the levels of predicted mortality are similar for each seasonal period.

1223. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult guillemots from the Forth Islands SPA population predicted due to displacement represents between 0.24% of the current adult breeding population at this colony (i.e. 34,580 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between 0.58 – 1.15% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report,), the estimates of adult displacement mortality equate to an increase of 3.3% for the Developer Approach and of 8.0 – 15.8% for the lower and upper estimates from the Scoping Approach.

1224. The potential levels of impact on the Forth Islands SPA guillemot population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

1225. PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms, as determined by both the Scoping and Developer Approaches (Table 5.68). The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.69: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	94669 (56296 – 155126)	*1.000*	1.000	*50.0*
Scoping A	200.88	200.60	74243 (44006 – 121879)	0.784	0.993	18.0
Scoping B	398.91	392.06	58559 (34573 – 96177)	0.618	0.987	3.7
Developer	82.82	80.12	85776 (50937 – 140669)	0.906	0.997	35.6

1226. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.67 with Table 5.69).

1227. For the Developer Approach, the CPS value indicates that the SPA population size would be reduced by approximately 9% after 35 years, relative to that in the absence of any wind farm effects (Table 5.69). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small, whilst the centile value of 35.6 indicates moderate overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

1228. The metrics associated with the Scoping Approach indicate markedly greater levels of impact, with sizeable reductions (i.e. 22 – 38%) in the predicted population size after 35 years relative to that predicted to occur in the absence of wind farm effects, and with the values of the centile metric indicating a high likelihood of the impacted population size being smaller than the un-impacted population size after 35 years (Table 5.69).

1229. As explained above, the assessment for the Proposed Development in-combination with the other Forth and Tay wind farms is equivalent to that for the Proposed Development in-combination with the other UK North Sea wind farms in the case of this SPA population.

In-combination: conclusion

1230. On the basis of the Developer Approach, the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms on the Forth Islands SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a reasonable likelihood of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Considering this within the context of the 'favourable maintained' condition of the SPA population, it is concluded that the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Forth Islands SPA guillemot population.

1231. For the Scoping Approach, the potential effects resulting from the Proposed Development in-combination with the other UK North Sea wind farms are markedly greater than as predicted by the Developer Approach. It is considered that the predicted levels of impact encompassed by the Scoping Approach would have the potential to result in an adverse effect on the Forth Islands SPA guillemot population. As for the Proposed Development alone, this conclusion should be considered within the context of the high levels of precaution incorporated in the assessment, particularly as determined by the Scoping Approach. As such, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the razorbill population

1232. The Forth Islands SPA razorbill population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony represents approximately 90% of the total SPA population. The razorbill population size in the SPA has increased since 1985, and despite a period of decline in the mid 2000's there has been sustained increases since 2013, with the population size being considerably higher than the citation level (Figure 5.22).

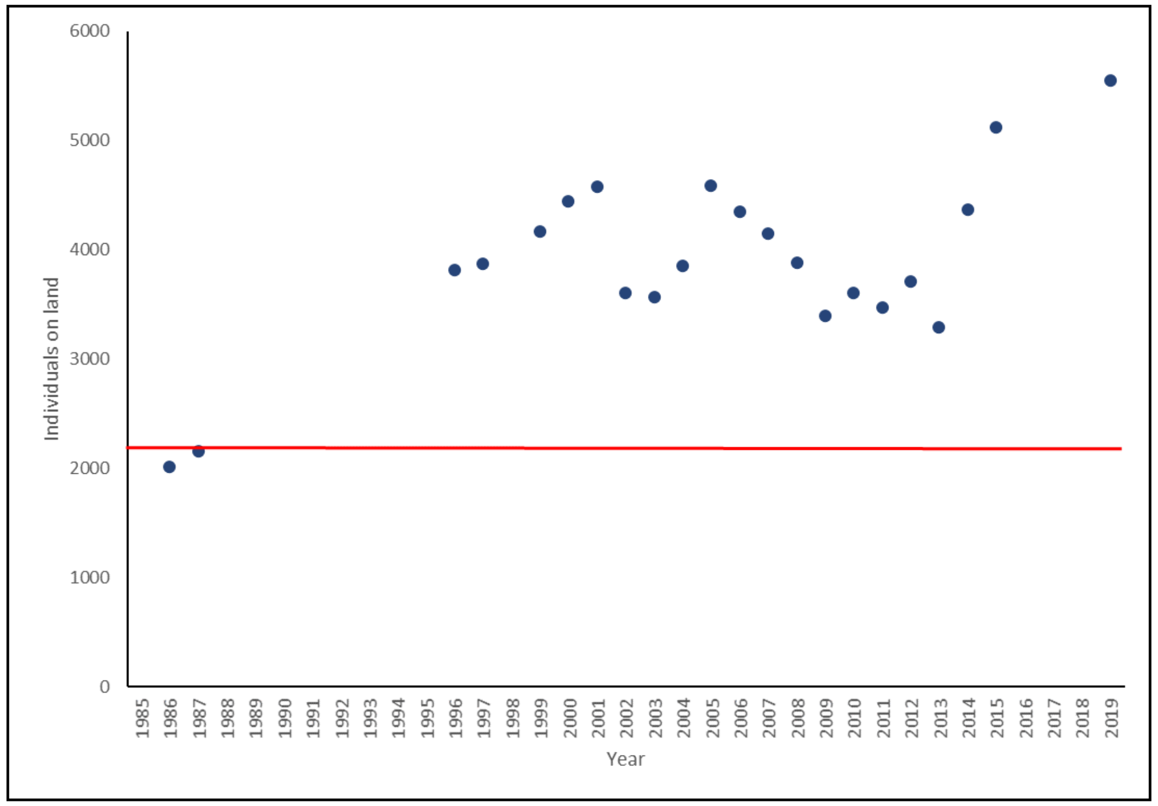

Figure 5.22: Razorbill Population Trend at the Forth Islands SPA Between 1986 and 2019 (Noting that the Latest SPA Count is Shown for 2019 because it Spans the Period 2017 – 2021). The Red Line Shows the Citation Population Size for the SPA (2,800 Individuals)[13]. Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the razorbill population

1233. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1234. From published information on razorbill foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017, Bogdanova *et al.* 2022), it is highly likely that during the breeding period razorbill from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 27% of the razorbill occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

1235. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the Forth Islands SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the Forth Islands SPA razorbill population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1236. Direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1237. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1238. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1239. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to razorbills from the Forth Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 10% of the breeding season foraging area if considering the mean maximum foraging range only.

1240. Tracking data (and associated modelling of foraging distributions) for razorbill suggest that the Proposed Development array area and Proposed Development export cable corridor have little overlap with waters that are heavily used by birds from the Forth Islands SPA during the breeding season (Cleasby *et al.* 2018, Bogdanova *et al.* 2022). For example, based on the data from 11 birds tracked from this SPA population during the 2021 breeding season, the Proposed Development array area does not overlap with the core foraging or 'resting at sea' areas of the tracked birds (as defined by the respective 50% utilisation distribution), whilst overlaps with the wider foraging and 'resting at sea' areas (as defined by the respective 90% utilisation distributions of these tracked birds) represent 2% or less of these areas (Bogdanova *et al.* 2022). None of the 272 individual flight tracks that were recorded from these 11 tracked birds passed through the Proposed Development array area. Evidence from other tracking data collected during earlier studies also indicates minimal overlap between the areas of sea that are used by this SPA population and the Proposed Development (Cleasby *et al.* 2018).

1241. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

1242. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1243. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1244. Given the moderate sensitivity of razorbill to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA razorbill population.

Displacement

1245. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Forth Islands SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1246. Based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA razorbill population.

Changes to prey availability

1247. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA razorbill population in the short-term.

1248. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Forth Islands SPA razorbill population are as for the St Abb's Head to Fast Castle SPA razorbill population (and are detailed above in the equivalent section for that SPA population).

1249. Given this, it is considered that there is relatively little potential for the Forth Islands SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA razorbill population.

Project alone: operation and maintenance

Disturbance

1250. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from Forth Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1251. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1252. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1253. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1254. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA razorbill population.

Displacement/barrier effects

1255. As outlined above, displacement effects on the Forth Islands SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1256. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1257. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1258. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1259. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Forth Islands SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.70). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Forth Islands SPA razorbill PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.70: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to belong to the Breeding Adult Age Class and to be from the Forth Islands SPA Population in Each Period. The proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,040	0.539	0.265	0.265	0.07
Autumn migration	8,849	N/A	0.009	0.006	N/A
Winter	1,399	N/A	0.007	0.002	N/A
Spring Migration	7,480	N/A	0.009	0.006	N/A

1260. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 11 adult and 10 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 19 adult and 17 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.71). The breeding season effects make the greatest contribution to these potential mortalities (comprising 92% and 87% of the total annual mortality for the lower and upper mortality rates, respectively) due to the higher assumed mortality rates and higher proportion of birds assumed to derive from the SPA population during this period (Table 5.71).

1261. The annual mortality from displacement as determined using the Developer Approach is predicted to be 4 adult and 3 immature birds, equating to approximately 33% and 18% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.71). As for the Scoping Approach, effects during the breeding season make the greatest contribution (82%) to the predicted annual mortality, with this being slightly less marked because the mortality rates for each seasonal period are assumed to be same under the Developer Approach.

Table 5.71: Estimated Potential Annual Mortality of Forth Islands SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	9.7	8.9
	Autumn migration	60%	1%	0.5	0.3
	Winter	60%	1%	0.1	0.0
	Spring migration	60%	1%	0.4	0.3
	Annual total	-	-	10.7	9.5
Scoping B	Breeding	60%	5%	16.2	14.9
	Autumn migration	60%	3%	1.4	1.0
	Winter	60%	3%	0.2	0.1
	Spring migration	60%	3%	1.2	0.8
	Annual total	-	-	19.0	16.8
Developer	Breeding	50%	1%	2.8	2.6
	Autumn migration	50%	1%	0.4	0.3
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	0.3	0.2
	Annual total	-	-	3.5	3.1

1262. The additional annual mortality of adult razorbill from the Forth Islands SPA population predicted due to displacement from the Proposed Development array represents 0.04% of the current adult breeding population at this colony (i.e. 7,878 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.14 – 0.24% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.5% for the Developer Approach and of 1.5 – 2.7% for the lower and upper estimates from the Scoping Approach.

1263. The potential levels of impact on the Forth Islands SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

1264. Potential impacts on key prey species for razorbills breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the Forth Islands SPA population.

1265. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Forth Islands SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1266. Given this, it is considered that there is relatively little potential for the Forth Islands SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA razorbill population.

Project alone: population-level impacts

1267. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1268. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.71 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2017 – 2021 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1269. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.*, 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.72: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	28645 *(14780 – 51528)*	*1.000*	1.000	*50.0*
Scoping A	10.62	9.51	27087 (13972 – 48794)	0.946	0.998	43.4
Scoping B	18.98	17.31	25906 (13356 – 46708)	0.905	0.997	38.2
Developer	3.56	3.06	28122 (14508 – 50610)	0.982	0.999	48.0

1270. The PVA predicted that the Forth Islands SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost four and three times larger than the current estimate of 7,878 adult birds under baseline conditions (i.e. no wind farm effects) and under the scenario of greatest annual mortality (i.e. Scoping Approach B), respectively (Table 5.72). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). Whilst the predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), the prediction for an increasing trend is broadly consistent with the documented, overall, long-term trend for this SPA population (Figure 5.22).

1271. The PVA metrics suggest relatively small effects overall. Thus, the CPS value for the Developer Approach indicates that the displacement effects from the Proposed Development alone would result in a reduction of less than 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 5 – 10% after 35 years, relative to that in the absence of any wind farm effects (Table 5.72). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1% for the Developer Approach and 0.2 – 0.3% for the Scoping Approach. The centile values indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.72).

1272. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the Forth Islands SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are equally relevant to the Forth Islands SPA population as to the St Abb's Head to Fast Castle SPA population. As for the St Abb's Head to Fast Castle SPA population, the evidence available from tracking data suggests low levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by razorbills from the Forth Islands SPA, as outlined above (Cleasby *et al.* 2018, Bogdanova *et al.* 2022).

Project alone: conclusion

1273. It is considered that the predicted levels of impact from the Proposed Development alone on the Forth Islands SPA razorbill population are of a relatively small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach) and a population for which the documented, long-term, trend is increasing, and which is considered to be in 'favourable maintained' condition. Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1274. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1275. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1276. As described in annex E of the Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Forth Islands SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1277. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see annex E of the Offshore EIA Report, volume 3, appendix 11.6 for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the Forth Islands SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.70). This was done separately for all of the other UK North Sea wind farms and for the subset represented by the other Forth and Tay wind farms.

Table 5.73: Estimated Annual Mortality of Forth Islands SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period: Breeding Adults	Breeding Immatures	Autumn Migration Adults	Autumn Migration Immatures	Winter Adults	Winter Immatures	Spring Migration Adults	Spring Migration Immatures	Annual Total Adults	Annual Total Immatures
Forth and Tay	Scoping A	43.0	38.9	0.9	0.6	0.3	0.0	0.4	0.3	44.6	39.8
	Scoping B	71.7	64.9	2.7	1.9	0.7	0.2	1.2	0.8	76.3	67.8
	Developer	12.1	10.9	0.8	0.6	0.1	0.0	0.3	0.2	13.3	11.7
UK North Sea	Scoping A	43.0	38.9	2.9	1.9	1.2	0.3	2.2	1.5	49.4	42.6
	Scoping B	71.7	64.9	8.6	5.9	3.6	1.0	6.7	4.5	90.6	76.2
	Developer	12.0	10.9	2.4	1.6	0.9	0.2	1.9	1.2	17.2	14.1

1278. The potential mortality resulting from the predicted displacement effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms represents an approximate fourfold increase in that predicted for the Proposed Development alone (for both Developer and Scoping Approaches), whilst for the Proposed Development in-combination with the other UK North Sea wind farms there is an almost fivefold increase in the predicted mortality compared to that for the Proposed Development alone (Tables 5.71 and 5.73). For all scenarios the predicted mortality is concentrated in the breeding season. Thus, for the Proposed Development in-combination with the other Forth and Tay wind farms, 91 – 96% of the predicted mortality is attributed to the breeding season, whilst for the Proposed Development in-combination with the other UK North Sea wind farms 70 – 87% of the predicted mortality is attributed to the breeding season (with the percentages being higher for the Scoping Approach than the Developer Approach).

1279. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult razorbills from the Forth Islands SPA population predicted due to displacement represents 0.16% of the current adult breeding population at this colony (i.e. 7,878 individuals – Table 3.3 in volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.57 – 0.97% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 1.9% for the Developer Approach and of 6.3 – 10.8% for the lower and upper estimates from the Scoping Approach.

1280. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult razorbills from the Forth Islands SPA population predicted due to displacement represents 0.22% of the current adult breeding population at this colony as determined by the Developer Approach, and between approximately 0.63 – 1.15% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 2.4% for the Developer Approach and of 7.0 – 12.8% for the lower and upper estimates from the Scoping Approach.

1281. The potential levels of impact on the Forth Islands SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1282. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.73 above).

1283. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.74: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other Forth and Tay Wind Farms

Approach	Additional Annual Mortality – Adults	Additional Annual Mortality – Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Baseline	*0*	*0*	28645 *(14780 – 51528)*	*1.000*	1.000	*50.0*
Scoping A	44.82	40.11	22638 (11654 – 40915)	0.790	0.993	23.6
Scoping B	77.28	69.01	19080 (9795 – 34602)	0.666	0.989	11.0
Developer	13.56	11.86	26690 (13766 – 48091)	0.932	0.998	41.7

Table 5.75: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development in-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality – Adults	Additional Annual Mortality – Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Baseline	*0*	*0*	28645 *(14780 – 51528)*	*1.000*	1.000	*50.0*
Scoping A	49.32	42.61	22189 (11419 – 40115)	0.775	0.993	21.9
Scoping B	90.58	76.71	17963 (9215 – 32605)	0.627	0.987	8.1
Developer	17.26	14.06	26248 (13534 – 47305)	0.917	0.998	39.4

1284. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.72 with Tables 5.74 and 5.75). However, on the basis of the effects as determined by the Developer Approach, the predicted levels of impact remain relatively small. Thus, the CPS value for the Proposed Development in-combination with the other UK North Sea wind farms indicates that the SPA population size would be reduced by 8% after 35 years relative to that in the absence of any wind farm effects (Table 5.75). The centile value of 39.4 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate lower levels of impact (as determined by the Developer Approach), as would be expected from the lower predicted mortalities (Table 5.74).

1285. The predicted levels of impact as determined by the Scoping Approach are considerably greater, with the CPS values indicating reductions of 21 – 33% and of 22 – 37% in the size of the SPA population after 35 years (relative to that in the absence of any wind farm effects) for the other Forth and Tay in-combination scenario and the other UK North Sea in-combination scenario, respectively (Tables 5.74 and 5.75). The centile values range from 11.0 – 23.6 for the Proposed Development in-combination with the other Forth and Tay wind farms and from 8.1 – 21.9 for the Proposed Development in-combination with the other UK North Sea wind farms. These suggest low to, at most, moderate overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

In-combination: conclusion

1286. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other Forth and Tay wind farms or the other UK North Sea wind farms would not result in an adverse effect on the Forth Islands SPA razorbill population. The predicted population-level impacts are relatively small, whilst there remains a reasonably high likelihood of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Furthermore, this level of impact is within the context of an assessment which incorporates high levels of precaution and a population for which the documented, long-term, trend is increasing and which is considered to be in 'favourable maintained' condition.

1287. For the Scoping Approach, the predicted levels of impact are markedly greater and are considered to be of a level for which the possibility of an adverse effect on the SPA population cannot be excluded. This conclusion is considered to apply to the effects from the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms, and as determined by either the lower or upper range of the Scoping Approach. However, as detailed above, it is considered that the displacement and mortality rates used in the Scoping Approach are overly precautionary and are not supported by the available evidence (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Therefore, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the puffin population

1288. Puffins are a burrow nesting colonial seabird that occurs around the coasts of the North Atlantic region, mostly on islands. In Europe, colonies occur along the Atlantic coasts of Brittany, offshore islands in the British and Ireland, Faroes, Iceland, Norway and Russia. They forage entirely at sea, diving for small shoaling fish, particularly Ammodytidae, Clupeidae and Gadidae (Mitchell *et al.* 2004). In winter, puffins are very widespread across north-west European seas (Stone *et al.* 1995) and the Atlantic (Jessopp *et al.* 2013).

1289. The Forth Islands SPA puffin population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Fidra, Inchmickery, and The Lamb. The Isle of May colony represents approximately 89% of the total SPA population. The SPA puffin population is only counted sporadically and there are very few counts across all the colonies in the SPA in any one year. Therefore, count data are shown only for the Isle of May, where the population is counted approximately every five years (Figure 5.23). This has shown an overall increase since 1984 but with evidence of a decline in more recent years from a peak in abundance in the early 2000s. The numbers breeding on the Isle of May remain well above the citation population size of 14,000 breeding pairs and the current population estimate for the whole SPA is 43,620 apparently occupied burrows (which is taken to equate to 87,240 breeding individuals – volume 3, appendix 11.5 of the Offshore EIA Report). The Forth Islands SPA puffin population is considered to be in 'favourable declining' condition.

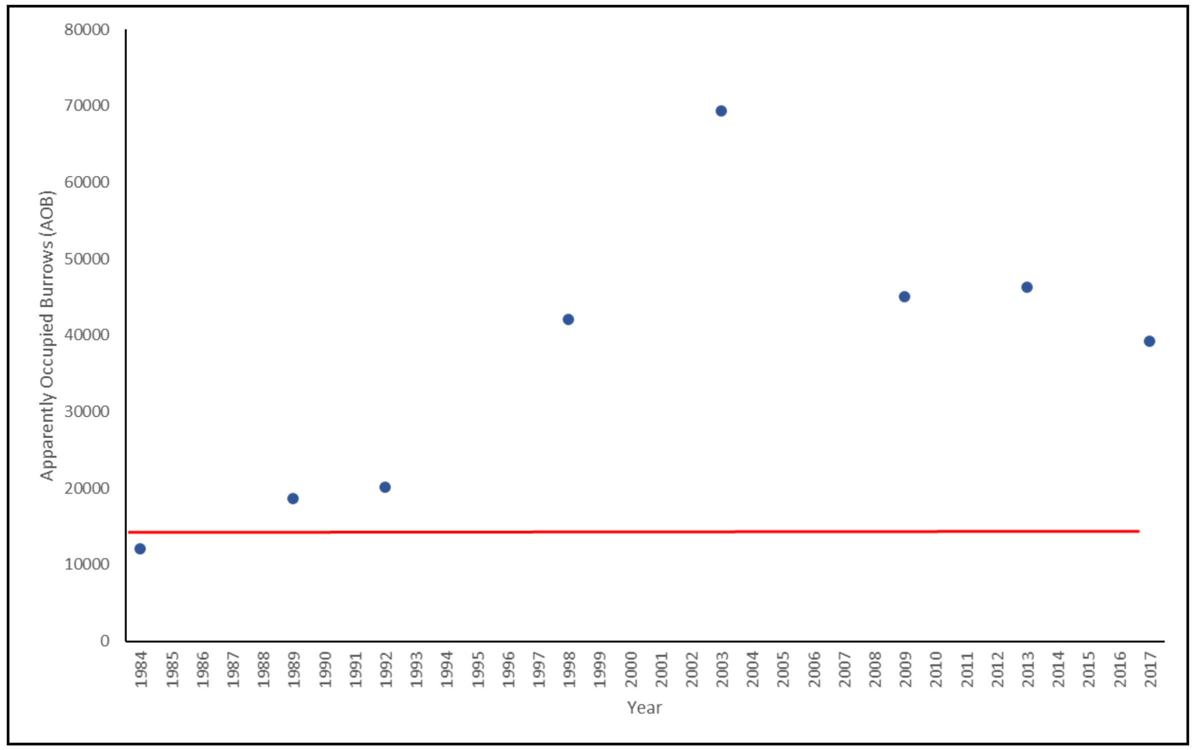

Figure 5.23: Puffin Population Trend on the Isle of May (Which Holds Almost 90% of the Forth Islands SPA Population) between 1984 and 2017. The Red Line Shows the Citation Population Size for the Forth Islands SPA (14,000 Breeding Pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the puffin population

1290. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Forth Islands SPA, so that potential impacts on its puffin population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1291. From published information on puffin foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Bogdanova *et al.* 2022), it is highly likely that during the breeding period puffin from the Forth Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that 50% of the puffin occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance.

1292. After the breeding season puffin migrate rapidly from their UK breeding areas, leaving the seas immediately adjacent to their colonies by late August and dispersing widely across north-west European seas and the Atlantic (Wernham *et al.* 2002, Harris and Wanless 2011, Stone *et al.* 1995, Jessopp *et al.* 2013). Consequently (and as advised in the NatureScot scoping advice - volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

Project alone: construction and decommissioning

Disturbance

1293. Direct disturbance to puffins during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1294. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1295. When using the marine environment (and not at the breeding colony), puffins are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign puffin as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1296. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to puffins from the Forth Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 1% of the total breeding season foraging area that is potentially available to the SPA puffin population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 137.1±128.3 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 4% of the breeding season foraging area if considering the mean maximum foraging range only.

1297. Tracking data for puffin from the Forth Islands SPA indicate that the Proposed Development array area and Proposed Development export cable corridor have little overlap with waters that are heavily used during the breeding season (Bogdanova *et al.* 2022). Based on the data from 24 birds tracked from this SPA population during the 2021 breeding season, there is no overlap between the core areas used by these birds for foraging and 'resting at sea' (as defined by the 50% utilisation distribution of the tracked birds when exhibiting these behaviours) and the Proposed Development array area, whilst only 1.5% of the wider area used for these behaviours (as defined by the 90% utilisation distribution of the tracked birds when exhibiting these behaviours) overlapped with the Proposed Development array area (Bogdanova *et al.* 2022). Similarly, only four of the tracked birds and 2% of the 713 individual flight tracks that were recorded from these birds passed through the Proposed Development array area. The areas used by the tracked birds (both whilst in flight and when foraging and/or resting) showed some, limited, overlap with the Proposed Development export cable corridor, although this was not quantified (Bogdanova *et al.* 2022).

1298. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1299. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1300. Given the relatively low sensitivity of puffin to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Forth Islands SPA puffin population.

Displacement

1301. As detailed above, puffin is considered to have a relatively low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Forth Islands SPA puffin population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffins from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1302. Based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA puffin population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Forth Islands SPA puffin population.

Changes to prey availability

1303. Sandeels are key prey for puffins, with a range of other species taken including clupeids and gadids (del Hoyo *et al*., 1996). Indirect effects on puffins may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Forth Islands SPA puffin population in the short-term.

1304. During construction and decommissioning there are a number of ways in which effects on key prey species may occur including temporary subtidal habitat loss/disturbance, long-term subtidal habitat loss, increases in SSC and associated sediment deposition, underwater noise and vibration, and colonisation of subsea structures (see section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population and volume 2, chapter 9 of the Offshore EIA Report). Increases in SSC and associated reductions in water clarity may also affect the ability of foraging puffins to locate fish in the water column, thereby reducing prey availability.

1305. It is considered that foraging puffins from the Forth Islands SPA will be largely unaffected by the low-level temporary increases in SSC, as the concentrations are likely to be within the range of natural variability (generally <5 mg/l but can increase to over 100 mg/l during storm events/increased wave heights) and will reduce to background concentrations within a very short period (approximately two tidal cycles). Furthermore, the Proposed Development array area and export cable corridor represent approximately 1% of the total breeding season foraging area that is potentially available to the SPA puffin population, as defined by the species' mean maximum breeding season foraging range plus 1 SD (i.e. 137.1±128.3 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, data on puffin foraging distributions indicates that the Proposed Development array area and export cable corridor have little overlap with waters that are predicted to be heavily used by birds from the Forth Islands SPA (Bogdanova *et al.,* 2022).

1306. Based upon the above, it is considered that there is relatively little potential for the Forth Islands SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Forth Islands SPA puffin population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on puffins during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

<u>Project alone: operation and maintenance</u>

<u>Disturbance</u>

1307. Vessel use within the Proposed Development array area and export cables corridor during the operation and maintenance phase may lead to direct disturbance of puffins from the Forth Islands SPA. As described in section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, puffins are considered to have low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1308. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1309. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1310. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1311. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Forth Islands SPA puffin population.

<u>Displacement/barrier effects</u>

1312. As outlined above, displacement effects on the Forth Islands SPA puffin population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1313. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on puffin are estimated for the breeding period only (see above). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for puffin are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.

1314. As with other species for which displacement effects are assessed (see above), the approach to estimating puffin displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1315. Based upon a consideration of the available evidence for puffin displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.

1316. Estimates of puffin mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Forth Islands SPA puffin population during the breeding season according to the NatureScot (2018) approach (Offshore EIA Report, volume 3, appendix 11.5, Table 5.76). The resulting mortality estimates for the breeding season were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Forth Islands SPA puffin PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.76: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer During the Breeding Season, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Forth Islands SPA Population

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,513	0.477	0.500	0.500	0.07

1317. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA puffin population as a result of displacement is estimated as 18 adult and 21 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 30 adult and 36 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.77). For the Developer Approach, the predicted annual mortality is five adult and six immature birds, equating to approximately 28% and 17% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.77).

Table 5.77: Estimated Potential Annual Mortality of Forth Islands SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	18.2	21.4
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	18.2	21.4
Scoping B	Breeding	60%	5%	30.2	35.6
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	30.2	35.6
Developer	Breeding	50%	1%	5.1	6.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	5.1	6.0

1318. The additional annual mortality of adult puffin from the Forth Islands SPA population predicted due to displacement from the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 87,240 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.02 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 – see Table 2.17 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of less than 0.1% for the Developer Approach and of 0.2 – 0.3% for the lower and upper estimates from the Scoping Approach.

1319. The potential levels of impact on the Forth Islands SPA puffin population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

1320. Potential impacts on key prey species for puffins breeding at Forth Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect puffin survival and productivity in the Forth Islands SPA population.

1321. During the operation and maintenance phase, there is potential for temporary habitat loss/disturbance for up to 989,000 m² as a result of the use of jack-up vessels during any component replacement activities and during any cable repair activities. These impacts will be similar to those identified for temporary habitat loss/disturbance during the construction phase (as discussed in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the SPA population) and will be highly restricted to the immediate vicinity of these operations.

1322. As outlined in the section on *Project Alone: Operation and Maintenance – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population, the presence of infrastructure within the Proposed Development, will result in long-term habitat loss of up to 7,798,856 m² during the operation and maintenance phase. These areas of habitat loss will be discrete, either in the immediate vicinity of foundations, or relatively small isolated stretches of cable, representing a very low proportion of available habitat for key prey species (0.7% of the Proposed Development fish and shellfish ecology study area).

1323. Increased SSC could occur as a result of repair or remedial burial activities during the operation and maintenance phase, as outlined in the section on *Project Alone: Operation and Maintenance – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The assessment in volume 2, chapter 9 of the Offshore EIA Report considered that any suspended sediments and associated deposition and water clarity reduction during operation and maintenance will be of the same magnitude, or lower, as for construction.

1324. The presence and operation of inter-array, interconnector and offshore export cables will result in emissions of localised EMF, however there is no evidence to suggest that the key prey species of auks (e.g. sandeel and clupeids) are electrosensitive and would respond to electrical and/or magnetic fields (volume 2, chapter 9 of the Offshore EIA Report).

1325. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions, particularly in relation to key prey species for puffin, remain largely unknown (Peschko *et al*., 2020; BOWL 2021a, 2021b;

Scott, 2022). Overall, any change in prey abundance and/or distribution through the presence of subsea structures of foundations is likely to be small relative to the area over which breeding SPA puffins forage.

1326. It is therefore considered that there is relatively little potential for the Forth Islands SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Forth Islands SPA puffin population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on puffins during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

1327. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA puffin population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1328. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.77 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.17 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2017 – 2021 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in volume 3, appendix 11.6).

1329. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.78: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Puffin Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	243955 (96523 - 542889)	*1.000*	1.000	*50.0*
Scoping A	18.19	21.44	241799 (95648 – 538155)	0.991	1.000	48.9
Scoping B	29.80	35.56	240414 (95085 – 535113)	0.986	1.000	48.3
Developer	5.11	6.01	243348 (96276 – 541558)	0.998	1.000	49.7

1330. The PVA predicted that the Forth Islands SPA puffin population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost three times larger than the current estimate of 87,240 adult birds under baseline conditions (i.e. no wind farm effects) and under each of the impact scenarios (Table 5.78). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). However, the differences between the scenarios in terms of the predicted increases and eventual 35 year population sizes are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), and whilst the prediction for an increasing trend is consistent with the overall long-term trend for this SPA population it does not reflect the more recent decline in numbers (Figure 5.23).

1331. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach the CPS value indicates that the predicted mortality associated with the Proposed Development alone would result in a reduction of approximately 1% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.78). The associated reductions in annual population growth rate (relative to that predicted under baseline conditions) are not detectable (at least when the CPGR value is expressed to three decimal places) and the centile values are all above 48.0, indicating a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.78).

Project alone: conclusion

1332. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Forth Islands SPA puffin population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population (with this conclusion being irrespective of whether these effects are determined by the Scoping or Developer Approach).

Effects in-combination

Effects of relevance to the in-combination assessment

1333. As detailed above, any effects from the Proposed Development alone on the Forth Islands SPA puffin population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1334. Therefore, the potential for effects of the Proposed Development to act on the Forth Islands SPA puffin population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1335. As described in annex E of the Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Forth Islands SPA puffin population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

Table 5.79: Estimated Annual Mortality of Forth Islands SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	158.1	183.1	N/A	N/A	158.1	183.1
	Scoping B	263.4	305.0	N/A	N/A	263.4	305.0
	Developer	44.0	50.9	N/A	N/A	44.0	50.9
UK North Sea	Scoping A	159.4	183.8	N/A	N/A	159.4	183.8
	Scoping B	265.5	306.1	N/A	N/A	265.5	306.1
	Developer	44.3	51.1	N/A	N/A	44.3	51.1

1336. Virtually all of the mortality associated with the other plans and projects was attributable to the other Forth and Tay wind farms, with the Kincardine and Hywind farms being the only other projects considered to have potential displacement effects on this SPA population (Table 5.79, annex D of Offshore EIA Report, volume 3, appendix 11.6). Given this, the Forth and Tay and UK North Sea in-combination scenarios are essentially the same and further consideration is limited to the Proposed Development in-combination with the other UK North Sea wind farms.

1337. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to a near ninefold increase in the predicted displacement mortality compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.77 and 5.79).

1338. The resultant additional annual mortality of adult puffins from the Forth Islands SPA population predicted due to the in-combination displacement effects represents 0.05% of the current adult breeding population at this colony (i.e. 87,240 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.18 – 0.30% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 – see Table 2.17 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.5% for the Developer Approach and of 1.8 – 3.1% for the lower and upper estimates from the Scoping Approach.

1339. The potential levels of impact on the Forth Islands SPA puffin population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

1340. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.79 above).

1341. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.80: Projected 35 Year Population Sizes and Associated PVA Metrics for the Forth Islands SPA Puffin Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	243955 (96523 - 542889)	*1.000*	1.000	*50.0*
Scoping A	159.39	183.80	225847 (89177 – 503131)	0.926	0.998	43.1
Scoping B	265.10	306.16	214574 (84601 – 478373)	0.880	0.996	38.9
Developer	44.31	51.11	238783 (94423 – 531535)	0.979	0.999	47.9

1342. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.80 with Table 5.78).

1343. For the Developer Approach, the CPS value indicates that the SPA population size would be reduced by 2% after 35 years, relative to that in the absence of any wind farm effects (Table 5.80). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small, whilst the centile value of 47.9 continues to indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

1344. The metrics associated with the Scoping Approach indicate greater levels of impact, with small to moderate reductions (i.e. 7 – 12%) in the predicted population size after 35 years relative to that predicted to occur in the absence of wind farm effects. However, the values of the centile metric, at 38.9 – 43.1, indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population size being of a similar size to the un-impacted population after 35 years (Table 5.80).

In-combination: conclusion

1345. Based on the Developer Approach, the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms on the Forth Islands SPA puffin population are predicted to be small, as are the resultant population-level impacts. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on this population.

1346. As would be expected, the Scoping Approach predicts greater levels of effects and consequent population-level impacts than as predicted by the Developer Approach. For the Proposed Development in-combination with the other UK North Sea wind farms, it is predicted that the SPA population could be reduced by up to 12% after 35 years, relative to the population size in the absence of wind farm effects. Although the centile metric indicates a high likelihood of the impacted population being similar in size to the un-impacted population after 35 years, the potential scale of reduction has to be considered within the context of a population which has shown declines in recent years and for which the condition status is regarded as 'favourable declining'. Given this, it is concluded that for the Scoping Approach the possibility of an adverse effect on the SPA population cannot be excluded. This conclusion is considered to apply to the effects from the Proposed Development in-combination with the other Forth and Tay wind farms, as well as to the Proposed Development in-combination with the other UK North Sea wind farms (on the basis of the small difference in the predicted effects).

1347. As detailed above, it is considered that the displacement and mortality rates used in the Scoping Approach are overly precautionary and are not supported by the available evidence (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Therefore, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the breeding seabird assemblage

1348. The breeding seabird assemblage for the Forth Islands SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that, as at 1986 – 1988, the SPA regularly supported 90,000 seabirds). Razorbill, guillemot, kittiwake, herring gull, gannet, lesser black-backed gull, puffin, Arctic tern and common tern are amongst the species identified in the citation as having nationally important populations which contribute to the Forth Islands SPA breeding seabird assemblage.

1349. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach, the assessments undertaken above identify the potential for an adverse effect only on the SPA kittiwake population in relation to both of the in-combination scenarios. For the Scoping Approach, the assessments undertaken above identify the potential for adverse effects on the SPA guillemot population for the project alone and for the SPA kittiwake, guillemot, razorbill and puffin populations in relation to both of the in-combination scenarios.

1350. Thus, for the Proposed Development alone, the potential for an adverse effect is identified only for the SPA guillemot population as determined by the Scoping Approach (but not as determined by the Developer Approach). Given the range of species present within the SPA seabird assemblage and their relative abundances, it is considered that the potential adverse effect on the SPA guillemot population (as determined by the Scoping Approach) would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

1351. For the in-combination scenarios, it is considered that the predicted impacts on the SPA kittiwake population (for both the Developer and Scoping Approaches) are sufficient to represent an increased risk of this population being lost from the breeding seabird assemblage due to the relatively small size of this population combined with its long-term decline. For the Scoping Approach (but not the Developer

Approach), it is also considered to be conceivable that the scale of the combined predicted in-combination impacts on the SPA kittiwake, guillemot, razorbill and puffin populations are such as to represent a risk of reducing the total number of individual seabirds present in the assemblage to a level that could represent an adverse effect on this qualifying feature. This conclusion should be considered within the context of the high levels of precaution incorporated within the assessment, with these being outlined above in the sections on the contributory SPA populations of the Forth Islands SPA breeding seabird assemblage.

1352. Given the above, it is concluded that there is the potential for an adverse effect on the Forth Islands SPA breeding seabird assemblage, in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

Developer approach

1353. It is concluded that the possibility of an adverse effect cannot be discounted for the Forth Islands SPA population of breeding kittiwake (noting this species is a named component of the seabird assemblage feature only), as well as the breeding seabird assemblage qualifying feature (due to the impacts on the kittiwake component only). For the kittiwake population, the potential for an adverse effect arises from the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. The potential for an adverse effect on the breeding seabird assemblage is a direct consequence of the potential effects on the SPA kittiwake population (which is a named component of this assemblage) and is, therefore, also associated with the in-combination effects only.

1354. Consequently, it is concluded that an Adverse Effects on Integrity of the Forth Islands SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects.

Scoping approach

1355. It is concluded that the possibility of adverse effects cannot be discounted for the Forth Islands SPA populations of breeding kittiwake, guillemot and razorbill (noting these species are named components of the seabird assemblage feature only), as well as the breeding puffin and breeding seabird assemblage qualifying features. For the guillemot population, the potential for an adverse effect arises from the Proposed Development alone and the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. For the kittiwake and razorbill populations, as well as the breeding puffin and breeding seabird assemblage qualifying features, the potential for an adverse effect is in relation to the effects of the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms (but not in relation to the effects of the Proposed Development alone). The potential for an adverse effect on the seabird assemblage is a direct consequence of the potential effects on these SPA populations, all of which are named components of this assemblage only except for puffin (which is a qualifying feature in its own right). Therefore, the potential for an adverse effect on the seabird assemblage is also considered to be limited to the in-combination scenarios.

1356. Consequently, it is concluded that an Adverse Effects on Integrity of the Forth Islands SPA cannot be excluded due to effects of the Proposed Development alone and in-combination with other plans and projects.

5.7.3. FOWLSHEUGH SPA

European site information and conservation objectives

1357. Fowlsheugh SPA is a mainland seabird colony on the coast of Aberdeenshire, north-east Scotland. The SPA is approximately 47 km north-west of the Proposed Development, and was classified in August 1992, with an additional 2 km marine extension to the site classified in September 2009. The SPA is underpinned by the Fowlsheugh SSSI.

1358. There are no Annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting in excess of 20,000 individual seabirds, with the breeding seabird assemblage feature including five named component species (Table 5.81). The potential for LSE has been identified in relation to four of these five named components (Table 5.81), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

1359. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

1360. Further information on this European site is presented in appendix 3A.

Table 5.81: Details on the Qualifying Features of the Fowlsheugh SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Favourable maintained	145,000 individuals	Yes
Kittiwake*	Breeding	Favourable maintained	36,650 pairs	Yes
Herring gull*	Breeding	Unfavourable declining	3,190 pairs	Yes
Guillemot*	Breeding	Favourable maintained	56,450 individuals	Yes
Razorbill*	Breeding	Favourable maintained	5,800 individuals	Yes
Fulmar*	Breeding	Favourable maintained	1,170 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

1361. The Fowlsheugh SPA kittiwake population is currently estimated to number 13,271 AONs, which is substantially below the citation population size of 36,650 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5). Estimates of the size of the Fowlsheugh SPA kittiwake population are not readily available from the Seabird Monitoring Database because the data from one of the four seabird count sectors which comprise the SPA are not fully aligned with the SPA boundary. However, it is apparent from the available data that the Fowlsheugh RSPB reserve has held in excess of 60% of the SPA population in all three of the earlier years for which data are available from all four of the SPA count sectors (i.e. 1986, 1992 and

1999). The SPA population estimate used for the current assessment derives from 2018 and is corrected to align with the SPA boundaries, with the Fowlsheugh RSPB reserve accounting for 71% of this estimate.

1362. Based on the counts from the Fowlsheugh RSPB reserve, it is apparent that the SPA kittiwake population has declined since the SPA was designated in 1992, with the population size almost certainly below the citation level in all subsequent years for which count data are available (Figure 5.24). As for the St Abb's Head to Fast Castle SPA and Forth Islands SPA kittiwake populations there is some indication of a levelling off in the population decline over the last decade or so.

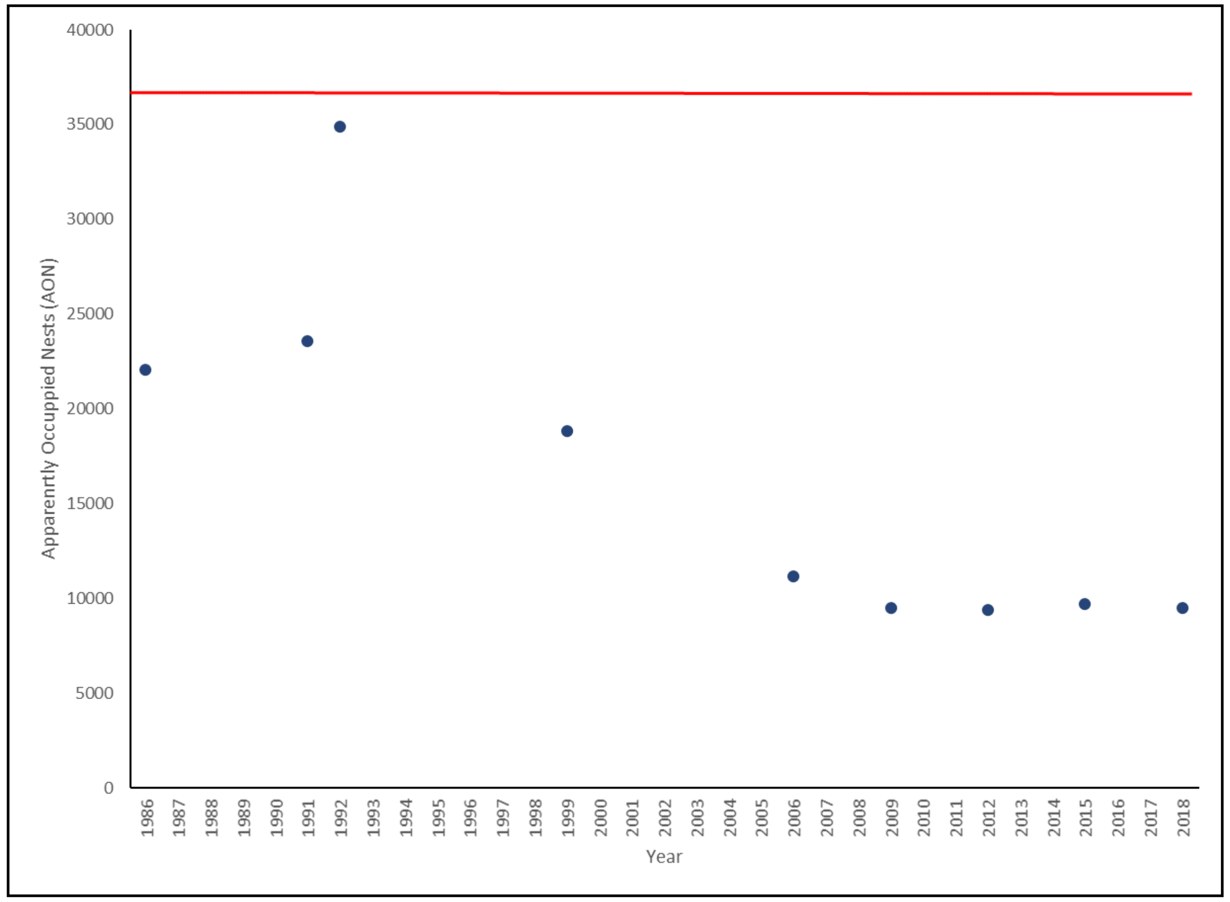

Figure 5.24: Kittiwake Population Trend at the Fowlsheugh RSPB Reserve between 1986 and 2018 (with this Site Accounting for 71% of the SPA Population Estimate in 2018). The Red Line Shows the Citation Population Size for the SPA (36,650 pairs). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the kittiwake population

1363. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Fowlsheugh SPA, so that potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1364. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017, Bogdanova *et al.* 2022), it is apparent that during the breeding period kittiwakes from the Fowlsheugh SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is reflected in the findings of the apportioning exercise, which estimates that approximately 17% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

1365. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Fowlsheugh SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Fowlsheugh SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1366. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1367. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1368. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1369. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Fowlsheugh SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the (main) seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

1370. Tracking data (and associated modelling of foraging distributions) for kittiwake show that the Proposed Development array area and Proposed Development export cable corridor overlap with, or occur close to, waters that are heavily used by birds from the Fowlsheugh SPA during the breeding season (Cleasby *et al.* 2018, Bogdanova *et al.* 2022). However, the degree of overlap is limited and excludes those areas of heaviest usage. For example, based on the data from 40 birds tracked from this SPA population during the 2021 breeding season, the Proposed Development array area does not overlap with the core areas used by the tracked birds for either foraging or resting at sea (as defined by the respective 50% utilisation distributions for these behaviours) (Bogdanova *et al.* 2022). The overlaps between the Proposed Development array and the wider foraging and 'resting at sea' areas of these tracked birds (as defined by the respective 90% utilisation distributions) represented 9% and 10% of these wider areas, respectively. Although 35% of these 40 tracked birds were recorded in flight through the Proposed Development array area at some point during the tracking period, only 5% of the 1,364 fight tracks were recorded doing so (Bogdanova *et al.* 2022). Evidence from other tracking data collected during earlier studies also suggests the Proposed Development array area is likely to be used by kittiwakes from the Fowlsheugh SPA but that it lies (largely) outside the areas of heaviest usage (Cleasby *et al.* 2018).

1371. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015) and the potential for effects of construction-related disturbance is lower than during the breeding season.

1372. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1373. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1374. Given the low sensitivity of kittiwake to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Fowlsheugh SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

1375. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Fowlsheugh SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1376. Therefore, based upon the above, it is considered that there is relatively little potential for the Fowlsheugh SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Fowlsheugh SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

1377. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Fowlsheugh SPA kittiwake population in the short-term.

1378. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Fowlsheugh SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

1379. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

1380. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Fowlsheugh SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1381. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1382. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1383. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1384. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Fowlsheugh SPA kittiwake population.

Displacement/barrier effects

1385. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1386. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

1387. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

1388. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4) and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.82). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.6), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.82: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, together with the Proportion of Birds Estimated to belong to the Breeding Adult Age Class and to be from the Fowlsheugh SPA Population in Each Period. The proportion of Adults Assumed to be Sabbaticals during the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	0.172	0.172	*0.10*
Autumn migration	*11,190*	*N/A*	0.013	0.008	*N/A*
Spring migration	*13,766*	*N/A*	0.018	0.008	*N/A*

1389. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as 11 adult and one immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 32 adult and three immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.83). As expected on the basis that kittiwakes from this breeding colony SPA use the waters within the vicinity of the Proposed Development array area during the breeding season (and as reflected by the seasonally-specific apportioning rates), the displacement effects predicted by the Scoping

Approach are largely attributable to the breeding season (with the potential breeding season mortality accounting for almost 85% of the overall annual mortality – Table 5.83).

1390. The annual mortality from displacement as determined using the Developer Approach is predicted to be approximately 19 adult and one immature birds, so lies midway between the mortality predictions from the Scoping Approach and is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.83: Estimated Potential Annual Mortality of Fowlsheugh SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	9.6	0.3
	Autumn migration	30%	1%	0.4	0.3
	Spring migration	30%	1%	0.7	0.3
	Annual total	-	-	10.8	0.9
Scoping B	Breeding	30%	3%	28.6	1.0
	Autumn migration	30%	3%	1.3	0.8
	Spring migration	30%	3%	2.2	1.0
	Annual total	-	-	32.1	2.8
Developer	Breeding	30%	2%	19.0	0.7
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	19.0	0.7

1391. The additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to displacement from the Proposed Development array represents 0.07% of the current adult breeding population at this colony (i.e. 26,542 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.04 – 0.12% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.5% for the Developer Approach and of 0.28 – 0.83% for the lower and upper estimates from the Scoping Approach.

1392. The potential levels of impact on the Fowlsheugh SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Collision risk</u>

1393. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

1394. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Fowlsheugh SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1395. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

1396. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of Offshore EIA Report, volume 3, appendix 11.3.

1397. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Fowlsheugh SPA is predicted to be approximately 98 adults and six immatures as determined by the Scoping Approach, and approximately 68 adults and four immatures as determined by the Developer Approach (Table 5.84). As for displacement, the vast majority of this mortality (i.e. over 90%) is predicted to occur during the breeding season.

Table 5.84: Predicted Collision Effects from the Proposed Development on the Fowlsheugh SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	92.6	3.2
	Autumn migration	2.3	1.4
	Spring migration	3.4	1.5
	Annual total	98.3	6.1
Developer	Breeding	63.9	2.2
	Autumn migration	1.4	0.8
	Spring migration	2.8	1.2
	Annual total	68.1	4.2

1398. The additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.26% of the number of adults currently estimated to breed at this colony (i.e. 26,542 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 0.37% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 1.8% and 2.6% for the Developer and Scoping Approaches, respectively.

1399. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Fowlsheugh SPA kittiwake population that are at least 50% lower than those presented in Table 5.84 above (and on which the assessment is based).

1400. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.84 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Changes to prey availability</u>

1401. Potential impacts on key prey species for kittiwakes breeding at the Fowlsheugh SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Fowlsheugh SPA kittiwake population.

1402. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Fowlsheugh SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1403. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA kittiwake population.

<u>Project alone: population-level impacts</u>

1404. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Fowlsheugh SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1405. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.83 and 5.84 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

1406. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.85: Projected 35 Year Population Sizes And Associated PVA Metrics for the Fowlsheugh SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	13615 (5563 – 31969)	*1.000*	1.000	*50.0*
	Scoping A	109.05	7.01	12143 (4946 – 28608)	0.892	0.997	38.9
	Scoping B	130.45	8.84	11869 (4831 – 27977)	0.872	0.996	36.8
	Developer	87.03	4.90	12436 (5068 – 29284)	0.914	0.997	41.0

1407. The PVA predicted a continuing population decline for the Fowlsheugh SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, under baseline conditions (i.e. no wind farm effects), the population is predicted to decline by almost 50% after 35 years from the current estimate of 26,542 adult birds (Table 5.85). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted declines are inevitably greater for those scenarios incorporating the effects from the Proposed Development.

1408. Considering the PVA metrics, the CPS values indicate that the SPA population size would be reduced by approximately 9% and 11 – 13%, relative to the predicted population size under baseline conditions, after 35 years for the Developer Approach and Scoping Approach, respectively (Table 5.85). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be approximately 0.3% on the basis of the Developer Approach and 0.3 – 0.4% on the basis of the Scoping Approach (Table 5.85). On the basis of the Developer Approach, the centile value is estimated to be 41.0 after 35 years, whilst for the Scoping Approach the equivalent values are 36.8 – 38.9 (Table 5.85). Thus, the centile metric indicates a moderate to considerable overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting at least a reasonably high likelihood of the impacted population being of similar size to the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

1409. The PVA outputs described above, and detailed in Table 5.85, need to be considered within the context of the fact that the SPA population is predicted to decline irrespective of the wind farm effects and that such a trend is broadly consistent with the documented long-term trend for this population, albeit that there is some suggestion of a levelling off in this decline over the past decade (Figure 5.24). As described in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population, the available evidence suggests that the long-term decline of kittiwake populations in the North Sea and the Forth and Tay region (including the Fowlsheugh SPA) is associated with fisheries management and climate change (Frederiksen *et al.* 2004). Therefore, without appropriate management to mitigate these effects, it is likely that the Fowlsheugh SPA population will remain in unfavourable condition and that the predicted effects from the Proposed Development may be unimportant in this regard. Furthermore, it is also relevant to consider the high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach (with this also detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

Project alone: conclusion

1410. Overall, it is considered that the predicted levels of impact from the Proposed Development alone on the Fowlsheugh SPA kittiwake population are of a small (for the Developer Approach) to, at most, moderate scale (for the upper range of the Scoping Approach). For both the Developer and Scoping Approaches it is also the case that the centile metric indicates at least a reasonably high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. Given this is within the context of a population which (consistent with the documented long-term trend) is predicted to decline irrespective of the effects from the Proposed Development, and for which the assessment incorporates high levels of precaution (particularly as determined by the Scoping Approach), it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1411. As detailed above, any effects from the Proposed Development alone on the Fowlsheugh SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1412. Therefore, the potential for effects of the Proposed Development to act on the Fowlsheugh SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for two in-combination scenarios, i.e. (i) the Proposed Development in-combination with the other Forth and Tay offshore wind farms and (ii) the Proposed Development in-combination with the offshore wind farms in the UK North Sea (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1413. As described in annex E of the Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Fowlsheugh SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1414. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (annex D in the Offshore EIA Report, volume 3, appendix 11.6), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in-combination *Displacement/Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

1415. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farm scenario and the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.86).

Table 5.86: Estimated Annual Mortality of Fowlsheugh SPA Kittiwakes as a result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	19.0	1.1	1.0	0.6	1.0	0.4	21.0	2.2
	Scoping B	56.8	3.4	3.1	1.9	2.9	1.3	62.9	6.6
	Developer	37.8	2.2	N/A	N/A	N/A	N/A	37.8	2.2
UK North Sea	Scoping A	20.0	1.1	2.4	1.4	3.7	1.6	26.1	4.2
	Scoping B	59.8	3.4	7.2	4.3	11.1	4.9	78.2	12.5
	Developer	39.8	2.2	N/A	N/A	N/A	N/A	39.8	2.2

1416. The incorporation of the potential mortality resulting from the predicted displacement effects associated with other plans and projects increases the levels predicted for the Proposed Development alone by factors of between two and (approximately) two and a half (Tables 5.83 and 5.86). These increases are greater for the other UK North Sea wind farms in-combination scenario than for the other Forth and Tay wind farms scenario, with this difference most marked for the Scoping Approach because of the incorporation of effects from a greater number of wind farms during the passage periods in the former scenario. However, for the Developer Approach no mortality is attributed to displacement during the non-breeding periods, and the difference between the UK North Sea and Forth and Tay in-combination scenarios is small and due only to the inclusion of breeding season effects from the Kincardine wind farm in the former but not the latter (annex D of Offshore EIA Report, volume 3, appendix 11.6). As for the Proposed Development alone, the vast majority (i.e. 70 – 100%) of the predicted mortality from displacement is attributed to effects during the breeding season (Table 5.86).

1417. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to displacement represents 0.14% of the current adult breeding population at this colony (i.e. 26,542 individuals – Table 3.3 in volume 3, appendix 11.5of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.08 – 0.24% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 1.0% for the Developer Approach and of 0.5 – 1.6% for the lower and upper estimates from the Scoping Approach.

1418. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to displacement represents between approximately 0.10 – 0.29% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.7 – 2.0% for the lower and upper estimates from the Scoping Approach. The equivalent figures for the predicted additional mortality as determined by the Developer Approach are hardly discernible from those for the Proposed Development in-combination with the other Forth and Tay wind farms.

1419. The potential levels of impact on the Fowlsheugh SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

1420. As for displacement, breeding season collision estimates attributed to the Fowlsheugh SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (annex E of Offshore EIA Report, volume 3, appendix 11.6). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (annex D of Offshore EIA Report, volume 3, appendix 11.6). The non-breeding season collision estimates were apportioned to the Fowlsheugh SPA population according to the BDMPS approach (Furness 2015).

1421. Collision estimates based on consented and 'as-built'[11] designs were also considered but for the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms and had minimal effects on those for the other UK North Sea wind farms (with the respective totals differing by 3.6 adults, representing less than 4% of the estimates for the consented designs). Therefore, only the estimates for the consented designs are considered in this case.

1422. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

1423. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.87).

Table 5.87: Predicted Collision Effects on the Fowlsheugh SPA Kittiwake Population due to the Proposed Development In-Combination with other Projects in the Forth and Tay and in UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach.

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Forth and Tay	Scoping	Breeding	126.4	6.2
		Autumn migration	6.2	2.3
		Spring migration	4.2	1.9
		Annual total	136.8	10.4
	Developer	Breeding	97.7	5.2
		Autumn migration	5.3	1.7
		Spring migration	3.6	1.6
		Annual total	106.6	8.5
UK North Sea	Scoping	Breeding	141.4	7.1
		Autumn migration	14.1	8.3
		Spring migration	18.8	8.3
		Annual total	174.3	23.7
	Developer	Breeding	112.7	6.2
		Autumn migration	13.1	7.7
		Spring migration	18.2	8.0
		Annual total	144.0	21.9

1424. The potential mortality resulting from the predicted collision effects associated with other plans and projects increases that predicted for the Proposed Development alone by approximately 41 – 59% for the other Forth and Tay wind farms in-combination scenario and by approximately 90 – 129% for the other UK North Sea wind farms in-combination scenario (with the greater increases associated with the Developer Approach in each case - Tables 5.84 and 5.87). The vast majority of the collision mortality predicted on the SPA population (i.e. approximately 70 – 90%) is again attributable to the breeding season effects (Table 5.87), with the breeding season effects essentially limited to the Proposed Development and the other Forth and Tay wind farms (see annex D of Offshore EIA Report, volume 3, appendix 11.6).

1425. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to collisions represents 0.40% of the current adult breeding population at this colony (i.e. 26,542 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.51% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 2.8% for the Developer Approach and of 3.6% for the Scoping Approach.

1426. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Fowlsheugh SPA population predicted due to collisions represents 0.54% of the current adult breeding population at this colony (i.e. 26,542 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.66% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 3.7% for the Developer Approach and of 4.5% for the Scoping Approach.

1427. The potential levels of impact on the Fowlsheugh SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1428. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.86 and 5.87 above).

1429. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.88: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other Forth and Tay Wind Farms

Period	Approach	Additional Annual Mortality Adults	Additional Annual Mortality Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
35 years	*Baseline*	*0*	*0*	13615 *(5563 – 31969)*	*1.000*	1.000	*50.0*
	Scoping A	155.35	12.51	11548 *(4697 – 27229)*	0.849	0.995	34.6
	Scoping B	197.25	16.94	11047 *(4485 – 26048)*	0.811	0.994	30.5
	Developer	141.70	10.80	11720 *(4769 – 27630)*	0.861	0.996	35.7

Table 5.89: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development in-Combination with the other UK North Sea Wind Farms.

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	13615 (5563 – 31969)	*1.000*	1.000	*50.0*
	Scoping A	200.35	27.91	10928 (4438 – 25769)	0.803	0.994	29.6
	Scoping B	252.35	36.24	10313 (4185 – 24338)	0.758	0.992	25.5
	Developer	183.60	24.10	11139 (4527 – 26268)	0.818	0.994	31.3

1430. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.88 and 5.89 with Table 5.85). Focussing on the outputs for the Proposed Development in-combination with the other UK North Sea wind farms, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by almost 20% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 20 – 24% (Table 5.89). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.6% for the Developer Approach and 0.6 – 0.8% for the Scoping Approach. The values for the centile metric are estimated as 31.3 after 35 years for the Developer Approach and as 25.5 – 29.6 for the Scoping Approach, suggesting low to moderate levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being smaller than the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate levels of impact which are midway between those for the Proposed Development alone and those for the UK North Sea in-combination scenario.

1431. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

In-combination: conclusion

1432. For both the Scoping and Developer Approaches, the predicted levels of impact associated with the two in-combination scenarios represent a marked increase compared to those associated with the Proposed Development alone. These levels of impact suggest the potential for the in-combination effects to lead to a marked reduction in the size of the Fowlsheugh SPA population after 35 years relative to that which would occur in the absence of these effects. The predicted levels of impact are such that for the Developer Approach (which predicts lower levels of impact than the Scoping Approach), this potential reduction in population size is 14% for the Proposed Development in-combination with the other Forth and Tay wind farms and almost 20% for the Proposed Development in-combination with the other UK North Sea wind farms.

1433. For the Proposed Development in-combination with the other Forth and Tay wind farms but not in-combination with the other UK North Sea wind farms), the centile values indicate a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years whilst the context that has been outlined above (in relation to (i) the high levels of precaution incorporated in the assessment and (ii) the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population) remains highly relevant. However, despite this, it is considered that the scale of the potential reduction in the size of the SPA population associated with the in-combination effects means that the possibility of an adverse effect on the SPA population cannot be excluded.

1434. Consequently, it is concluded that there is the potential for an adverse effect on the Fowlsheugh kittiwake population as a result of the predicted effects from (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the herring gull population

1435. The Fowlsheugh SPA herring gull population is currently estimated to number 707 breeding pairs, which is substantially below the citation population of 3,190 pairs (Offshore EIA Report, volume 3, appendix 11.5). As for the Fowlsheugh SPA kittiwakes, earlier estimates of the size of the SPA herring gull population are not readily available from Seabird Monitoring Database (SMP 2022) because the data from one of the four seabird count sectors which comprise the SPA are not fully aligned with the SPA boundary. Based upon the available data it seems clear that the SPA population size has been below the citation level since designation in 1992, and numbers were probably higher in the 1980s and early 1990s than currently (based upon counts from the 'Tremuda/Old Hall Bay' count sector of approximately 1000 AONs in 1986 and 1992 compared to 451 AONs in 2018). The more frequent count data from the Fowlsheugh RSPB reserve count sector also indicate an overall decline since the late 1980s, although numbers are lower and show some fluctuation.

1436. The Fowlsheugh SPA herring gull is considered to be in 'unfavourable declining' condition.

The potential for impacts on the herring gull population

1437. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Fowlsheugh SPA, so that potential impacts on its herring gull population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1438. From published information on herring gull foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period herring gulls from the Fowlsheugh SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is supported by the findings of the apportioning exercise, which estimates that 3.5% of the herring gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for herring gull is defined as April to August, following NatureScot (2020).

1439. In the non-breeding season, herring gulls in Great Britain are largely sedentary with relatively short local movements only (Wernham *et al.* 2002). However, there is an influx of breeding birds of Scandinavian breeding subspecies, *L. argentatus argentatus* (Coulson *et al.,* 1984). On this basis,and following the scoping advice from NatureScot (volume 3, appendix 6.2 of the Offshore EIA Report), it is assumed that during the non-breeding period herring gulls remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Offshore EIA Report, volume 3, appendix 11.5). To account for the influx of birds from other regions to this regional population during the non-breeding period, the regional non-breeding population is assumed to increase (relative to the size of the breeding population) in accordance with the proportion of continental and western UK birds estimated to be present in the UK North Sea and Channel BDMPS (Furness 2015, Offshore EIA Report, volume 3, appendix 11.5).

1440. Given the above, there is potential for the Proposed Development to have effects on the Fowlsheugh SPA herring gull population during both the breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

1441. Herring gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on herring gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Fowlsheugh SPA herring gull population in the short-term.

1442. During construction there are a number of ways in which effects on herring gull prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent c. 10% of the total breeding season foraging area that is potentially available to the SPA herring gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 58.8±26.8 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for herring gulls breeding at the Fowlsheugh SPA. Non-breeding season effects are expected to similar since herring gulls in Great Britain do not disperse widely during winter (Wernham *et al.* 2002).

1443. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect herring gull prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding herring gulls forage.

1444. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA herring gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

1445. Predictions of the number of herring gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 99.0% were applied to the outputs from option 2 and option 3, respectively.

1446. As outlined for the St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes population and in Offshore EIA Report, volume 3, appendix 11.3 but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for herring gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1447. In addition to the above, collision estimates for herring gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA herring gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of the Offshore EIA Report, volume 3, appendix 11.3.

1448. Herring gull collision estimates are calculated for the breeding and non-breeding periods, with estimates apportioned to the Fowlsheugh SPA population according to the NatureScot (2018) approach but with allowance made for the influx of birds from other regions during the non-breeding period (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes according to the plumage characteristics of herring gulls recorded during the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst on the basis of advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

1449. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of herring gulls from the Fowlsheugh SPA is predicted to be no more than a single adult bird (plus a small fraction of an immature bird) as determined by either the Scoping Approach or Developer Approach (Table 5.90). The vast majority of this mortality (i.e. over 80%) is predicted to occur during the breeding season. The collision estimates for option 3 of the deterministic CRM with a 99.0% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.90 but give outputs that are approximately 40% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA Report, volume 3, appendix 11.3). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 99.0% avoidance rate, and hence also substantially lower than those presented in Table 5.90 below (see annex C of the Offshore EIA Report, volume 3, appendix 11.3).

Table 5.90: Predicted Collision Effects from the Proposed Development on the Fowlsheugh SPA Herring Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.9	0.1
	Non-breeding	0.1	0.1
	Annual total	1.0	0.2
Developer	Breeding	0.5	0.1
	Non-breeding	0.1	0.0
	Annual total	0.6	0.1

1450. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult herring gulls from the Fowlsheugh SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 1,414 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.07% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.3% and 0.6% for the Developer and Scoping Approaches, respectively.

1451. The potential levels of impact on the Fowlsheugh SPA herring gull population resulting from the predicted collision mortalities in Table 5.90 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

Changes to prey availability

1452. Potential impacts on key prey species for herring gulls breeding at the Fowlsheugh SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect herring gull survival and productivity in the Fowlsheugh SPA population.

1453. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1454. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA herring gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

1455. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Fowlsheugh SPA herring gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1456. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.90 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.90 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.11 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle kittiwake above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1457. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;

- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.91: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	16451 (9143 – 28431)	*1.000*	1.000	*50.0*
Scoping	1.02	0.18	16174 (8984 – 27957)	0.983	1.000	47.6
Developer	0.61	0.10	16285 (9048 – 28150)	0.990	1.000	48.7

1458. The PVA predicted that the Fowlsheugh SPA herring gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be more than 10 times larger than the current estimate of 1,414 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.91). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase does not concur with the long-term documented status of this population (which remains well below the citation level and has likely been declining since the late 1980s – see above).

1459. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, the CPS values indicate that the collision mortality associated with the Proposed Development alone would result in a reduction of less than 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.91). The associated reductions in annual population growth rate (relative to that predicted under baseline conditions) are not detectable (at least when the CPGR value is expressed to three decimal places) and the centile values are above 47.0, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. Furthermore, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that are 40% lower than those used for the PVA.

Project alone: conclusion

1460. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Fowlsheugh SPA herring gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population

Effects in-combination

Effects of relevance to the in-combination assessment

1461. As detailed above, any effects from the Proposed Development alone on the Fowlsheugh SPA herring gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1462. Therefore, the potential for effects of the Proposed Development to act on the Fowlsheugh SPA herring gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Collision risk - operation and maintenance

1463. Breeding and non-breeding season collision estimates attributed to the Fowlsheugh SPA herring gull population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (annex E of Offshore EIA Report, volume 3, appendix 11.6). As for the Proposed Development, the non-breeding season collision estimates for the other plans and projects were adjusted to account for the influx of birds from other regions to this regional population during the non-breeding period, in accordance with the estimates used for the UK North Sea and Channel BDMPS (see above, Offshore EIA Report, volume 3, appendix 11.5, Furness 2015).

1464. The collision estimates derived for the other plans and projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. The two in-combination scenarios differed due to the inclusion of collision estimates from the Aberdeen and Kincardine wind farms within the UK North Sea (but not the Forth and Tay) scenario. Options based on consented and 'as-built'[12] designs did not affect the collision estimates from the other plans and projects, so that estimates are reported for the consented designs only. The collision estimates used for the Proposed Development are those presented in Table 5.90, which derived from the more precautionary of the two different CRM approaches recommended by the Scoping Opinion (see above).

1465. The existing collision estimates for the other plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects included with the in-combination scenario having followed the 'standard' approach of using the mean density). As explained for St Abb's Head to Fast Castle SPA kittiwake above, such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data. Thus, it is only the estimates for the Proposed Development which differentiate the Developer and Scoping Approaches for the in-combination scenarios that are presented below.

Table 5.92: Predicted Collision Effects on the Fowlsheugh SPA Herring Gull Population Due to the Proposed Development In-Combination with Other Projects in the Forth and Tay and in UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Forth and Tay	Scoping	Breeding	1.1	0.3
		Non-breeding	0.4	0.2
		Annual total	1.5	0.5
	Developer	Breeding	0.7	0.3
		Non-breeding	0.3	0.2
		Annual total	1.0	0.5
UK North Sea	Scoping	Breeding	2.6	0.3
		Non-breeding	0.7	0.2
		Annual total	3.3	0.5
	Developer	Breeding	2.2	0.3
		Non-breeding	0.7	0.2
		Annual total	2.9	0.5

1466. Incorporating the potential mortality resulting from the predicted collision effects associated with other Forth and Tay wind farms increases the predicted annual collision mortality of adult birds by approximately one and half times compared to the Proposed Development alone for both the Developer and Scoping Approaches (with the increase slightly greater for the Developer Approach - Tables 5.90 and 5.92). Incorporating the predicted collision effects from the other UK North Sea wind farms results in an approximate fivefold and threefold increase compared to the Proposed Development alone for the Developer and Scoping Approaches, respectively. The increase in the predicted collision mortality amongst the immature age class when compared to the Proposed Development alone is of a similar extent, with the level of mortality predicted amongst this age class continuing to be smaller than that predicted amongst adult birds.

1467. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult herring gull from the Fowlsheugh SPA population predicted due to collisions represents 0.07% of the current adult breeding population at this colony (i.e. 1,414 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.11% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 0.6% for the Developer Approach and of 0.9% for the Scoping Approach.

1468. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult herring gull from the Fowlsheugh SPA population predicted due to collisions represents 0.21% of the current adult breeding population at this colony (i.e. 1,414 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.23% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 1.7% for the Developer Approach and of 1.9% for the Scoping Approach.

1469. The potential levels of impact on the Fowlsheugh SPA herring gull population resulting from the predicted collision mortalities in Table 5.92 are considered in more detail below in the *In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1470. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.92 above).

1471. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.93: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other Forth and Tay Wind Farms

Approach	Additional Annual Mortality Adults	Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Baseline	*0*	*0*	16451 *(9143 – 28431)*	*1.000*	1.000	*50.0*
Scoping	1.52	0.58	15987 *(8879 – 27635)*	0.972	0.999	46.1

Approach	Additional Annual Mortality Adults	Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Developer	1.11	0.50	16097 (8942 – 27826)	0.979	0.999	47.0

Table 5.94: Projected 35 Year Population Sizes And Associated PVA Metrics for the Fowlsheugh SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality Adults	Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Baseline	*0*	*0*	16451 (9143 – 28431)	*1.000*	1.000	*50.0*
Scoping	3.32	0.58	15568 (8635 – 26926)	0.946	0.998	42.7
Developer	2.91	0.50	15676 (8698 – 27106)	0.953	0.999	44.0

1472. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.93 and 5.94 with Table 5.91). However, whilst the levels of impact are clearly greater than for the Proposed Development alone, they remain relatively small. Focussing on the outputs for the Proposed Development in-combination with the other UK North Sea wind farms, the CPS values indicate that the SPA population size would be reduced by approximately 5% relative to the predicted population size under baseline conditions after 35 years, as determined by both the Scoping and Developer Approaches (Table 5.94). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.2% or less, whilst the centile values remain above 40, suggesting considerable levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being similar in size to the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate lower levels of impact, being intermediate between those for the Proposed Development alone and the Proposed Development in-combination with the other UK North Sea wind farms.

1473. It is also the case that these predicted levels of impact are derived using the more precautionary of the two CRM approaches recommended by the Scoping Opinion for the Proposed Development. Reliance on the alternative approach would result in a noticeable reduction in the predicted levels of impact, particularly for the Scoping Approach (for which the contribution of the Proposed Development to the in-combination effects is greatest).

In-combination: conclusion

1474. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms would not produce an adverse effect on the Fowlsheugh SPA herring gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the guillemot population

1475. The Fowlsheugh SPA guillemot population is currently estimated to number 91,358 breeding individuals, which is substantially above the citation population size of 56,450 individuals (Offshore EIA Report, volume 3, appendix 11.5). As for the Fowlsheugh SPA kittiwakes, earlier estimates of the size of the SPA guillemot population are not readily available from Seabird Monitoring Database (Seabird Monitoring Programme | JNCC (bto.org)) because the data from one of the four seabird count sectors which comprise the SPA are not fully aligned with the SPA boundary. However, it is apparent from the available data that the Fowlsheugh RSPB reserve has held at least 90% of the SPA population in all three years for which data are available from all four of the SPA count sectors (i.e. 1986, 1999 and 2018).

1476. Based on the counts from the Fowlsheugh RSPB reserve, it is apparent that the SPA guillemot population has shown relative stability since the SPA was designated in 1992, with the counts from the Fowlsheugh RSPB reserve (which likely comprises approximately 90%, or slightly more, of the SPA population) being above the citation level in all years for which data are available (Figure 5.25).

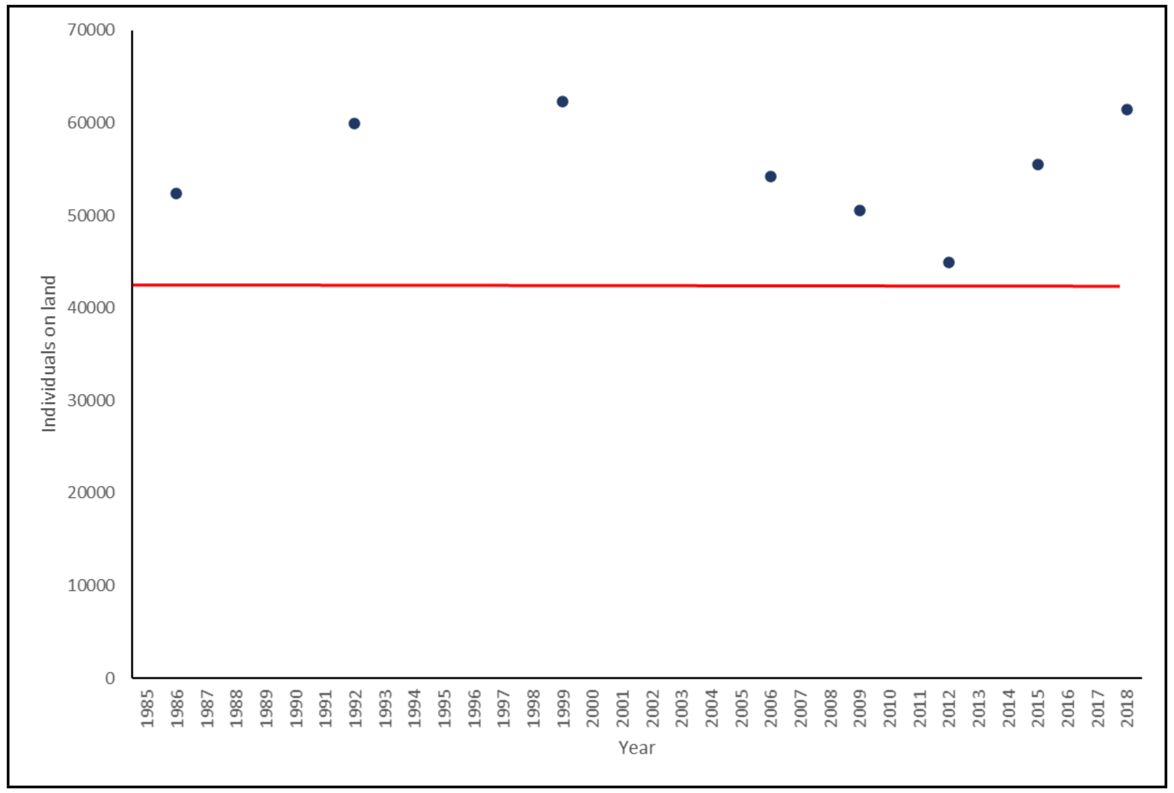

Figure 5.25: Guillemot Population Trend at the Fowlsheugh RSPB Reserve Between 1986 and 2018 (Noting that this Site Likely Accounts For Approximately 90% Of The SPA Population – see text). The Red Line Shows the Citation Population Size for the SPA (56,450 Individuals[13]). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the guillemot population

1477. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Fowlsheugh SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features.

1478. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is highly likely that during the breeding period guillemot from the Fowlsheugh SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 36% of the guillemot occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemot is defined as April to mid-August, following the NatureScot (2020) guidance.

1479. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, Offshore EIA Report, volume 3, appendix 11.5). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the Fowlsheugh SPA guillemot population during the non-breeding period as during the breeding season, with 22% of the guillemots occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

1480. Direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1481. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1482. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1483. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the Fowlsheugh SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only. Additionally, modelling of guillemot foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area and Proposed Development export cable corridor have minimal overlap with waters that are predicted to be used by birds from the Fowlsheugh SPA and exclude those areas of predicted greatest usage (Cleasby *et al.* 2018).

1484. During the non-breeding period, guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD. Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

1485. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1486. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1487. Given the moderate sensitivity of guillemot to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Fowlsheugh SPA guillemot population.

Displacement

1488. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Fowlsheugh SPA guillemot population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1489. Based upon the above, it is considered that there is relatively little potential for the Fowlsheugh SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Fowlsheugh SPA guillemot population.

Changes to prey availability

1490. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Fowlsheugh SPA guillemot population in the short-term.

1491. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Fowlsheugh SPA guillemot population are as for the St Abb's Head to Fast Castle SPA guillemot population (and are detailed above in the equivalent section for that SPA population).

1492. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA guillemot population.

Project alone: operation and maintenance

Disturbance

1493. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from Fowlsheugh SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1494. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1495. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (volume 4, appendix 25 of the Offshore EIA Report) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1496. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1497. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Fowlsheugh SPA guillemot population.

Displacement/barrier effects

1498. As outlined above, displacement effects on the Fowlsheugh SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1499. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1500. As with other species for which displacement effects are assessed (see above), the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1501. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1502. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Fowlsheugh SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.95). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Fowlsheugh SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.95: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Fowlsheugh SPA Population in Each Period. The proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.515	0.359	0.359	0.07
Non-breeding	44,171	0.515	0.223	0.223	N/A

1503. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as 260 adult and 261 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 473 adult and 473 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.96). The breeding season effects make the greatest contribution to these potential mortalities (comprising 89% and 81% of the total annual mortality for the lower and upper ranges, respectively) due to the larger mean peak population size, higher assumed mortality rates and higher proportion of birds assumed to derive from the SPA population during the breeding period (Table 5.96).

1504. The annual mortality from displacement as determined using the Developer Approach is predicted to be 89 adult and 88 immature birds, equating to approximately 34% and 19% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.96). The breeding season effects comprise 72% of the total annual mortality, as determined by the Developer Approach.

Table 5.96: Estimated Potential Annual Mortality of Fowlsheugh SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	229.6	232.5
	Non-breeding	60%	1%	30.3	28.5
	Annual total	-	-	259.9	261.0
Scoping B	Breeding	60%	5%	382.7	387.6
	Non-breeding	60%	3%	90.6	85.3
	Annual total	-	-	473.3	472.9
Developer	Breeding	50%	1%	63.8	64.6
	Non-breeding	50%	1%	25.2	23.7
	Annual total	-	-	89.0	88.3

1505. The additional annual mortality of adult guillemot from the Fowlsheugh SPA population predicted due to displacement from the Proposed Development array represents 0.10% of the current adult breeding population at this colony (i.e. 91,358 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.28 - 0.52% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.073 – see Table 2.9 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 1.3% for the Developer Approach and of 3.9 – 7.1% for the lower and upper estimates from the Scoping Approach.

1506. The potential levels of impact on the Fowlsheugh SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

1507. Potential impacts on key prey species for guillemots breeding at the Fowlsheugh SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the Fowlsheugh SPA population.

1508. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Fowlsheugh SPA guillemot population as to the St Abb's Head to Fast Castle SPA guillemot population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1509. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA guillemot population.

Project alone: population-level impacts

1510. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Fowlsheugh SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1511. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.96 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1512. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.97: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	269127 (153973 – 441376)	*1.000*	1.000	*50.0*
Scoping A	259.90	261.04	238851 (136609 – 391967)	0.887	0.997	33.3
Scoping B	473.32	472.88	216549 (123726 – 355661)	0.805	0.994	21.7
Developer	89.20	88.52	258400 (147820 – 423922)	0.960	0.999	44.3

1513. The PVA predicted that the Fowlsheugh SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be three times larger than the current estimate of 91,358 adult birds under baseline conditions (i.e. no wind farm effects) and more than twice its current size under the scenario of greatest annual mortality (i.e. Scoping Approach B) (Table 5.97). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented long-term trend of relative stability for this SPA population (as indexed by the trend for the Fowlsheugh RSPB reserve - Figure 5.25).

1514. The PVA metrics suggest relatively marked differences in the predicted population-level impacts according to the Developer and Scoping Approaches. Thus, for the Developer Approach, the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 4% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.97). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 44.3 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

1515. For the Scoping Approach, the CPS values indicate a reduction of 11 – 20% in population size after 35 years, relative to that in the absence of any wind farm effects (Table 5.97). The reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.3 – 0.6%. The centile metric indicates low to moderate overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

1516. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA guillemot population, the assessment of the Fowlsheugh SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by guillemot are equally relevant to the Fowlsheugh SPA population as to the St Abb's Head to Fast Castle SPA population. As for the St Abb's Head to Fast Castle SPA population, the evidence available from tracking data suggests low levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by guillemots from the Fowlsheugh SPA, as outlined above (Cleasby *et al.* 2018).

Project alone: conclusion

1517. Based on the Developer Approach, the potential effects from the Proposed Development alone on the Fowlsheugh SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The size of the SPA population has been relatively stable over the long-term, remains above the citation level and is considered to be in 'favourable maintained' condition. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

1518. The Scoping Approach predicts greater effects from the Proposed Development alone, with the potential resultant population-level impacts being relatively large when considering the upper range of the effects. These potential impacts are of a scale which would be considered likely to result in an adverse effect on the SPA population. However, as has been detailed above (and in Offshore EIA Report, volume 3, appendix 11.4), it is considered that the level of effects on guillemots assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. The potential for gross overestimation of the population-level impacts is further exacerbated by other precautionary elements of the assessment, which have been incorporated irrespective of the Developer or Scoping Approaches. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach, which concluded no adverse effect on the Fowlsheugh SPA guillemot population as a result of the Proposed Development alone.

Effects in-combination

Effects of relevance to the in-combination assessment

1519. As detailed above, any effects from the Proposed Development alone on the Fowlsheugh SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1520. Therefore, the potential for effects of the Proposed Development to act on the Fowlsheugh SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot (provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1521. As described in annex E of the Offshore EIA Report, volume 3, appendix 11.4, estimates of displacement mortality during both the breeding and non-breeding periods which had been attributed to the Fowlsheugh SPA guillemot population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1522. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. However, the potential effects on the SPA population were limited to the other Forth and Tay wind farms, noting that apportioning of the non-breeding season effects for guillemot did not rely on the BDMPS approach (as stated above, see also volume 3, appendix 11.5 of the Offshore EIA Report). Given that these two different in-combination scenarios are equivalent, the predicted effects are reported solely for the UK North Sea wind farms in the tables below (Table 5.98).

Table 5.98: Estimated Annual Mortality of Fowlsheugh SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea[1]	Scoping A	367.8	365.7	62.4	57.4	430.2	423.2
	Scoping B	613.0	609.5	187.0	172.1	799.9	781.6
	Developer	102.2	101.6	51.9	47.8	154.1	149.4

[1]The Forth and Tay and UK North Sea in-combination effects for the SPA population are equivalent (so that they are reported for the latter scenario only).

1523. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to an increase of approximately 65 – 70% in the predicted displacement mortality of adult birds compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.96 and 5.98). As for the Proposed Development alone, the breeding season effects make the greatest contribution to the potential mortality as determined by the Scoping and Developer Approaches (comprising 66 - 85% of the total annual mortality), with this seasonal difference in the scale of the effects again greatest for the Scoping Approach.

1524. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult guillemots from the Fowlsheugh SPA population predicted due to displacement represents between 0.17% of the current adult breeding population at this colony (i.e. 91,358 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between 0.47 – 0.88% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 2.3% for the Developer Approach and of 6.5 – 12.0% for the lower and upper estimates from the Scoping Approach.

1525. The potential levels of impact on the Fowlsheugh SPA guillemot population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1526. PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms, as determined by both the Scoping and Developer Approaches (Table 5.98). The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.99: Projected 35 year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	269127 (153973 – 441376)	*1.000*	1.000	*50.0*
Scoping A	430.29	423.20	221233 (126429 – 363302)	0.822	0.995	23.7
Scoping B	800.04	781.75	187032 (106644 – 307532)	0.695	0.990	9.6
Developer	154.10	149.42	251032 (143584 – 411908)	0.933	0.998	39.8

1527. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.99 with Table 5.97).

1528. For the Developer Approach, the CPS value indicates that the SPA population size would be reduced by approximately 7% after 35 years, relative to that in the absence of any wind farm effects (Table 5.99). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small, whilst the centile value of 39.8 indicates considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

1529. The metrics associated with the Scoping Approach indicate markedly greater levels of impact, with sizeable reductions (i.e. 18 – 31%) in the predicted population size after 35 years relative to that predicted to occur in the absence of wind farm effects, and with the values of the centile metric indicating a high likelihood of the impacted population size being smaller than the un-impacted population size after 35 years (Table 5.99).

1530. As explained above, the assessment for the Proposed Development in-combination with the other Forth and Tay wind farms is equivalent to that for the Proposed Development in-combination with the other UK North Sea wind farms in the case of this SPA population.

<u>In-combination: conclusion</u>

1531. On the basis of the Developer Approach, the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms on the Fowlsheugh SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a reasonable likelihood of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Considering this within the context of the 'favourable maintained' condition of the SPA population, it is concluded that the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Fowlsheugh SPA guillemot population.

1532. For the Scoping Approach, the potential effects resulting from the Proposed Development in-combination with the other UK North Sea wind farms are markedly greater than as predicted by the Developer Approach. It is considered that the potential levels of impact encompassed by the Scoping Approach would have the potential to result in an adverse effect on the Fowlsheugh SPA guillemot population. As for the Proposed Development alone, this conclusion should be considered within the context of the high levels of precaution incorporated in the assessment, particularly as determined by the Scoping Approach. As such, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the razorbill population

1533. The Fowlsheugh SPA razorbill population is currently estimated to number 17,817 breeding individuals, which is substantially above the citation population size of 5,800 individuals (volume 3, appendix 11.5 of the Offshore EIA Report). As for the Fowlsheugh SPA kittiwakes, earlier estimates of the size of the SPA razorbill population are not readily available from Seabird Monitoring Database (Seabird Monitoring Programme | JNCC (bto.org)) because the data from one of the four seabird count sectors which comprise the SPA are not fully aligned with the SPA boundary, whilst there are few years with counts undertaken across the entire SPA. However, it is apparent from the available data that the Fowlsheugh RSPB reserve holds the vast majority of the SPA population, with an estimated 88% of the current population estimated to be within this site (based upon the 2018 count data). The SPA population estimate used for the current assessment derives from 2018 and is corrected to align with the SPA boundaries.

1534. Based on the counts from the Fowlsheugh RSPB reserve, the SPA razorbill population size appears to have been relatively stable since the mid 1980s but with a marked increase in recent years. The counts from the Fowlsheugh RSPB reserve are above, or close to, the citation level in all years for which data are available (Figure 5.26).

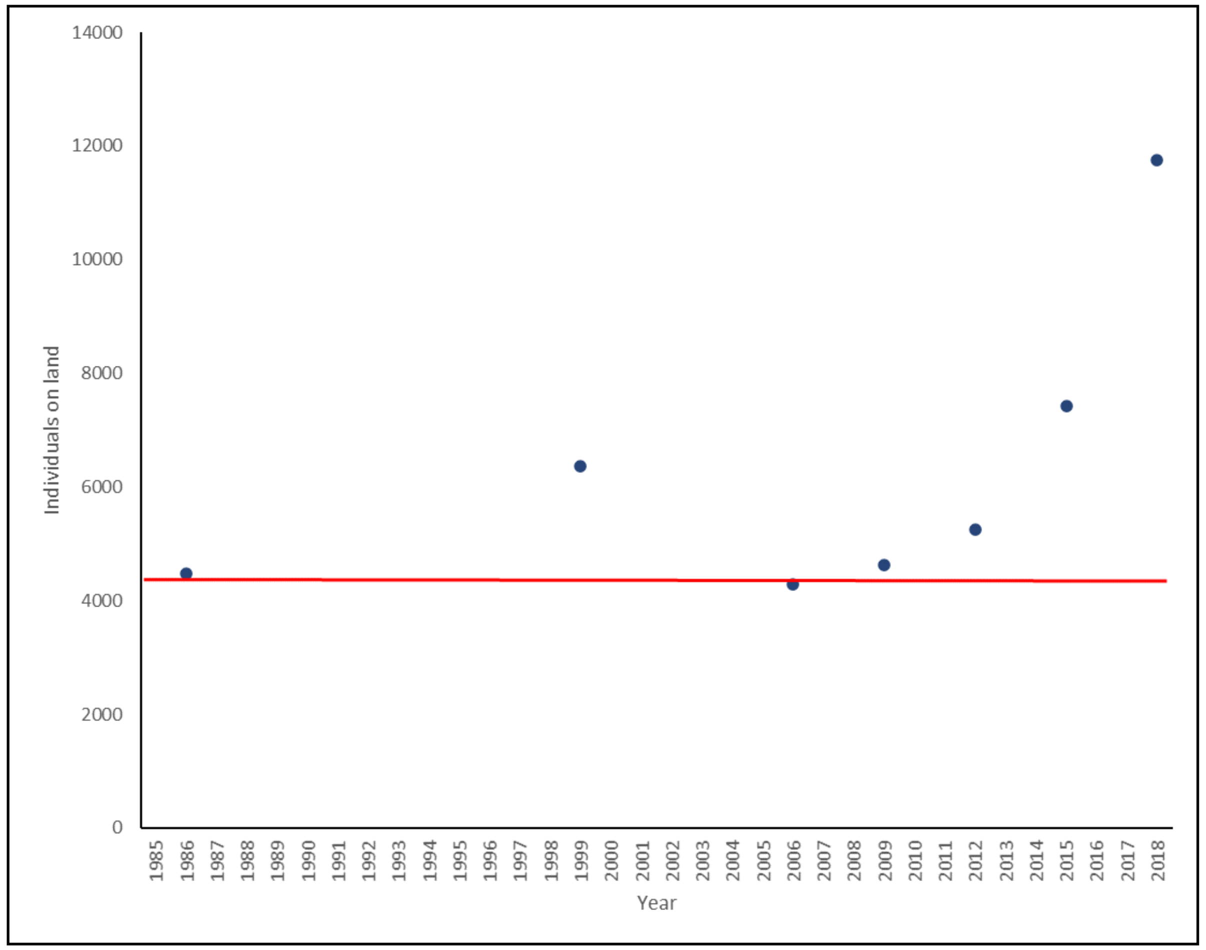

Figure 5.26: Razorbill Population Trend at the Fowlsheugh RSPB Reserve Between 1986 and 2018 (Noting that this Site Accounts for a High Proportion of the SPA Population – see text). The Red Line Shows the Citation Population Size for the SPA (5,800 INDIVIDUALS[13]). Data are from the Seabird Monitoring Programme Database (Seabird Monitoring Programme | JNCC (bto.org))

The potential for impacts on the razorbill population

1535. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Fowlsheugh SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1536. From published information on razorbill foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is highly likely that during the breeding period razorbill from the Fowlsheugh SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 29% of the razorbill occurring on the Proposed Development array area during the breeding season derive from this SPA colony (volume 3, appendix 11.5 of the Offshore EIA Report). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

1537. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the Fowlsheugh SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, volume 3, appendix 11.5 of the Offshore EIA Report). Given this, the Proposed Development may have potential effects on the Fowlsheugh SPA razorbill population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1538. Direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1539. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1540. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1541. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to razorbills from the Fowlsheugh SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array area and export cable corridor represent approximately 10% of the breeding season foraging area if considering the mean maximum foraging range only. Modelling of razorbill foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development has minimal overlap with waters that are predicted to be used by birds from the Fowlsheugh SPA and is beyond those areas of most concentrated usage (Cleasby *et al.* 2018).

1542. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

1543. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1544. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1545. Given the moderate sensitivity of razorbill to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Fowlsheugh SPA razorbill population.

Displacement

1546. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Fowlsheugh SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1547. Based upon the above, it is considered that there is relatively little potential for the Fowlsheugh SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Fowlsheugh SPA razorbill population.

Changes to prey availability

1548. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Fowlsheugh SPA razorbill population in the short-term.

1549. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Fowlsheugh SPA razorbill population are as for the St Abb's Head to Fast Castle SPA razorbill population (and are detailed above in the equivalent section for that SPA population).

1550. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA razorbill population.

Project alone: operation and maintenance

Disturbance

1551. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from Fowlsheugh SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1552. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1553. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 13 of the Offshore EIA Report, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (volume 4, appendix 25 of the Offshore EIA Report) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1554. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1555. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Fowlsheugh SPA razorbill population.

Displacement/barrier effects

1556. As outlined above, displacement effects on the Fowlsheugh SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1557. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1558. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1559. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1560. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Fowlsheugh SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (volume 3, Offshore EIA Report, volume 3, appendix 11.5; Table 5.100). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Fowlsheugh SPA razorbill PVAs in this assessment (volume 3, appendix 11.6 of the Offshore EIA Report). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.100: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Fowlsheugh SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			ADULTS	IMMATURES	
Breeding	4,040	0.580	0.292	0.292	0.07
Autumn migration	8,849	N/A	0.012	0.008	N/A
Winter	1,399	N/A	0.010	0.002	N/A
Spring Migration	7,480	N/A	0.012	0.008	N/A

1561. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 13 adult and 10 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 23 adult and 18 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.101). The breeding season effects make the greatest contribution to these potential mortalities (comprising 93% and 84% of the total annual mortality for the lower and upper mortality rates, respectively) due to the higher assumed mortality rates and higher proportion of birds assumed to derive from the SPA population during this period (Table 5.101).

1562. The annual mortality from displacement as determined using the Developer Approach is predicted to be 4 adult and 3 immature birds, equating to approximately 33% and 18% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.101). As for the Scoping Approach, effects during the breeding season make the greatest contribution (79%) to the predicted annual mortality, with this being slightly less marked because the mortality rates for each seasonal period are assumed to be same under the Developer Approach.

Table 5.101: Estimated Potential Annual Mortality of Fowlsheugh SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	11.5	9.0
	Autumn migration	60%	1%	0.6	0.4
	Winter	60%	1%	0.1	0.0
	Spring migration	60%	1%	0.5	0.4
	Annual total	-	-	12.7	9.8
Scoping B	Breeding	60%	5%	19.2	15.0
	Autumn migration	60%	3%	1.9	1.3
	Winter	60%	3%	0.3	0.1
	Spring migration	60%	3%	1.6	1.1
	Annual total	-	-	23.0	17.5
Developer	Breeding	50%	1%	3.3	2.6
	Autumn migration	50%	1%	0.5	0.4
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	0.4	0.3
	Annual total	-	-	4.2	3.3

1563. The additional annual mortality of adult razorbill from the Fowlsheugh SPA population predicted due to displacement from the Proposed Development array represents 0.02% of the current adult breeding population at this colony (i.e. 17,817 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.07 – 0.13% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.3% for the Developer Approach and of 0.8 – 1.4% for the lower and upper estimates from the Scoping Approach.

1564. The potential levels of impact on the Fowlsheugh SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

1565. Potential impacts on key prey species for razorbills breeding at Fowlsheugh SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the Fowlsheugh SPA population.

1566. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Fowlsheugh SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1567. Given this, it is considered that there is relatively little potential for the Fowlsheugh SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Fowlsheugh SPA razorbill population.

Project alone: population-level impacts

1568. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Fowlsheugh SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1569. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.101 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2018 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1570. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.102: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development Alone.

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	29933 (12538 – 65441)	*1.000*	1.000	*50.0*
Scoping A	12.73	9.76	29059 (12170 – 63568)	0.971	0.999	47.5
Scoping B	22.95	17.38	28382 (11887 – 62117)	0.948	0.999	45.6
Developer	4.34	3.25	29635 (12412 – 64801)	0.990	1.000	48.8

1571. The PVA predicted that the Fowlsheugh SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to increase by 68% from the current estimate of 17,817 adult birds under baseline conditions (i.e. no wind farm effects) and by 59% under the scenario of greatest annual mortality (i.e. Scoping Approach B), respectively (Table 5.102). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). The prediction of an increasing population trend has some, broad level, consistency with the documented long-term trend for this SPA population (as indexed by the trend for the Fowlsheugh RSPB reserve) of relative stability with a recent marked increase (Figure 5.26).

1572. The PVA metrics suggest relatively small effects overall. Thus, the CPS value for the Developer Approach indicates that the displacement effects from the Proposed Development alone would result in a reduction of 1% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 3 – 5% after 35 years, relative to that in the absence of any wind farm effects (Table 5.102). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable for the Developer Approach (at least when the CPGR value is expressed to three decimal places) and is only 0.1% for the Scoping Approach. The centile values are all above 45, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.102).

1573. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the Fowlsheugh SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are equally relevant to the Fowlsheugh SPA population as to the St Abb's Head to Fast Castle SPA population. As for the St Abb's Head to Fast Castle SPA population, the evidence available from tracking data suggests low levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by razorbills from the Fowlsheugh SPA, as outlined above (Cleasby *et al.* 2018).

Project alone: conclusion

1574. It is considered that the predicted levels of impact from the Proposed Development alone on the Fowlsheugh SPA razorbill population are of a relatively small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach) and a population for which the documented, long-term, trend is relative stability with a recent marked increase, and which is considered to be in 'favourable maintained' condition. Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1575. As detailed above, any effects from the Proposed Development alone on the Fowlsheugh SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1576. Therefore, the potential for effects of the Proposed Development to act on the Fowlsheugh SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

1577. As described in annex E of Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Fowlsheugh SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1578. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see annex D of Offshore EIA Report, volume 3, appendix 11.6 for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the Fowlsheugh SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.101). This was done separately for all of the other UK North Sea wind farms and for the subset represented by the other Forth and Tay wind farms.

Table 5.103: Estimated Annual Mortality of Fowlsheugh SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period: Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	48.8	41.5	1.2	0.8	0.3	0.1	0.5	0.4	50.8	42.7
	Scoping B	81.4	69.1	3.7	2.5	0.9	0.3	1.6	1.1	87.6	73.0
	Developer	13.7	11.6	1.0	0.7	0.2	0.1	0.4	0.3	15.2	12.7
UK North Sea	Scoping A	48.8	41.5	3.9	2.6	1.6	0.4	3.0	2.0	57.3	46.5
	Scoping B	81.4	69.1	11.6	7.8	4.8	1.2	9.0	6.0	106.8	84.1
	Developer	13.7	11.6	3.2	2.2	1.3	0.3	2.5	1.7	20.7	15.8

1579. The potential mortality resulting from the predicted displacement effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms represents an approximate fourfold increase in that predicted for the Proposed Development alone (for both Developer and Scoping Approaches), whilst for the Proposed Development in-combination with the other UK North Sea wind farms there is an almost fivefold increase in the predicted mortality compared to that for the Proposed Development alone (Tables 5.101 and 5.103). For all scenarios the predicted mortality is concentrated in the breeding season. Thus, for the Proposed Development in-combination with the other Forth and Tay wind farms, 91 – 97% of the predicted mortality is attributed to the breeding season, whilst for the Proposed Development in-combination with the other UK North Sea wind farms 69 – 87% of the predicted mortality is attributed to the breeding season (with the percentages being higher for the Scoping Approach than the Developer Approach).

1580. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult razorbills from the Fowlsheugh SPA population predicted due to displacement represents 0.09% of the current adult breeding population at this colony (i.e. 17,817 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.29 – 0.49% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.9% for the Developer Approach and of 3.2 – 5.5% for the lower and upper estimates from the Scoping Approach.

1581. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult razorbills from the Fowlsheugh SPA population predicted due to displacement represents 0.12% of the current adult breeding population at this colony as determined by the Developer Approach, and between approximately 0.32 – 0.60% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 1.3% for the Developer Approach and of 3.6 – 6.7% for the lower and upper estimates from the Scoping Approach.

1582. The potential levels of impact on the Fowlsheugh SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1583. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.103 above).

1584. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.104: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other Forth and Tay Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	29933 (12538 – 65441)	*1.000*	1.000	*50.0*
Scoping A	50.93	42.76	26485 (11086 – 58013)	0.885	0.997	38.8
Scoping B	88.25	73.38	24224 (10137 – 53142)	0.809	0.994	30.9
Developer	15.64	12.85	28834 (12077 – 63086)	0.963	0.999	47.0

Table 5.105: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fowlsheugh SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	29933 (12538 – 65441)	*1.000*	1.000	*50.0*
Scoping A	57.23	46.46	26134 (10938 – 57257)	0.873	0.996	37.6
Scoping B	106.70	84.18	23293 (9743 – 51130)	0.778	0.993	27.7
Developer	20.74	15.75	28527 (11947 – 62426)	0.953	0.999	46.0

1585. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.102 with Tables 5.104 and 5.105). However, on the basis of the effects as determined by the Developer Approach, the predicted levels of impact remain relatively small. Thus, the CPS value for the Proposed Development in-combination with the other UK North Sea wind farms indicates that the SPA population size would be reduced by 5% after 35 years relative to that in the absence of any wind farm effects (Table 5.105). The centile value of 46.0 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate lower levels of impact (as determined by the Developer Approach), as would be expected from the lower predicted mortalities (Table 5.104).

1586. The predicted levels of impact as determined by the Scoping Approach are considerably greater, with the CPS values indicating reductions of 12 – 19% and of 13 – 22% in the size of the SPA population after 35 years (relative to that in the absence of any wind farm effects) for the other Forth and Tay in-combination scenario and the other UK North Sea in-combination scenario, respectively (Tables 5.104 and 5.105). The centile values range from 30.9 – 38.8 for the Proposed Development in-combination with the other Forth and Tay wind farms and from 27.7 – 37.6 for the Proposed Development in-combination with the other UK North Sea wind farms. These suggest a moderate overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, overall a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years.

In-combination: conclusion

1587. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other Forth and Tay wind farms or the other UK North Sea wind farms would not result in an adverse effect on the Fowlsheugh SPA razorbill population. The predicted population-level impacts are small, whilst there remains a high likelihood of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Furthermore, this level of impact is within the context of an assessment which incorporates high levels of precaution and a population for which the documented, long-term, trend has been relatively stable over the long-term (but with a recent marked increase) and which is considered to be in 'favourable maintained' condition.

1588. For the Scoping Approach, the predicted levels of impact are markedly greater. For the upper, but not lower, range of effects encompassed by the Scoping Approach it is considered that the possibility of an adverse effect on the SPA population cannot be excluded. This conclusion is considered to apply to the effects from the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms. However, as detailed above, it is also considered that the displacement and mortality rates used in the Scoping Approach are overly precautionary and are not supported by the available evidence (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Therefore, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the breeding seabird assemblage

1589. The breeding seabird assemblage for the Fowlsheugh SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supports 145,000 seabirds). Razorbill, guillemot, kittiwake and herring gull comprise four of the five species identified in the citation as having populations which are considered to be of European or national importance and which contribute to the Fowlsheugh SPA breeding seabird assemblage (the fifth such species being fulmar, for which no LSE was determined in relation to the Proposed Development – HRA Stage One Screening Report).

1590. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach, the assessments undertaken above identify the potential for an adverse effect only on the SPA kittiwake population in relation to both of the in-combination scenarios. For the Scoping Approach, the assessments undertaken above identify the potential for adverse effects on the SPA guillemot population for the project alone and for the SPA kittiwake, guillemot and razorbill populations in relation to both of the in-combination scenarios.

1591. Thus, for the Proposed Development alone, the potential for an adverse effect is identified only for the SPA guillemot population as determined by the Scoping Approach (but not as determined by the Developer Approach). Given the range of species present within the SPA seabird assemblage and their relative abundances, it is considered that the potential adverse effect on the SPA guillemot population (as determined by the Scoping Approach) would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

1592. For the in-combination scenarios as determined by the Developer Approach, the potential for an adverse effect is identified only in relation to the SPA kittiwake population. The Fowlsheugh SPA kittiwake population is currently two and half to three times larger than those at the St Abb's Head to Fast Castle SPA and at the Forth Islands SPA. Therefore, despite the documented long-term decline in this population, it is not considered that the in-combination effects are likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Fowlsheugh SPA (in contrast to the conclusions reached for the St Abb's Head to Fast Castle SPA and Forth Islands SPA). Also, given the range of species present within the SPA seabird assemblage and their relative abundances, it is considered that the potential adverse effect on the SPA kittiwake population would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

1593. For the in-combination scenarios as determined by the Scoping Approach, it is also the case that the predicted impacts on the SPA kittiwake are not considered likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Fowlsheugh SPA. However, it is considered conceivable that the combined predicted in-combination impacts on the SPA kittiwake, guillemot and razorbill populations are such as to represent a risk of reducing the total number of individual seabirds present in the assemblage to a level that could represent an adverse effect on this qualifying feature. This conclusion should be considered within the context of the high levels of precaution incorporated within the assessment, with these being outlined above in the sections on the contributory SPA populations of the Fowlsheugh SPA breeding seabird assemblage.

1594. Given the above, it is concluded that there is the potential for an adverse effect on the Fowlsheugh SPA breeding seabird assemblage in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms, as determined by the Scoping Approach. No potential for an adverse effect on the SPA breeding seabird assemblage is identified in relation to the Proposed Development alone (irrespective of whether determined by the Developer or Scoping Approaches) or in relation to the Proposed Development in-combination with (i) the other Forth and Tay wind farms and (ii) the other UK North Sea wind farms, as determined by the Developer Approach.

Site conclusion

Developer approach

1595. It is concluded that the possibility of an adverse effect cannot be discounted for the Fowlsheugh SPA population of breeding kittiwake (noting this species is a named component of the seabird assemblage feature only). For the kittiwake population, the potential for an adverse effect arises from the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. The predicted impacts on the SPA kittiwake population are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature.

1596. Consequently, it is concluded that an Adverse Effects on Integrity of the Fowlsheugh SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects.

Scoping approach

1597. It is concluded that the possibility of adverse effects cannot be discounted for the Fowlsheugh SPA populations of breeding kittiwake, guillemot and razorbill (noting these species are named components of the seabird assemblage feature only), as well as the breeding seabird assemblage qualifying feature (due to the impacts on kittiwake, guillemot and razorbill components only). For the guillemot population, the potential for an adverse effect arises from the Proposed Development alone and the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms. For the kittiwake and razorbill populations, and the breeding seabird assemblage feature, the potential for an adverse effect is in relation to the effects of the Proposed Development in-combination with either (i) the other Forth and Tay wind farms or (ii) the other UK North Sea wind farms.

1598. For the Proposed Development alone, the predicted impacts on the SPA guillemot population are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature, whilst the potential for an adverse effect on the breeding seabird assemblage feature in relation to the in-combination scenarios is a direct consequence of the potential in-combination effects on the kittiwake, guillemot and razorbill populations.

1599. Consequently, it is concluded that an Adverse Effects on Integrity of the Fowlsheugh SPA cannot be excluded due to effects of the Proposed Development alone and in-combination with other plans and projects.

5.7.4. FARNE ISLANDS SPA

European site information and conservation objectives

1600. The Farne Islands SPA are a group of low-lying islands located 2 - 8 km off the coast of Northumberland in northeast England, approximately 50 km from the Proposed Development. The Farne Islands was first classified as an SPA in 1985, with the surrounding marine environment protected by the Northumberland Marine SPA, which was classified in 2017 to protect the foraging areas of breeding seabirds.

1601. There are four Annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting one migratory seabird species and in excess of 20,000 breeding seabirds, including four named component species as identified on the citation but with a further six identified by Natural England in their scoping advice (Table 5.106, volume 3, appendix 6.2 of the Offshore EIA Report). The potential for LSE has been identified in relation to six of these 15 species (Table 5.106), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

1602. The conservation objectives of this SPA (as determined through Natural England's Access to Evidence) are to:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

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

1603. Further information on this European site, including the SACOs, is presented in appendix 3A.

Table 5.106: Details on the Qualifying Features of the Farne Islands SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Not available	163,819 individuals	Yes
Kittiwake*	Breeding	Not available	8,241 individuals	Yes
Sandwich tern	Breeding	Not available	1,724 individuals	No
Roseate tern	Breeding	Not available	26 individuals	No
Common tern	Breeding	Not available	366 individuals	No
Arctic tern	Breeding	Not available	4,006 individuals	No
Guillemot	Breeding	Not available	65,751 individuals	Yes
Puffin*	Breeding	Not available	76,798 individuals	Yes
Cormorant*	Breeding	Not available	230 individuals	No
Shag*	Breeding	Not available	1,677 individuals	No
Fulmar**	Breeding	Not available	Not available	No
Black-headed gull**	Breeding	Not available	Not available	No
Great black-backed gull**	Breeding	Not available	Not available	No
Lesser black-backed gull**	Breeding	Not available	Not available	Yes
Herring gull**	Breeding	Not available	Not available	Yes
Razorbill**	Breeding	Not available	Not available	Yes

*Named components of the assemblage only.

**Named components of the assemblage only which are not identified on the citation but are included on the basis of the Natural England scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report).

Assessment for the kittiwake population

1604. The Farne Islands SPA kittiwake population is currently estimated to number 8,804 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). The SPA population was estimated to number between approximately 12,000 – 12,500 birds during the early 1990s (SMP 2022) but has since declined, although the decline is not as marked as in many of the kittiwake SPA populations on the east coast of Scotland and numbers remain just above the citation level.

The potential for impacts on the kittiwake population

1605. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its kittiwake population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other Conservation Objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

1606. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is apparent that during the breeding period kittiwakes from the Farne Islands SPA may occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is reflected in the findings of the apportioning exercise, which estimates that approximately 5% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

1607. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Farne Islands SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Farne Islands SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1608. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1609. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1610. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1611. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Farne Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the (main) seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

1612. Tracking data (and associated modelling of foraging distributions) for kittiwake appear to suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are heavily used by birds from the Farne Islands SPA during the breeding season (Wakefield *et al.* 2017).

1613. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015) and the potential for effects of construction-related disturbance is lower than during the breeding season.

1614. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1615. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1616. Given the low sensitivity of kittiwake to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Farne Islands SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

1617. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Farne Islands SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1618. Therefore, based upon the above, it is considered that there is relatively little potential for the Farne Islands SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Farne Islands SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

1619. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA kittiwake population in the short-term.

1620. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Farne Islands SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

1621. Given this, it is considered that there is relatively little potential for the Farne Islands SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

1622. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Farne Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1623. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1624. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 13 of the Offshore EIA Report, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (volume 4, appendix 25 of the Offshore EIA Report) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1625. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1626. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Farne Islands SPA kittiwake population.

Displacement/barrier effects

1627. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.5). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.5).

1628. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

1629. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

1630. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.5), with these estimates then apportioned to the Farne Islands SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5; Table 5.107). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.107: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Farne Islands SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	0.045	0.045	*0.10*
Autumn migration	*11,190*	*N/A*	0.005	0.003	*N/A*
Spring migration	*13,766*	*N/A*	0.007	0.003	*N/A*

1631. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as three adult and 0.3 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as nine adult and one immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.108). As expected on the basis that kittiwakes from this breeding colony SPA may use the waters within the vicinity of the Proposed Development array area during the breeding season (and as reflected by the seasonally-specific apportioning rates), the displacement effects predicted by the Scoping Approach are largely attributable to the breeding season (with the potential breeding season mortality accounting for almost 80% of the overall annual mortality – Table 5.108).

1632. The annual mortality from displacement as determined using the Developer Approach is predicted to be approximately five adult and 0.2 immature birds, so lies midway between the mortality predictions from the Scoping Approach and is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.108: Estimated Potential Annual Mortality of Farne Islands SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	2.5	0.1
	Autumn migration	30%	1%	0.2	0.1
	Spring migration	30%	1%	0.3	0.1
	Annual total	-	-	3.0	0.3
Scoping B	Breeding	30%	3%	7.5	0.3
	Autumn migration	30%	3%	0.5	0.3
	Spring migration	30%	3%	0.9	0.4
	Annual total	-	-	8.9	0.9
Developer	Breeding	30%	2%	5.0	0.2
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	5.0	0.2

1633. The additional annual mortality of adult kittiwakes from the Farne Islands SPA population predicted due to displacement from the Proposed Development array represents 0.06% of the current adult breeding population at this colony (i.e. 8,804 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.03 – 0.10% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.4% for the Developer Approach and of 0.24 – 0.70% for the lower and upper estimates from the Scoping Approach.

1634. The potential levels of impact on the Farne Islands SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

1635. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

1636. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Farne Islands SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1637. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

1638. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of the Offshore EIA Report, volume 3, appendix 11.3.

1639. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the Farne Islands SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (volume 3, appendix 11.5, Table 5.107 of the Offshore EIA Report). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.107).

1640. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Farne Islands SPA is predicted to be approximately 26 adults and two immatures as determined by the Scoping Approach, and approximately 18 adults and one immature as determined by the Developer Approach (Table 5.109). As for displacement, the vast majority of this mortality (i.e. over 90%) is predicted to occur during the breeding season.

Table 5.109: Predicted Collision Effects from the Proposed Development on the Farne Islands SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenarioand are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	24.2	0.8
	Autumn migration	0.9	0.5
	Spring migration	1.3	0.6
	Annual total	26.4	1.9
Developer	Breeding	16.7	0.6
	Autumn migration	0.5	0.3
	Spring migration	1.1	0.5
	Annual total	18.3	1.4

1641. The additional annual mortality of adult kittiwakes from the Farne Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.21% of the number of adults currently estimated to breed at this colony (i.e. 8,804 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.30% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 1.4% and 2.1% for the Developer and Scoping Approaches, respectively.

1642. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Farne Islands SPA kittiwake population that are at least 50% lower than those presented in Table 5.109 above (and on which the assessment is based).

1643. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.109 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

1644. Potential impacts on key prey species for kittiwakes breeding at the Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Farne Islands SPA kittiwake population.

1645. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Farne Islands SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1646. Given this, it is considered that there is relatively little potential for the Farne Islands SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA kittiwake population.

Project alone: population-level impacts

1647. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1648. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.108 and 5.109 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

1649. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.110: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	4867 (2088 – 11242)	*1.000*	1.000	*50.0*
	Scoping A	29.33	2.21	4437 (1902 – 10267)	0.911	0.997	41.1
	Scoping B	35.19	2.82	4354 (1865 – 10079)	0.894	0.997	39.3
	Developer	23.18	1.50	4527 (1941 – 10468)	0.930	0.998	43.1

1650. The PVA predicted a continuing population decline for the Farne Islands SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, under baseline conditions (i.e. no wind farm effects), the population is predicted to decline by 45% after 35 years from the current estimate of 8,804 adult birds (Table 5.110). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted declines are inevitably greater for those scenarios incorporating the effects from the Proposed Development (with the predicted decline in population size being 50% as determined by Scoping Approach B, for which the predicted effects are greatest).

1651. Considering the PVA metrics, the CPS values indicate that the SPA population size would be reduced by approximately 7% and 9 – 11%, relative to the predicted population size under baseline conditions, after 35 years for the Developer Approach and Scoping Approach, respectively (Table 5.110). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be approximately 0.2% on the basis of the Developer Approach and 0.3% on the basis of the Scoping Approach (Table 5.110). On the basis of the Developer Approach, the centile value is estimated to be 43 after 35 years, whilst for the Scoping Approach the equivalent values are 39.3 – 41.1 (Table 5.110). Thus, overall, the centile metric indicates considerable overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

1652. The PVA outputs described above, and detailed in Table 5.110, need to be considered within the context of the fact that the SPA population is predicted to decline irrespective of the wind farm effects and that such a trend is broadly consistent with the documented long-term trend for this population (see above). As described in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population, the available evidence suggests that the long-term decline of kittiwake populations in the North Sea (including the Farne Islands SPA) is associated with fisheries management and climate change (Frederiksen *et al.* 2004). Therefore, without appropriate management to mitigate these effects, it is likely that the Farne Islands SPA population will continue to decline and that the predicted effects from the Proposed Development may be of limited importance relative to these broader-scale effects. Furthermore, it is also relevant to consider the high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach (with this also detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

Project alone: conclusion

1653. Overall, it is considered that the predicted levels of impact from the Proposed Development alone on the Farne Islands SPA kittiwake population are of a relatively small scale. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. Given this is within the context of a population which (consistent with the documented long-term trend) is predicted to decline irrespective of the effects from the Proposed Development, and for which the assessment incorporates high levels of precaution (particularly as determined by the Scoping Approach), it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1654. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1655. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the offshore wind farms in the UK North Sea.

Displacement/barrier effects – operation and maintenance

1656. As described in annex E of Offshore EIA Report, volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Farne Islands SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1657. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (annex D of Offshore EIA Report, volume 3, appendix 11.6), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in-combination *Displacement/barrier effects – operation and maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

1658. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates according to both the Scoping Approach and Developer Approach (Table 5.111).

Table 5.111: Estimated Annual Mortality of Farne Islands SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	2.5	0.1	0.9	0.5	1.4	0.6	4.8	1.2
	Scoping B	7.5	0.3	2.7	1.6	4.1	1.8	14.3	3.6
	Developer	5.0	0.2	N/A	N/A	N/A	N/A	5.0	0.2

1659. The potential mortality from the displacement effects associated with the other UK North Sea wind farms is limited to the passage periods, with none of these other wind farms identified as contributing to breeding season effects on this SPA population (see annex E of the Offshore EIA Report, volume 3, appendix 11.6). Thus, for the Developer Approach (for which the potential displacement mortality is limited to the breeding season), the in-combination effects from displacement are equivalent to those from the Proposed Development alone (Tables 5.108 and 5.111). For the Scoping Approach, the incorporation of the effects from the other UK North Sea wind farms leads to a near doubling in the mortality predicted from displacement compared to the Proposed Development alone, with less than 50% of the in-combination mortality attributed to the breeding season.

1660. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Farne Islands SPA population predicted due to displacement represents 0.05 – 0.16% of the current adult breeding population at this colony (i.e. 8,804 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.4 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 0.4 – 1.1% for the lower and upper estimates from the Scoping Approach. For the Developer Approach, the equivalent percentages are as calculated above for the Proposed Development alone.

1661. The potential levels of impact on the Farne Islands SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

1662. As for displacement, breeding season collision estimates attributed to the Farne Islands SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (annex D of the Offshore EIA Report, volume 3, appendix 11.6). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (annex D of the Offshore EIA Report, volume 3, appendix 11.46). The non-breeding season collision estimates were apportioned to the Farne Islands SPA population according to the BDMPS approach (Furness 2015).

1663. Collision estimates based on consented and 'as-built'[11] designs were also considered but for the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms and had minimal effects on those for the other UK North Sea wind farms (with the respective totals differing by approximately one adult bird). Therefore, only the estimates for the consented designs are considered in this case.

1664. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

1665. As for displacement, the potential mortality estimates derived for the other plans and projects were combined with those for the Proposed Development to give estimates for the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.112).

Table 5.112: Predicted Collision Effects on the Farne Islands SPA Kittiwake Population Due to the Proposed Development In-Combination with Other Projects in the UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	24.2	0.8
		Autumn migration	5.2	3.1
		Spring migration	7.0	3.1
		Annual total	36.4	7.0
	Developer	Breeding	16.7	0.6
		Autumn migration	4.9	2.9
		Spring migration	6.8	3.0
		Annual total	28.4	6.5

1666. As for the in-combination displacement effects on this SPA population (detailed above), the potential collision mortality associated with the other UK North Sea wind farms is limited to the passage periods, with none of these other wind farms identified as contributing to breeding season effects (see annex E of Offshore EIA Report, volume 3, appendix 11.6). The predicted collisions associated with other plans and projects increases that predicted for the Proposed Development alone by 53% for the Scoping Approach and 77% for the Developer Approach (Tables 5.109 and 5.112). In contrast to the effects associated with the Proposed Development alone, only 50 – 58% of the predicted collision mortality is attributed to the breeding season.

1667. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Farne Islands SPA population predicted due to collisions represents 0.32% of the current adult breeding population at this colony (i.e. 8,804 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.41% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 2.2% for the Developer Approach and of 2.9% for the Scoping Approach.

1668. The potential levels of impact on the Farne Islands SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-Combination: Population-Level Impacts

1669. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.111 and 5.112 above).

1670. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.113: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	4867 (2088 – 11242)	*1.000*	1.000	*50.0*
Scoping A	41.13	8.21	4229 (1811 – 9793)	0.869	0.996	37.2
Scoping B	50.69	10.62	4089 (1750 – 9473)	0.840	0.995	34.3

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Developer	33.18	6.60	4346 (1863 – 10059)	0.893	0.997	39.2

1671. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.113 with Table 5.110). Thus, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by almost 11% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 13 – 16% (Table 5.113). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.3% for the Developer Approach and 0.4 – 0.5% for the Scoping Approach. The values for the centile metric are estimated as 39.2 after 35 years for the Developer Approach and as 34.3 – 37.2 for the Scoping Approach. For the Scoping Approach these suggest moderate levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years, whilst for the Developer Approach this likelihood is higher.

1672. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

In-combination: conclusion

1673. For the Developer Approach, the predicted levels of impact associated with the Proposed Development in-combination with the other UK North Sea wind farms remain relatively small, whilst the likelihood of the impacted population being similar in size to the un-impacted population after 35 years remains reasonably high. This is within the context of a population which (consistent with the documented long-term trend) is predicted to decline irrespective of the potential wind farm effects (which are likely to be of minor importance relative to other management and environmental factors in determining population status), and an assessment which incorporates high levels of precaution. Consequently, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on this SPA population, as determined by the Developer Approach.

1674. For the Scoping Approach, the predicted levels of impact for the Proposed Development in-combination with the other UK North Sea wind farms are inevitably greater than as determined by the Developer Approach. It is considered that these may, potentially, be sufficient to result in an adverse effect on this SPA population. However, as has been detailed above (and in the Offshore EIA Report, volume 3, appendix 11.3), it is considered that the level of effects on kittiwakes assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the herring gull population

1675. The Farne Islands SPA herring gull population is currently estimated to number 1,496 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). The earliest counts of herring gull that are available on the SMP database (SMP 2022) for the SPA give an estimate of 1,148 individuals in 2000, with subsequent counts showing that the numbers of breeding individuals in the SPA population have fluctuated between a low of 1,048 in 2002 and a peak of 2,090 in 2006.

The potential for impacts on the herring gull population

1676. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its herring gull population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

1677. From published information on herring gull foraging ranges (Woodward *et al.* 2019), it is possible that during the breeding period herring gulls from the Farne Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is supported by the findings of the apportioning exercise, which estimates that 3% of the herring gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (volume 3, appendix 11.5 of the Offshore EIA Report). The breeding period for herring gull is defined as April to August, following NatureScot (2020).

1678. In the non-breeding season, herring gulls in Great Britain are largely sedentary with relatively short local movements only (Wernham *et al.* 2002). However, there is an influx of breeding birds of Scandinavian breeding subspecies, *L. argentatus argentatus* (Coulson *et al.,* 1984). On this basis, and following the scoping advice from NatureScot (volume 3, appendix 6.2 of the Offshore EIA Report), it is assumed that during the non-breeding period herring gulls remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, volume 3, appendix 11.5). To account for the influx of birds from other regions to this regional population during the non-breeding period, the regional non-breeding population is assumed to increase (relative to the size of the breeding population) in accordance with the proportion of continental and western UK birds estimated to be present in the UK North Sea and Channel BDMPS (Furness 2015, volume 3, appendix 11.5 of the Offshore EIA Report).

1679. Given the above, there is potential for the Proposed Development to have effects on the Farne Islands SPA herring gull population during both the breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

1680. Herring gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on herring gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA herring gull population in the short-term.

1681. During construction there are a number of ways in which effects on herring gull prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent c. 10% of the total breeding season foraging area that is potentially available to the SPA herring gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 58.8±26.8 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for herring gulls breeding at the Farne Islands SPA. Non-breeding season effects are expected to similar since herring gulls in Great Britain do not disperse widely during winter (Wernham *et al.* 2002).

1682. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect herring gull prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding herring gulls forage.

1683. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA herring population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

1684. Predictions of the number of herring gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 99.0% were applied to the outputs from option 2 and option 3, respectively.

1685. As outlined for the St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes population and in Offshore EIA Report, volume 3, appendix 11.3 but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for herring gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1686. In addition to the above, collision estimates for herring gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA herring gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of Offshore EIA Report, volume 3, appendix 11.3.

1687. Herring gull collision estimates are calculated for the breeding and non-breeding periods, with estimates apportioned to the Farne Islands SPA population according to the NatureScot (2018) approach but with allowance made for the influx of birds from other regions during the non-breeding period (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes according to the plumage characteristics of herring gulls recorded during the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst on the basis of advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

1688. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of herring gulls from the Farne Islands SPA is predicted to be a single individual (adults and immatures combined) as determined by the Scoping Approach, and less than a single individual as determined by the Developer Approach (Table 5.114). Almost all this mortality is predicted to occur during the breeding season. The collision estimates for option 3 of the deterministic CRM with a 99.0% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.114but give outputs that are approximately 40% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA Report, volume 3, appendix 11.3). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 99.0% avoidance rate, and hence also substantially lower than those presented in Table 5.114below (see annex C of the Offshore EIA Report, volume 3, appendix 11.3).

Table 5.114: Predicted Collision Effects from the Proposed Development on the Farne Islands SPA Herring Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.8	0.1
	Non-breeding	0.1	0.0
	Annual total	0.9	0.1
Developer	Breeding	0.5	0.1
	Non-breeding	0.1	0.0
	Annual total	0.6	0.1

1689. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult herring gulls from the Farne Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 1,496 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.06% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.122 – see Table 2.11 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.3% and 0.5% for the Developer and Scoping Approaches, respectively.

1690. The potential levels of impact on the Farne Islands SPA herring gull population resulting from the predicted collision mortalities in Table 5.114 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

<u>Changes to prey availability</u>

1691. Potential impacts on key prey species for herring gulls breeding at the Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect herring gull survival and productivity in the Farne Islands SPA population.

1692. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1693. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA herring gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on herring gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

<u>Project alone: population-level impacts</u>

1694. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA herring gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1695. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.114 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.114 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion - volume 3, appendix 6.2 of the Offshore EIA Report). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.11 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle kittiwake above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1696. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (Offshore EIA Report, volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.115: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Herring Gull Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	16280 (9331 – 28159)	*1.000*	1.000	*50.0*
Scoping	0.87	0.15	16057 (9204 – 27787)	0.986	1.000	48.2
Developer	0.52	0.09	16147 (9255 – 27934)	0.992	1.000	49.1

1697. The PVA predicted that the Farne Islands SPA herring gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be more than 10 times larger than the current estimate of 1,496 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.115). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented relative stability (albeit with between-year fluctuations) in the size of this SPA population over the last 20 years or so (see above).

1698. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the Scoping Approach, the CPS value indicates that the collision mortality associated with the Proposed Development alone would result in a reduction of less than 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.115). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable (at least when the CPGR value is expressed to three decimal places), whilst the centile value of 48.2 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the Developer Approach suggest even smaller levels of impact (Table 5.115). In addition, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that are 40% lower than those used for the PVA.

Project alone: conclusion

1699. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Farne Islands SPA herring gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

1700. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA herring gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1701. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA herring gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance.

1702. As for other SPA populations, consideration was given to the potential collision mortality associated with the Proposed Development in-combination with the other UK North Sea wind farms. However, none of these other wind farms were identified as contributing to either the breeding or non-breeding season effects on the Farne Islands SPA herring gull population. This is unsurprising, given the considerable distance of this SPA to most other North Sea wind farms, together with the fact that during the non-breeding season the potential for effects was also assumed to be limited to those plans and projects which are within the breeding season foraging range of the herring gull SPA population (as advised by the Scoping Opinion – volume 3, appendix 6.2 of the Offshore EIA Report).

In-combination: conclusion

1703. Based on the above, the effects from the Proposed Development in-combination with the other UK North Sea wind farms are equivalent to those from the Proposed Development alone. Consequently, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Farne Islands SPA herring gull population. This conclusion applies to both the Scoping and Developer Approaches.

Assessment for the lesser black-backed gull population

1704. The Farne Islands SPA lesser black-backed gull population is currently estimated to number 1,362 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). The earliest counts of lesser black-backed gull that are available on the SMP database (SMP 2022) for the SPA give an estimate of 1,330 individuals in 2000, with subsequent counts showing that the numbers of breeding individuals in the SPA population have fluctuated between a low of 862 in 2005 and a peak of 1,598 in 2006.

The potential for impacts on the lesser black-backed gull population

1705. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its lesser black-backed gull population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

1706. From published information on lesser black-backed gull foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period lesser black-backed gulls from the Farne Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that almost 14% of the lesser black-backed gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (volume 3, appendix 11.5 of the Offshore EIA Report). The breeding period for lesser black-backed gull is defined as mid-March to August, following NatureScot (2020).

1707. In the non-breeding season lesser black-backed gulls from the Farne Islands SPA migrate south through the southern North Sea, undertaking the return journey in spring. It is likely that they winter predominantly in Iberia or on the coast of northwest Africa although a proportion may remain within the North Sea and Channel (Wernham *et al.* 2002, Furness 2015). Therefore, it is likely that there is the potential for birds from the Farne Islands SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to October and the first half of March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5), and to a lesser extent in winter as well (defined as November to February – Furness 2015). Given the above, the Proposed Development may have potential effects on the Farne Islands SPA lesser black-backed gull population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Changes to prey availability

1708. Lesser black-backed gulls have a highly opportunistic diet (del Hoyo *et al*., 1996), utilising terrestrial, intertidal and marine habitats to forage for a wide variety of prey species including invertebrates, small fish and carrion (including fishery discards). Indirect effects on lesser black-backed gulls may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA lesser black-backed gull population in the short-term.

1709. During construction there are a number of ways in which effects on lesser black-backed gull prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent c. 1% of the total breeding season foraging area that is potentially available to the SPA lesser black-backed gull population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 127±109 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Furthermore, given their flexible foraging habits and the distance between the Proposed Development and the SPA, it is likely that the area of marine habitat encompassed by the Proposed Development is not of key importance for lesser black-backed gulls breeding at the Farne Islands SPA. Effects during the non-breeding season are considered to be lower than during the breeding season given that birds migrate south through UK waters to their wintering grounds (Wernham *et al*., 2002; Furness 2015).

1710. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect the prey species of lesser black-backed gull (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which lesser-black-backed gulls forage.

1711. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA lesser-back-backed gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on lesser black-backed gulls during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Collision risk

1712. Predictions of the number of lesser black-backed gulls at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), and as advised by the Scoping Opinion, avoidance rates of 99.5% and 98.9% were applied to the outputs from option 2 and option 3, respectively.

1713. As outlined for the St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes population and in Offshore EIA Report, volume 3, appendix 11.3 but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for lesser black-backed gull were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1714. In addition to the above, collision estimates for lesser black-backed gulls were also calculated using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA lesser black-backed gull populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of Offshore EIA Report, volume 3, appendix 11.3.

1715. Lesser black-backed gull collision estimates are calculated for the defined breeding period, with estimates apportioned to the Farne Islands SPA population according to the NatureScot (2018) approach (Offshore EIA Report, volume 3, appendix 11.5). The resulting estimates were apportioned to age classes according to the plumage characteristics of lesser black-backed gulls recorded during the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst on the basis of advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 35% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of adult collisions estimated during the breeding season was adjusted accordingly.

1716. No lesser black-backed gull collisions were estimated for the non-breeding periods (Offshore EIA Report, volume 3, appendix 11.3).

1717. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of lesser black-backed gulls from the Farne Islands SPA is predicted to be less than a single individual (adults and immatures combined) as determined by the Scoping Approach, and approximately one half of a bird as determined by the Developer Approach (Table 5.116). The collision estimates for option 3 of the deterministic CRM with a 98.9% avoidance rate applied (which was also recommended by the Scoping Opinion as a basis for the assessment) are not presented in Table 5.116 but give outputs that are 33 - 44% lower than the option 2 estimates for both the Scoping and Developer Approaches (Offshore EIA Report, volume 3, appendix 11.3). In addition, the collision estimates produced using options 2 and 3 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied were similar to those obtained from option 3 of the deterministic CRM with the SNCB recommended 98.9% avoidance rate, and hence also substantially lower than those presented in Table 5.116 below (see annex C of the Offshore EIA Report, volume 3, appendix 11.3).

Table 5.116: Predicted Collision Effects from the Proposed Development on the Farne Islands SPA Lesser Black-Backed Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.7	0.1
	Autumn migration	0.0	0.0
	Winter	0.0	0.0
	Spring migration	0.0	0.0
	Annual total	0.7	0.1
Developer	Breeding	0.5	0.1
	Autumn migration	0.0	0.0
	Winter	0.0	0.0
	Spring migration	0.0	0.0
	Annual total	0.5	0.1

1718. Based upon the estimates from option 2 of the CRM, the additional annual mortality of adult lesser black-backed gulls from the Farne Islands SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 1,362 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.05% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.087 – see Table 2.15 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.4% and 0.6% for the Developer and Scoping Approaches, respectively.

1719. The potential levels of impact on the Farne Islands SPA lesser black-backed gull population resulting from the predicted collision mortalities in Table 5.116 are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted collision mortality on the SPA population.

<u>Changes to prey availability</u>

1720. Potential impacts on key prey species for lesser black-backed gulls breeding at the Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect lesser black-backed gull survival and productivity in the Farne Islands SPA population.

1721. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

1722. Given their wide-ranging foraging behaviour and plasticity in foraging habitat and diet (del Hoyo *et al.*, 1996), together with any effects on prey during operation and maintenance being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA lesser black-backed gull population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on lesser black-backed gulls during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: population-level impacts

1723. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA lesser black-backed gull population are limited to collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1724. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the collisions associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.116 above). This was undertaken using the outputs from option 2 of the deterministic CRM with a 99.5% avoidance rate applied, as presented in Table 5.116 (noting that these are the more precautionary of the outputs from the different CRM approaches recommended by the Scoping Opinion - volume 3, appendix 6.2 of the Offshore EIA Report). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.15 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The approach and methods to undertaking the PVA are as described for the St Abb's Head to Fast Castle kittiwake above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

1725. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.117: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Lesser Black-Backed Gull Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	6852 *(4312 – 10828)*	*1.000*	1.000	*50.0*
Scoping	0.72	0.11	6757 *(4252 – 10683)*	0.986	1.000	47.3
Developer	0.51	0.08	6784 *(4268 – 10722)*	0.990	1.000	48.0

1726. The PVA predicted that the Farne Islands SPA lesser black-backed gull population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be approximately five times larger than the current estimate of 1,362 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.117). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the two impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented relative stability (albeit with between-year fluctuations) in the size of this SPA population over the last 20 years or so (see above).

1727. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the Scoping Approach, the CPS value indicates that the collision mortality associated with the Proposed Development alone would result in a reduction of less than 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.117). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable (at least when the CPGR value is expressed to three decimal places), whilst the centile value of 47.3 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the Developer Approach suggest even smaller levels of impact (Table 5.117). In addition, it should be noted that these predicted levels of impact are derived from the more precautionary of the two CRM approaches recommended by the Scoping Opinion, with the alternative approach giving collision estimates that are 33 - 44% lower than those used for the PVA.

Project alone: conclusion

1728. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Farne Islands SPA lesser black-backed gull population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

1729. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA lesser black-backed gull population during construction and decommissioning and resulting from changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1730. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA lesser black-backed gull population in-combination with other plans and projects is limited to the collision risk effect pathway during operation and maintenance. The following sections consider this potential effect for the Proposed Development in-combination with the offshore wind farms in the UK North Sea.

Collision risk - operation and maintenance

1731. Existing assessments for offshore wind farms that are in planning, consented, under construction or in operation were checked to determine the collision estimates to be attributed to the Farne Islands SPA lesser black-backed gull population during the breeding and non-breeding periods (annex E of Offshore EIA Report, volume 3, appendix 11.6).

1732. None of these assessments identified breeding season effects on the SPA population, noting that the Scoping Opinion for the revised designs of the three Forth and Tay projects (which are in closest proximity to the SPA) did not require this SPA population to be assessed (Marine Scotland 2017a,b,c). Additionally, the Appropriate Assessment for the original consents of the Forth and Tay projects predicted a reduction in adult survival rate of less than 0.1% as a result of the Neart na Gaoithe wind farm and concluded no adverse effect on the SPA population (Marine Scotland 2014).

1733. Cumulative collisions of lesser black-backed gulls for UK North Sea wind farms during the non-breeding periods have been estimated recently as approximately 365 (MacArthur Green and Royal HaskoningDHV 2021). During the non-breeding periods, adult lesser black-backed gulls from the Farne Islands SPA are estimated to comprise less than 1% of the autumn and spring passage populations in the North Sea and Channel BDMPS (each of which number approximately 200,000 birds) and approximately 1.5% of the smaller winter population in this BDMPS (which numbers approximately 39,000 birds) (Furness 2015)[15]. Given this, it is unlikely that more than 1% of the total collisions during the non-breeding periods (i.e. approximately 3.6 individuals) would be adults from the Farne Islands SPA population. Immatures associated with the Farne Islands SPA population are estimated to represent approximately 0.3% of the passage populations and 0.2% of the winter population (Furness 2015), suggesting that fewer than one collision from the total 365 non-breeding season collisions may be attributable to immatures from this SPA population.

1734. Combining the above collision estimates for the non-breeding season with those for the breeding season (Table 5.116) suggests a total of approximately four adult collisions and fewer than a single immature collision for the Proposed Development in-combination with the other UK North Sea wind farms, as determined by the Scoping and Developer Approaches.

1735. The PVA undertaken for the Farne Islands SPA lesser black-backed gull population using incremental mortalities gives a CPS value of 0.884 and a CPGR value of 0.997 for a mortality of four adult birds per year (see Table 3.148 in the Offshore EIA Report, volume 3, appendix 11.6). This suggests a reduction in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, of almost 12% as determined by the Scoping and Developer Approaches. The centile value associated with this level of mortality is 29.7, suggesting a reasonable likelihood that the impacted population will be similar in size to the un-impacted population after 35 years (see Table 3.148 in the Offshore EIA Report, volume 3, appendix 11.6).

1736. However, the PVA for the incremental mortalities assumes that mortality across age classes occurs in proportion to the asymptotic age distribution (as calculated by the population model). Given that adults are estimated to comprise just 45% of the population, this means that the PVA grossly overestimates the level of immature mortality (relative to that estimated from the in-combination collision effects), meaning that the above metrics represent an overestimation of the population-level impacts.

In-combination: conclusion

1737. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Farne Islands SPA lesser black-backed gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the guillemot population

1738. The Farne Islands SPA guillemot population is currently estimated to number 85,816 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). The SPA population has shown a strongly increasing population trend over the long-term, with numbers increasing (virtually) year on year from an estimated 24,958 individuals in 1986 (SMP 2022). The current population size for this SPA qualifying feature is above the citation level (Table 5.106).

[15] The data in Furness (2015) do not specifically identify the Farne Islands SPA population, so these percentages are calculated by relating the 2019 count from the SMP to the seasonal BDMPS population sizes as estimated in Furness (2015).

The potential for impacts on the guillemot population

1739. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the '*breeding population: abundance*' attribute which has the target of maintaining the abundance of the breeding population of this feature above the citation level, whilst avoiding deterioration from its current levels. Clearly, other attributes (e.g. *connectivity with supporting habitats*) are also relevant but, as for the conservation objectives above, their significance is linked to whether they prevent achievement of the attribute concerned with maintaining the abundance of the breeding population (see appendix 3A).

1740. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is likely that during the breeding period guillemots from the Farne Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 9% of the guillemots occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemot is defined as April to mid-August, following the NatureScot (2020) guidance.

1741. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, Offshore EIA Report, volume 3, appendix 11.5). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the Farne Islands SPA guillemot population during the non-breeding period as during the breeding season, with 21% of the guillemots occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

1742. Direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1743. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1744. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1745. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the Farne Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only.

1746. Tracking data (and associated modelling of foraging distributions) for guillemot appear to suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are heavily used by birds from the Farne Islands SPA during the breeding season (Wakefield *et al.* 2017).

1747. During the non-breeding period guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD). Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

1748. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1749. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1750. Given the moderate sensitivity of guillemot to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Farne Islands SPA guillemot population.

Displacement

1751. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Farne Islands SPA guillemot population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1752. Based upon the above, it is considered that there is relatively little potential for the Farne Islands SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Farne Islands SPA guillemot population.

Changes to prey availability

1753. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA guillemot population in the short-term.

1754. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Farne Islands SPA guillemot population are as for the St Abb's Head to Fast Castle SPA guillemot population (and are detailed above in the equivalent section for that SPA population).

1755. Given this, it is considered that there is relatively little potential for the Farne Islands SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA guillemot population.

Project alone: operation and maintenance

Disturbance

1756. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from Farne Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1757. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1758. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1759. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1760. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Farne Islands SPA guillemot population.

Displacement/barrier effects

1761. As outlined above, displacement effects on the Farne Islands SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1762. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1763. As with other species for which displacement effects are assessed (see above), the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1764. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1765. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Farne Islands SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.118). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Farne Islands SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.118: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Farne Islands SPA Population in Each Period. The proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.486	0.088	0.088	0.07
Non-breeding	44,171	0.486	0.206	0.206	N/A

1766. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as 80 adult and 89 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 168 adult and 185 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.119). The breeding season effects make the greatest contribution to these potential mortalities (comprising 68% and 54% of the total annual mortality for the lower and upper ranges, respectively) due to the larger mean peak population size and higher assumed mortality rates during this period (although the proportion of birds assumed to derive from the SPA population is substantially higher during the non-breeding period) (Table 5.119).

1767. The annual mortality from displacement as determined using the Developer Approach is predicted to be 37 adult and 40 immature birds, equating to approximately 46% and 21% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.119). In contrast to the Scoping Approach, the levels of predicted mortality are lower during the breeding season than during the non-breeding period, with the difference between the Developer and Scoping Approaches in this respect being due to the fact that the Developer Approach assumes the same mortality rates in each seasonal period.

Table 5.119 Estimated Potential Annual Mortality of Farne Islands SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	53.1	60.4
	Non-breeding	60%	1%	26.6	28.2
	Annual total	-	-	79.7	88.5
Scoping B	Breeding	60%	5%	88.5	100.6
	Non-breeding	60%	3%	79.7	84.3
	Annual total	-	-	168.2	184.9
Developer	Breeding	50%	1%	14.8	16.8
	Non-breeding	50%	1%	22.1	23.4
	Annual total	-	-	36.9	40.2

1768. The additional annual mortality of adult guillemot from the Farne Islands SPA population predicted due to displacement from the Proposed Development array represents 0.04% of the current adult breeding population at this colony (i.e. 85,816 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.09 – 0.20% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.073 – see Table 2.9 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.6% for the Developer Approach and of 1.3 – 2.7% for the lower and upper estimates from the Scoping Approach.

1769. The potential levels of impact on the Farne Islands SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

1770. Potential impacts on key prey species for guillemots breeding at Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the Farne Islands SPA population.

1771. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Farne Islands SPA guillemot population as to the St Abb's Head to Fast Castle SPA guillemot population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1772. Given this, it is considered that there is relatively little potential for the Farne Islands SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA guillemot population.

Project Alone: Population-Level Impacts

1773. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1774. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.118 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1775. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.120: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	372689 (220897 – 595801)	*1.000*	1.000	*50.0*
Scoping A	79.84	88.67	358473 (212289 – 573519)	0.962	0.999	44.0
Scoping B	167.20	183.90	343474 (203213 – 549959)	0.922	0.998	37.1
Developer	36.92	40.21	366107 (216909 – 585471)	0.982	1.000	47.4

1776. The PVA predicted that the Farne Islands SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be approximately four times larger than the current estimate of 85,816 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.120). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. Whilst the predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), the prediction for an increasing trend is consistent with the documented long-term trend for this SPA population (see above).

1777. The PVA metrics suggest small effects overall. Thus, the CPS value for the Developer Approach indicates that the displacement effects from the Proposed Development alone would result in a reduction of less than 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 4 – 8% after 35 years, relative to that in the absence of any wind farm effects (Table 5.120). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable (at least when the CPGR value is expressed to three decimal places) for the Developer Approach and is 0.1 – 0.2% for the Scoping Approach. The centile values indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, at least a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.120).

1778. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA guillemot population, the assessment of the Farne Islands SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by guillemot are equally relevant to the Farne Islands SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by guillemots from the Farne Islands SPA are likely to be low (Wakefield *et al.* 2017).

Project alone: conclusion

1779. It is considered that the predicted levels of impact from the Proposed Development alone on the Farne Islands SPA guillemot population are of a relatively small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates at least a reasonably high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach) and a population for which the documented, long-term, trend is strongly increasing. Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

1780. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1781. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) pathway during operation and maintenance.

1782. As for other SPA populations, consideration was given to the potential displacement mortality associated with the Proposed Development in-combination with the other UK North Sea wind farms. However, none of these other wind farms were identified as contributing to either the breeding or non-breeding season effects on the Farne Islands SPA guillemot population. This is unsurprising, given the considerable distance of this SPA to most other North Sea wind farms, together with the fact that during the non-breeding season the potential for effects was also assumed to be limited to those plans and projects which are within the breeding season foraging range of the guillemot SPA population (as advised by the Scoping Opinion – volume 3, appendix 6.2 of the Offshore EIA Report).

In-combination: conclusion

1783. Based on the above, the effects from the Proposed Development in-combination with the other UK North Sea wind farms are equivalent to those from the Proposed Development alone. Consequently, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Farne Islands SPA guillemot population. This conclusion applies to both the Scoping and Developer Approaches.

Assessment for the razorbill population

1784. The Farne Islands SPA razorbill population is currently estimated to number 572 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). This small SPA population has increased over the long term, with the population estimated as only 62 AOSs in 1986 (which would be expected to equate to 124 individuals) (SMP 2022). Numbers appear to have been relatively stable since 2005, albeit with some marked between-year fluctuations (with the annual population size varying from 421 to 677 between 2005 and 2019[16]).

The potential for impacts on the razorbill population

1785. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

1786. From published information on razorbill foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is possible that during the breeding period razorbills from the Farne Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 0.4% of the razorbills occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

1787. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North

[16] This omits the data from 2014 – 2018, which are based on counts of AOS rather than of individuals and may not be directly comparable.

Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the Farne Islands SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the Farne Islands SPA razorbill population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1788. Direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1789. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer – Offshore EIA Report, volume 2, chapter 13).

1790. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1791. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to razorbills from the Farne Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 10% of the breeding season foraging area if considering the mean maximum foraging range only.

1792. Tracking data (and associated modelling of foraging distributions) for razorbill suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are heavily used by birds from the Farne Islands SPA during the breeding season (Wakefield *et al.* 2017).

1793. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

1794. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1795. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1796. Given the moderate sensitivity of razorbill to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Farne Islands SPA razorbill population.

Displacement

1797. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Farne Islands SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1798. Based upon the above, it is considered that there is relatively little potential for the Farne Islands SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Farne Islands SPA razorbill population.

Changes to prey availability

1799. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA razorbill population in the short-term.

1800. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Farne Islands SPA razorbill population are as for the St Abb's Head to Fast Castle SPA razorbill population (and are detailed above in the equivalent section for that SPA population).

1801. Given this, it is considered that there is relatively little potential for the Farne Islands SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA razorbill population.

Project alone: operation and maintenance

Disturbance

1802. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from Farne Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1803. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1804. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1805. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1806. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Farne Islands SPA razorbill population.

Displacement/barrier effects

1807. As outlined above, displacement effects on the Farne Islands SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1808. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

1809. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1810. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

1811. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Farne Islands SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.121). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Farne Islands SPA razorbill PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.121: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Farne Islands SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,040	0.501	0.004	0.004	0.07
Autumn migration	8,849	N/A	0.001	0.001	N/A
Winter	1,399	N/A	0.001	0.000	N/A
Spring Migration	7,480	N/A	0.001	0.001	N/A

1812. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as a single individual (adults and immatures combined) as determined by the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B), and as only fractions of an individual as determined by the lower mortality rates of the Scoping Approach and by the Developer Approach (Table 5.122). These small effects are attributable to both the breeding and non-breeding periods.

Table 5.122: Estimated Potential Annual Mortality of Farne Islands SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.1	0.1
	Autumn migration	60%	1%	0.1	0.1
	Winter	60%	1%	0.0	0.0
	Spring migration	60%	1%	0.0	0.0
	Annual total	-	-	0.2	0.2
Scoping B	Breeding	60%	5%	0.2	0.2
	Autumn migration	60%	3%	0.2	0.2
	Winter	60%	3%	0.0	0.0
	Spring migration	60%	3%	0.1	0.1
	Annual total	-	-	0.5	0.5
Developer	Breeding	50%	1%	0.0	0.0
	Autumn migration	50%	1%	0.0	0.0
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	0.0	0.0
	Annual total	-	-	0.1	0.1

1813. The additional annual mortality of adult razorbill from the Farne Islands SPA population predicted due to displacement from the Proposed Development array represents 0.02% of the current adult breeding population at this colony (i.e. 572 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.03 – 0.09% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.2% for the Developer Approach and of 0.4 – 1.0% for the lower and upper estimates from the Scoping Approach.

1814. The potential levels of impact on the Farne Islands SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

1815. Potential impacts on key prey species for razorbills breeding at Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the Farne Islands SPA population.

1816. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Farne Islands SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1817. Given this, it is considered that there is relatively little potential for the Farne Islands SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA razorbill population.

<u>Project alone: population-level impacts</u>

1818. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1819. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.122 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of volume 3, appendix 11.6 Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in volume 3, appendix 11.6 of the Offshore EIA Report).

1820. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.123: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	3988 (2118 – 7206)	*1.000*	1.000	*50.0*
Scoping A	0.22	0.20	3928 (2086 – 7100)	0.985	1.000	47.9
Scoping B	0.46	0.40	3867 (2053 – 6989)	0.970	0.999	45.8
Developer	0.10	0.08	3963 (2105 – 7162)	0.994	1.000	49.2

1821. The PVA predicted that the Farne Islands SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost seven times larger than the current estimate of 572 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.123). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented relative stability (albeit with between-year fluctuations) in the size of this SPA population over the last 15 years or so (see above).

1822. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the higher mortality rates for the Scoping Approach (B), the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.123). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 45.8 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics as determined from either the lower mortality rates of the Scoping Approach or the Developer Approach suggest even smaller levels of impact (Table 5.123).

1823. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the Farne Islands SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are equally relevant to the Farne Islands SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by razorbills from the Farne Islands SPA are likely to be low (Wakefield *et al.* 2017).

Project alone: conclusion

1824. It is considered that the predicted levels of impact from the Proposed Development alone on the Farne Islands SPA razorbill population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach). Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this spa population.

Effects in-combination

Effects of relevance to the in-combination assessment

1825. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1826. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

1827. As described in Offshore EIA Report, annex E of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Farne Islands SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1828. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report annex D of volume 3, appendix 11.6 for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the Farne Islands SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.122).

Table 5.124: Estimated Annual Mortality of Farne Islands SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period: Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.1	0.1	0.2	0.2	0.1	0.0	0.2	0.1	0.6	0.4
	Scoping B	0.2	0.2	0.7	0.5	0.3	0.1	0.6	0.4	1.8	1.2
	Developer	0.0	0.0	0.2	0.1	0.1	0.0	0.2	0.1	0.5	0.2

1829. The potential mortality from the displacement effects associated with the other UK North Sea wind farms is limited to the passage periods, with none of these other wind farms identified as contributing to breeding season effects on this SPA population (see annex E of Offshore EIA Report, volume 3, appendix 11.6). Overall, the effects from the Proposed Development in-combination with the other UK North Sea wind farms represented an approximate threefold increase in the potential mortality predicted for the Proposed Development alone (for both Developer and Scoping Approaches). The potential mortality from the in-combination scenario was concentrated in the non-breeding periods for both the Developer and Scoping Approaches (Table 5.124).

1830. The additional annual mortality of adult razorbills from the Farne Islands SPA population predicted due to displacement from the Proposed Development in-combination with the other UK North Sea wind farms represents 0.09% of the current adult breeding population at this colony (i.e. 572 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.10 – 0.31% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 1.0% for the Developer Approach and of 1.2 – 3.5% for the lower and upper estimates from the Scoping Approach.

1831. The potential levels of impact on the Farne Islands SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

1832. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.124 above).

1833. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.125: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development in-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality: Adults	Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
Baseline	*0*	*0*	3988 *(2118 – 7206)*	*1.000*	1.000	*50.0*
Scoping A	0.62	0.50	3829 *(2033 – 6926)*	0.960	0.999	44.8
Scoping B	1.76	1.20	3578 *(1899 – 6474)*	0.897	0.997	37.1
Developer	0.50	0.20	3884	0.974	0.999	46.4

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
			(2063 – 7021)			

1834. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.125 with Table 5.123). However, overall, the predicted levels of impact remain relatively small.

1835. The CPS value for the Developer Approach indicates that the in-combination displacement effects would result in a reduction of less than 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 4 – 10% after 35 years, relative to that in the absence of any wind farm effects (Table 5.125). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1% for the Developer Approach and 0.1 – 0.3% for the Scoping Approach. The centile values of 37.1 (for the higher mortality rates of the Scoping Approach) to 46.4 (for the Developer Approach) indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, at least a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.125).

In-combination: conclusion

1836. It is considered that the predicted levels of impact from the Proposed Development in-combination with the other UK North Sea wind farms on the Farne Islands SPA razorbill population are of a relatively small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates at least a reasonably high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. Furthermore, in relation to the Scoping Approach the predicted levels of impact should be considered within the context of the overly precautionary displacement and mortality rates used (volume 3, appendix 11.4, annex G of the Offshore EIA Report).

1837. Given this, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on this SPA population. This conclusion applies to both the Scoping and Developer Approaches.

Assessment for the puffin population

1838. The Farne Islands SPA puffin population is currently estimated to number 87,504 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). This is above the citation level (Table 5.106) and represents a substantial increase from the earliest count available for the SPA on the SMP database, which estimated 52,658 individuals in 1989 (SMP 2022). Since 1989, the available count data indicate that numbers increased to a peak in the early 2000s (with 111,348 individuals in 2003) but have since varied from 73,670 (in 2008) to 87,912 (in 2018).

The potential for impacts on the puffin population

1839. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Farne Islands SPA, so that potential impacts on its puffin population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

1840. From published information on puffin foraging ranges (Woodward *et al.* 2019), it is likely that during the breeding period puffins from the Farne Islands SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that 38% of the puffins occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance.

1841. After the breeding season puffin migrate rapidly from their UK breeding areas, leaving the seas immediately adjacent to their colonies by late August and dispersing widely across north-west European seas and the Atlantic (Wernham *et al.* 2002, Harris and Wanless 2011, Stone *et al.* 1995, Jessopp *et al.* 2013). Consequently (and as advised in the NatureScot scoping advice - volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

Project alone: construction and decommissioning

Disturbance

1842. Direct disturbance to puffins during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1843. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1844. When using the marine environment (and not at the breeding colony), puffins are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign puffin as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1845. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to puffins from the Farne Islands SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 1% of the total breeding season foraging area that is potentially available to the SPA puffin population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 137.1±128.3 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 4% of the breeding season foraging area if considering the mean maximum foraging range only.

1846. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1847. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1848. Given the relatively low sensitivity of puffin to disturbance effects, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Farne Islands SPA puffin population.

<u>Displacement</u>

1849. As detailed above, puffin is considered to have a relatively low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Farne Islands SPA puffin population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffins from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1850. Based upon the above, it is considered that there is relatively little potential for the Farne Islands SPA puffin population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Farne Islands SPA puffin population.

<u>Changes to prey availability</u>

1851. Sandeels are key prey for puffins, with a range of other species taken including clupeids and gadids (del Hoyo *et al*., 1996). Indirect effects on puffins may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Farne Islands SPA puffin population in the short-term.

1852. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Farne Islands SPA puffin population are as for the Forth Islands SPA puffin population (with the exception that tracking data are not available to inform the foraging ranges used by the Farne Islands birds). These details are presented above in the equivalent section for the Forth Islands SPA puffin population.

1853. Given this, it is considered that there is relatively little potential for the Farne Islands SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Farne Islands SPA puffin population.

<u>Project alone: operation and maintenance</u>

<u>Disturbance</u>

1854. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of puffins from Farne Islands SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, puffins are considered to have a low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1855. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1856. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA

Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1857. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1858. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Farne Islands SPA puffin population.

<u>Displacement/barrier effects</u>

1859. As outlined above, displacement effects on the Farne Islands SPA puffin population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1860. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on puffin are estimated for the breeding period only (see above). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for puffin are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.

1861. As with other species for which displacement effects are assessed (see above), the approach to estimating puffin displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

1862. Based upon a consideration of the available evidence for puffin displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.

1863. Estimates of puffin mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Farne Islands SPA puffin population during the breeding season according to the NatureScot (2018) approach (Offshore EIA Report, volume 3, appendix 11.5, Table 5.126). The resulting mortality estimates for the breeding season were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Farne Islands SPA puffin PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.126: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer During the Breeding Season, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Farne Islands SPA Population

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,513	0.443	0.382	0.382	0.07

1864. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA puffin population as a result of displacement is estimated as 13 adult and 17 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 21 adult and 29 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.127). For the Developer Approach, the predicted annual mortality is four adult and five immature birds, equating to approximately 28% and 17% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.127).

Table 5.127: Estimated Potential Annual Mortality of Farne Islands SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	12.9	17.4
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	12.9	17.4
Scoping B	Breeding	60%	5%	21.4	28.9
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	21.4	28.9
Developer	Breeding	50%	1%	3.6	4.9
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	3.6	4.9

1865. The additional annual mortality of adult puffin from the Farne Islands SPA population predicted due to displacement from the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 87,504 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.01 – 0.02% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 – see Table 2.17 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of less than 0.1% for the Developer Approach and of 0.1 – 0.2% for the lower and upper estimates from the Scoping Approach.

1866. The potential levels of impact on the Farne Islands SPA puffin population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

1867. Potential impacts on key prey species for puffins breeding at Farne Islands SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect puffin survival and productivity in the Farne Islands SPA population.

1868. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Farne Islands SPA puffin population as to the Forth Islands SPA puffin population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the Forth Islands SPA population.

1869. Given this, it is considered that there is relatively little potential for the Farne Islands SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Farne Islands SPA puffin population.

Project alone: population-level impacts

1870. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Farne Islands SPA puffin population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1871. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.127 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.17 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (volume 3, appendix 11.5 of the Offshore EIA Report). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

1872. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.128: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Puffin Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	483381 (196815 – 1079847)	*1.000*	1.000	*50.0*
Scoping A	12.91	17.45	480338 (195552 – 1073157)	0.994	1.000	49.3
Scoping B	21.40	28.94	478355 (194725 – 1068778)	0.990	1.000	48.9
Developer	3.62	4.89	482525 (196462 – 1077968)	0.998	1.000	49.9

1873. The PVA predicted that the Farne Islands SPA puffin population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be more than five times larger than the current estimate of 87,504 adult birds under baseline conditions (i.e. no wind farm effects) and under each of the impact scenarios (Table 5.128). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted increases are inevitably greatest for the baseline scenario and least for the scenario involving highest annual mortality (i.e. Scoping Approach B). However, the differences between the scenarios in terms of the predicted increases and eventual 35 year population sizes are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), and whilst the prediction for an increasing trend is broadly consistent with the overall long-term trend for this SPA population it does not reflect the more recent (relative) stability in numbers (see above).

1874. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach the CPS value indicates that the predicted mortality associated with the Proposed Development alone would result in a reduction of 1% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.128). The associated reductions in annual population growth rate (relative to that predicted under baseline conditions) are not detectable (at least when the CPGR value is expressed to three decimal places) and the centile values are all close to, or above, 49, indicating a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.128).

Project alone: conclusion

1875. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Farne Islands SPA puffin population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population (with this conclusion being irrespective of whether these effects are determined by the Scoping or Developer Approach).

Effects in-combination

Effects of relevance to the in-combination assessment

1876. As detailed above, any effects from the Proposed Development alone on the Farne Islands SPA puffin population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1877. Therefore, the potential for effects of the Proposed Development to act on the Farne Islands SPA puffin population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

1878. As described in Offshore EIA Report annex E of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Farne Islands SPA puffin population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

Table 5.129: Estimated Annual Mortality of Farne Islands SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	17.3	23.8	N/A	N/A	17.3	23.8
	Scoping B	28.8	39.4	N/A	N/A	28.8	39.4
	Developer	4.9	6.6	N/A	N/A	4.9	6.6

1879. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to increases of approximately 35% in the predicted displacement mortality compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.127 and 5.129).

1880. The resultant additional annual mortality of adult puffins from the Farne Islands SPA population predicted due to the in-combination displacement effects less than 0.01% of the current adult breeding population at this colony (i.e. 87,504 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.02 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 – see Table 2.17 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of less than 0.1% for the Developer Approach and of 0.2 – 0.3% for the lower and upper estimates from the Scoping Approach.

1881. The potential levels of impact on the Farne Islands SPA puffin population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

1882. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.129 above).

1883. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.130: Projected 35 Year Population Sizes and Associated PVA Metrics for the Farne Islands SPA Puffin Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	483381 (196815 – 1079847)	*1.000*	1.000	*50.0*
Scoping A	17.31	23.75	479280 (195110 – 1070825)	0.992	1.000	49.1
Scoping B	28.80	39.44	476592 (193989 – 1064891)	0.986	1.000	48.6
Developer	4.82	6.69	482229 (196336 – 1077315)	0.998	1.000	49.9

1884. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.128 with Table 5.130). However, the changes in the values of the PVA metrics are small, with the reduction in the size of the SPA population after 35 years relative to that in the absence of any wind farm effects predicted to be approximately 1 - 1.5% for the Scoping Approach (compared to approximately 0.5 – 1% for the Proposed Development alone). The equivalent reduction is smaller for the metrics associated with the Developer Approach. For both the Developer and Scoping Approaches, the values for the centile metric remain close to, or above, 49 and continue to indicate a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.130).

In-combination: conclusion

1885. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the Farne Islands SPA puffin population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the breeding seabird assemblage

1886. The breeding seabird assemblage for the Farne Islands SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation stating that the SPA supports 163,819 individual seabirds). Puffin and kittiwake are amongst the species identified in the citation as having nationally important populations which contribute to the Farne Islands SPA breeding seabird assemblage, whilst guillemot is a qualifying feature in its own right. Furthermore, the scoping advice from Natural England identified herring gull, lesser black-backed gull and razorbill as further components of the assemblage feature (volume 3, appendix 6.2 of the Offshore EIA Report).

1887. Potential impacts of the Proposed Development alone and in-combination with the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature, such that the SACOs to (i) maintain the abundance of the breeding seabird assemblage qualifying feature at a level above 163,819 individuals, whilst avoiding deterioration from its current levels; and (ii) maintain the species diversity of the breeding seabird assemblage qualifying feature are not achieved.

1888. For the Developer Approach, the assessments undertaken above identify no adverse effect in relation to any SPA populations which contribute to the assemblage feature (both for the Proposed Development alone and in-combination).

1889. However, for the Scoping Approach, the assessments identify the potential for an adverse effect on the SPA kittiwake population in relation to the Proposed Development in-combination with the other UK North Sea wind farms. The potential impact on the SPA kittiwake population is not considered likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Farne Islands SPA, on the basis of the limited scale of the predicted impact (relative to the population size) and the limited extent of the existing documented decline of this population. Also, given the range of species present within the SPA seabird assemblage and their relative abundances, the potential adverse effect on the SPA kittiwake population is not considered to be sufficient to result in an adverse effect on the seabird assemblage via reductions in the overall abundance of this assemblage.

1890. Therefore, it is concluded that there is no potential for an adverse effect on the breeding seabird assemblage feature, irrespective of whether the effects are determined by the Scoping or Developer Approach.

Site conclusion

Developer approach

1891. It is concluded that there is no potential for an adverse effect on the qualifying features of the Farne Islands SPA or on the named component species of the breeding seabird assemblage qualifying feature due to the effects from the Proposed Development alone or in-combination with other plans and projects. Consequently, it is concluded that there is no potential for an Adverse Effects on Integrity of the Farne Islands SPA.

Scoping approach

1892. It is concluded that the possibility of an adverse effect cannot be discounted for the Farne Islands SPA population of breeding kittiwake (noting this species is a named component of the seabird assemblage feature only). For the kittiwake population, the potential for an adverse effect arises from the Proposed Development in-combination with the other UK North Sea wind farms. The predicted impacts on the SPA kittiwake population are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature.

1893. Consequently, it is concluded that an Adverse Effects on Integrity of the Farne Islands SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects.

5.7.5. BUCHAN NESS TO COLLIESTON COAST SPA

European site information and conservation objectives

1894. Buchan Ness to Collieston Coast SPA is a stretch of south-east facing cliff in Aberdeenshire, located approximately 94 km from the Proposed Development. The boundary of the SPA follows the boundaries of Bullers of Buchan Coast SSSI and Collieston to Whinnyfold Coast SSSI, and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1998, with the marine extension classified in 2009.

1895. The site qualifies under Article 4.2 by regularly supporting in excess of 20,000 breeding seabirds, including five named component species (Table 5.131). The potential for LSE has been identified in relation to two of these five qualifying features (Table 5.131), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

1896. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

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

1897. Further information on this European site is presented in appendix 3A.

Table 5.131: Details on the Qualifying Features of the Buchan Ness to Collieston Coast SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Favourable recovered	95,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable no change	30,452 pairs	Yes
Herring gull*	Breeding	Unfavourable no change	4,292 pairs	No
Guillemot*	Breeding	Favourable maintained	8,640 pairs	Yes
Fulmar*	Breeding	Unfavourable declining	1,045 pairs	No
Shag*	Breeding	Unfavourable no change	1,765 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

1898. The Buchan Ness to Collieston Coast SPA kittiwake population is currently estimated to number 22,590 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). This is substantially below the citation level (which is equivalent to almost 61,000 individuals - Table 5.131). The peak count from the data available on the SMP is 49,914 individuals in 1995, with subsequent data suggesting a rapid decline to levels close to the current population size by the early 2000s (SMP 2022).

The potential for impacts on the kittiwake population

1899. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Buchan Ness to Collieston Coast SPA, so that potential impacts on its kittiwake population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1900. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is apparent that during the breeding period kittiwakes from the Buchan Ness to Collieston Coast SPA could occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is reflected in the findings of the apportioning exercise, which estimates that approximately 1% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

1901. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Buchan Ness to Collieston Coast SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Buchan Ness to Collieston Coast SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

1902. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1903. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1904. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as ‘2’ on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1905. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Buchan Ness to Collieston Coast SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species’ mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

1906. Tracking data (and associated modelling of foraging distributions) for kittiwake suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are heavily used by birds from the Buchan Ness to Collieston Coast SPA during the breeding season (Cleasby *et al.* 2018).

1907. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015). Thus, the potential for effects of construction-related disturbance is generally lower than during the breeding season (but noting that in the case of the Buchan Ness to Collieston Coast SPA, the distance of the SPA from the Proposed Development means that the likelihood of usage of the Proposed Development by the SPA birds during the breeding season is also low and, hence, any such seasonal effect will be less marked).

1908. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1909. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1910. Given the low sensitivity of kittiwake to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated kittiwake breeding season foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which ‘screened’ out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

1911. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Buchan Ness to Collieston Coast SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

1912. Therefore, based upon the above, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which ‘screened’ out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

1913. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Buchan Ness to Collieston Coast SPA kittiwake population in the short-term.

1914. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb’s Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Buchan Ness to Collieston Coast SPA kittiwake population as to the St Abb’s Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population. Additionally, the large distance of the Proposed Development from the Buchan Ness to Collieston Coast SPA (relative to the breeding season foraging range) is relevant because it reduces the likelihood that kittiwakes from this SPA will use the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5).

1915. Given this, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

1916. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Buchan Ness to Collieston Coast SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1917. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1918. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 13 of the Offshore EIA Report, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1919. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1920. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population.

Displacement/barrier effects

1921. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

1922. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

1923. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

1924. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Buchan Ness to Collieston Coast SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.132). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.132: The Mean Peak Abundance Estimates Of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Buchan Ness to Collieston Coast SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals during the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	0.012	0.012	*0.10*
Autumn migration	*11,190*	*N/A*	0.018	0.011	*N/A*
Spring migration	*13,766*	*N/A*	0.024	0.011	*N/A*

1925. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as two adult and one immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as seven adult and three immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.133). The displacement effects predicted by the Scoping Approach are attributable mainly to the non-breeding season (which accounts for almost 80% of the overall potential annual mortality – Table 5.133), reflecting the fact that this SPA is distant from the Proposed Development with a low likelihood of use by the SPA kittiwake population during the breeding season.

1926. The annual mortality from displacement as determined using the Developer Approach is predicted to be approximately one adult bird, which (in contrast to the estimates from the Scoping Approach) is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.133: Estimated Potential Annual Mortality of Buchan Ness to Collieston Coast SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.7	0.0
	Autumn migration	30%	1%	0.6	0.4
	Spring migration	30%	1%	1.0	0.5
	Annual total	-	-	2.3	0.8
Scoping B	Breeding	30%	3%	2.0	0.1
	Autumn migration	30%	3%	1.8	1.1
	Spring migration	30%	3%	3.0	1.4
	Annual total	-	-	6.8	2.5
Developer	Breeding	30%	2%	1.3	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	1.3	0.0

1927. The additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to displacement from the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 22,590 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.01 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of less than 0.1% for the Developer Approach and of approximately 0.1 – 0.2% for the lower and upper estimates from the Scoping Approach.

1928. The potential levels of impact on the Buchan Ness to Collieston Coast SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

1929. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

1930. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Buchan Ness to Collieston Coast SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

1931. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

1932. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of Offshore EIA Report, volume 3, appendix 11.3.

1933. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the Buchan Ness to Collieston Coast SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool

(Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report volume 3, appendix 11.5, Table 5.132). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.132).

1934. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Buchan Ness to Collieston Coast SPA is predicted to be approximately 14 adults and four immatures as determined by the Scoping Approach, and approximately 10 adults and three immatures as determined by the Developer Approach (Table 5.134). The majority of this mortality (i.e. 64%) is predicted to occur during the non-breeding season (for the same reasons as outlined above for the displacement effects on this SPA population, as determined by the Scoping Approach).

Table 5.134: Predicted Collision Effects from the Proposed Development on the Buchan Ness to Collieston Coast SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenarioand are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	6.5	0.2
	Autumn migration	3.2	2.0
	Spring migration	4.6	2.1
	Annual total	14.3	4.3
Developer	Breeding	4.5	0.2
	Autumn migration	1.9	1.1
	Spring migration	3.7	1.7
	Annual total	10.1	3.0

1935. The additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 22,590 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.06% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.3% and 0.4% for the Developer and Scoping Approaches, respectively.

1936. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Buchan Ness to Collieston Coast SPA kittiwake population that are at least 50% lower than those presented in Table 5.134 above (and on which the assessment is based).

1937. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.134 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

1938. Potential impacts on key prey species for kittiwakes breeding at the Buchan Ness to Collieston Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Buchan Ness to Collieston Coast SPA kittiwake population.

1939. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Buchan Ness to Collieston Coast SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

1940. Given this, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population.

Project alone: population-level impacts

1941. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

1942. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.133 and 5.134 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in the volume 3, appendix 11.6 of the Offshore EIA Report).

1943. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and

- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.135: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	4374 (1680 – 11054)	*1.000*	1.000	*50.0*
	Scoping A	16.47	4.94	4266 (1637 – 10786)	0.975	0.999	47.9
	Scoping B	21.01	6.58	4236 (1625 – 10711)	0.968	0.999	47.3
	Developer	11.06	2.95	4302 (1652 – 10877)	0.984	1.000	48.6

1944. The PVA predicted a continuing decline in the size of the Buchan Ness to Collieston Coast SPA kittiwake population over the 35 year projection period, irrespective of the effects from the Proposed Development. Thus, the population is predicted to decline by 81% from the current estimate of 22,590 adult birds under all scenarios, including baseline conditions which assume no wind farm effects (Table 5.135). Although the predicted declines in population size are inevitably smallest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small.

1945. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.135). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1%, whilst the centile value of 47.3 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.135).

1946. The PVA outputs described above, and detailed in Table 5.135, need to be considered within the context of the fact that the SPA population is predicted to decline irrespective of the wind farm effects and that such a trend is broadly consistent with the documented long-term trend for this population (see above). As described in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population, the available evidence suggests that the long-term decline of kittiwake populations in the North Sea (including the Buchan Ness to Collieston Coast SPA) is associated with fisheries management and climate change (Frederiksen *et al.* 2004). Therefore, without appropriate management to mitigate these effects, it is likely that the Buchan Ness to Collieston Coast SPA population will continue to decline and that the predicted effects from the Proposed Development may be of limited importance relative to these broader-scale effects. Furthermore, it is also relevant to consider the high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach (with this also detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

<u>Project alone: conclusion</u>

1947. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Buchan Ness to Collieston Coast SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

<u>Effects in-combination</u>

<u>Effects of relevance to the in-combination assessment</u>

1948. As detailed above, any effects from the Proposed Development alone on the Buchan Ness to Collieston Coast SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

1949. Therefore, the potential for effects of the Proposed Development to act on the Buchan Ness to Collieston Coast SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for two in-combination scenarios, i.e. (i) the Proposed Development in-combination with the other Forth and Tay offshore wind farms and (ii) the Proposed Development in-combination with the offshore wind farms in the UK North Sea (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

<u>Displacement/barrier effects – operation and maintenance</u>

1950. As described in Offshore EIA Report annex A of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Buchan Ness to Collieston Coast SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

1951. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (Offshore EIA Report annex E in volume 3, appendix 11.6), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in- combination *Displacement/Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

1952. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farm scenario and the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.136).

Table 5.136: Estimated Annual Mortality of Buchan Ness to Collieston Coast SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	0.7	0.0	1.4	0.9	1.3	0.6	3.4	1.5
	Scoping B	2.0	0.1	4.3	2.5	3.9	1.8	10.2	4.4
	Developer	1.3	0.0	N/A	N/A	N/A	N/A	1.3	0.0
UK North Sea	Scoping A	0.7	0.0	3.2	1.9	5.0	2.2	8.9	4.1
	Scoping B	2.0	0.1	9.7	5.8	14.9	6.6	26.6	12.4
	Developer	1.3	0.0	N/A	N/A	N/A	N/A	1.3	0.0

1953. The incorporation of the potential mortality resulting from the predicted displacement effects associated with other plans and projects increases the levels predicted for the Proposed Development alone for the Scoping Approach but not for the Developer Approach (because the predicted effects from the other plans and projects are limited to the non-breeding periods and the Developer Approach assumes that displacement during the non-breeding periods does not result in detectable impacts on the population – volume 3, appendix 11.4, annex G of the Offshore EIA Report). For the Scoping Approach, these increases are by factors of approximately 1.5 and four for the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms, respectively (Tables 5.133 and 5.136).

1954. For the Scoping Approach, the vast majority (i.e. 86 – 95%) of the of the predicted mortality from displacement is attributed to effects during the non-breeding periods (Table 5.136).

1955. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to displacement represents less than 0.01% of the current adult breeding population at this colony (i.e. 22,590 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.02 – 0.05% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of less than 0.1% for the Developer Approach and of 0.1 – 0.3% for the lower and upper estimates from the Scoping Approach.

1956. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to displacement represents between approximately 0.04 – 0.12% of the current adult breeding population at this colony as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.3 – 0.8% for the lower and upper estimates from the Scoping Approach. The equivalent figures for the predicted additional mortality as determined by the Developer Approach are as for the Proposed Development in-combination with the other Forth and Tay wind farms (and also as for the Proposed Development alone).

1957. The potential levels of impact on the Buchan Ness to Collieston Coast SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Collision risk - operation and maintenance</u>

1958. As for displacement, breeding season collision estimates attributed to the Buchan Ness to Collieston Coast SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (Offshore EIA Report annex E of volume 3, appendix 11.6). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (Offshore EIA Report, annex E of volume 3, appendix 11.6). The non-breeding season collision estimates were apportioned to the Buchan Ness to Collieston Coast SPA population according to the BDMPS approach (Furness 2015).

1959. Collision estimates based on consented and 'as-built'[11] designs were also considered (Offshore EIA Report, annex E of volume 3, appendix 11.6). For the current SPA population this did not affect the collision estimates for the other Forth and Tay wind farms but had a small effect on those for the other UK North Sea wind farms (with the respective totals for adults and immatures differing by approximately five and three collisions, respectively).

1960. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

1961. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other

UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.137).

Table 5.137: Predicted Collision Effects on the Buchan Ness to Collieston Coast SPA Kittiwake Population due to the Proposed Development In-Combination with Other Projects in the Forth and Tay and in UK North Sea Waters. Estimates are presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Forth and Tay	Scoping	Breeding	6.5	0.2
		Autumn migration	5.3	3.2
		Spring migration	5.7	2.6
		Annual total	17.5	6.0
	Developer	Breeding	4.5	0.2
		Autumn migration	3.9	2.3
		Spring migration	4.8	2.2
		Annual total	13.2	4.7
UK North Sea	Scoping	Breeding	27.0	0.6
		Autumn migration	19.1	11.3
		Spring migration	25.2	11.2
		Annual total	71.3	23.1
	Developer	Breeding	25.0	0.6
		Autumn migration	17.7	10.4
		Spring migration	24.4	10.8
		Annual total	67.1	21.8

1962. The potential mortality resulting from the predicted collision effects associated with other plans and projects increases that predicted for the Proposed Development alone by 21 – 27% for the other Forth and Tay wind farms in-combination scenario and by factors of approximately five to seven for the other UK North Sea wind farms in-combination scenario (with the greater increases associated with the Developer Approach in each case - Tables 5.134 and 5.137). As for the Proposed Development alone, the majority of the collision mortality predicted on the SPA population (i.e. approximately 70%) is again attributable to effect during the non-breeding passage periods (Table 5.137).

1963. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to collisions represents 0.06% of the current adult breeding population at this colony (i.e. 22,590 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.08% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 0.4% for the Developer Approach and of 0.5% for the Scoping Approach.

1964. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Buchan Ness to Collieston Coast SPA population predicted due to collisions represents 0.30% of the current adult breeding population at this colony (i.e. 22,590 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.32% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 2.0% for the Developer Approach and of 2.2% for the Scoping Approach.

1965. Using the collision estimates for the 'as-built' (as opposed to the consented) designs reduces the total annual collision estimates for the Proposed Development in-combination with the other UK North Sea wind farms to 66.5 adult and 20.6 immature birds for the Scoping Approach and to 62.3 adult and 19.3 immature birds for the Developer Approach. These potential mortalities would give estimates of the additional annual collision mortality as a percentage of the current adult population and as a percentage increase to the baseline annual adult mortality which are slightly lower than those given in the paragraph above for the Developer Approach. Use of the 'as-built' designs does not affect the annual collision estimates for the Proposed Development in-combination with the other Forth and Tay wind farms.

1966. The potential levels of impact on the Buchan Ness to Collieston Coast SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>In-combination: population-level impacts</u>

1967. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.136 and 5.137 above).

1968. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.138: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other Forth and Tay Wind Farms

Period	Approach	Additional Annual Mortality Adults	Immatures	Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
35 years	*Baseline*	*0*	*0*	4374 (1680 – 11054)	*1.000*	1.000	*50.0*
	Scoping A	20.77	7.24	4235 (1625 – 10708)	0.968	0.999	47.3

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
	Scoping B	27.51	10.18	4189 (1607 – 10593)	0.958	0.999	46.6
	Developer	14.16	4.65	4279 (1643 – 10820)	0.978	0.999	48.3

Table 5.139: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms.

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	4374 (1680 – 11054)	*1.000*	1.000	*50.0*
	Scoping A	80.17	27.04	3863 (1479 – 9783)	0.883	0.997	40.0
	Scoping B	97.91	35.28	3751 (1436 – 9504)	0.858	0.996	37.7
	Developer	68.16	21.75	3940 (1509 – 9974)	0.901	0.997	41.2

1969. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.138 and 5.139 with Table 5.135).

1970. However, these impacts remain relatively small for the Proposed Development in-combination with the other Forth and Tay wind farms. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of 4% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.138). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) remains at 0.1%, whilst the centile value of 46.6 continues to indicate a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.138).

1971. The predicted levels of impact are markedly higher for the Proposed Development in-combination with the other UK North Sea wind farms. For the Scoping Approach, the CPS values indicate a reduction of 12 - 14% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst the associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.3 – 0.4% (Table 5.139). The values of the centile metric (for the Scoping Approach) suggest at least moderate overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the predicted levels of impact are lower for the Developer Approach, with (most notably) the CPS value indicating a 10% reduction in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects.

1972. Undertaking the PVAs on the basis of the collision estimates for the 'as-built' (as opposed to the consented) designs for the Proposed Development in-combination with the other UK North Sea wind farms has a small effect only on the values for the resulting PVA metrics (see Tables 3.1 and 3.3 in the Offshore EIA Report, volume 3, appendix 11.6). Therefore, no further consideration is given to the outputs produced using the 'as-built' collision estimates.

1973. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

<u>In-combination: conclusion</u>

1974. For both the Scoping and Developer Approaches, the predicted levels of impact associated with the Proposed Development in-combination with the other Forth and Tay wind farms remain small, whilst the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of these impacts after 35 years. Given this, it is concluded that the effects associated with this in-combination scenario would not result in an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population.

1975. The predicted levels of impact are higher for the Proposed Development in-combination with the other UK North Sea wind farms but for the Developer Approach they are considered to remain at a level which would not be sufficient to result in an adverse effect on the SPA population. This conclusion is reached within the context that has been outlined above in relation to (i) the high levels of precaution incorporated in the assessment and (ii) the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population. By contrast, the higher levels of impact predicted by the Scoping Approach for this in-combination scenario (which suggest a potential reduction in population size of up to 14%) are of a scale which is considered sufficient to potentially lead to an adverse effect on this SPA population, even when taking account of the above context. However, as has been detailed above (and in Offshore EIA Report, volume 3, appendix 11.3), it is considered that the level of effects on kittiwakes assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

1976. Consequently, it is concluded that there is the potential for an adverse effect on the Buchan Ness to Collieston Coast SPA kittiwake population as a result of the predicted effects from the Proposed Development in-combination with the other UK North Sea wind farms, as determined by the Scoping Approach. However, when based upon the Developer Approach, it is concluded that there is no potential for an adverse effect on the SPA population as a result of the predicted effects from the Proposed Development in-combination with the other UK North Sea wind farms.

Assessment for the guillemot population

1977. The Buchan Ness to Collieston Coast SPA guillemot population is currently estimated to number 39,553 individuals, based upon the most recently available count data from 2019 (Offshore EIA Report, volume 3, appendix 11.5). This is more than double the citation level, which is equivalent to 17,280 individuals as derived from the 1986 population estimate (Table 5.131). Count data for the population are sporadic but tend to suggest that numbers have been largely stable since at least the mid-1990s (but noting that the 2007 count is markedly lower than the other three counts which are available between 1995 and 2019) (SMP 2022).

The potential for impacts on the guillemot population

1978. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Buchan Ness to Collieston Coast SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

1979. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is possible that during the breeding period guillemots from the Buchan Ness to Collieston Coast SPA may occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 1% of the guillemot occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemots is defined as April to mid-August, following the NatureScot (2020) guidance.

1980. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, Offshore EIA Report, volume 3, appendix 11.5). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the Buchan Ness to Collieston Coast SPA guillemot population during the non-breeding period as during the breeding season, with 3% of the guillemots occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

1981. Direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

1982. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

1983. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as ‘3’ on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

1984. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the Buchan Ness to Collieston Coast SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species’ mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only. Additionally, modelling of guillemot foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area and Proposed Development export cable corridor have minimal overlap with waters that are predicted to be used by birds from the Buchan Ness to Collieston Coast SPA and exclude those areas of predicted greatest usage (Cleasby *et al.* 2018).

1985. During the non-breeding period, guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD. Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

1986. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

1987. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

1988. Given the moderate sensitivity of guillemot to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated guillemot foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population.

Displacement

1989. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Buchan Ness to Collieston Coast SPA guillemot population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas (which, relative to guillemot foraging range, are distant to the SPA), with the potential effects also being of a temporary nature.

1990. Based upon the above, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population.

Changes to prey availability

1991. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Buchan Ness to Collieston Coast SPA guillemot population in the short-term.

1992. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Buchan Ness to Collieston Coast SPA guillemot population are as for the St Abb's Head to Fast Castle SPA guillemot population (and are detailed above in the equivalent section for that SPA population). Additionally, the relatively large distance of the Proposed Development from the Buchan Ness to Collieston Coast SPA is relevant because it reduces the likelihood that guillemots from this SPA will use the Proposed Development (Offshore EIA Report, volume 3, appendix 11.5).

1993. Given this, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population.

Project alone: operation and maintenance

Disturbance

1994. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from Buchan Ness to Collieston Coast SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

1995. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

1996. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

1997. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

1998. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population.

Displacement/barrier effects

1999. As outlined above, displacement effects on the Buchan Ness to Collieston Coast SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement / barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2000. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report, displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

2001. As with other species for which displacement effects are assessed (see above), the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2002. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

2003. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Buchan Ness to Collieston Coast SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.140). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Buchan Ness to Collieston Coast SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.140: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development array area and 2 km Buffer for each Seasonal Period, together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Buchan Ness to Collieston Coast SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.515	0.009	0.009	0.07
Non-breeding	44,171	0.515	0.030	0.030	N/A

2004. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as 10 adult and nine immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 22 adult and 20 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.141). These effects are relatively evenly split between the breeding and non-breeding periods (Table 5.141).

2005. The annual mortality from displacement as determined using the Developer Approach is predicted to be five adult and five immature birds, equating to 50% and 23% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.141). The breeding season effects represent approximately one third of the total annual mortality, as determined by the Developer Approach.

Table 5.141: Estimated Potential Annual Mortality of Buchan Ness to Collieston Coast SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	5.5	5.5
	Non-breeding	60%	1%	4.1	3.6
	Annual total	-	-	9.6	9.1
Scoping B	Breeding	60%	5%	9.1	9.2
	Non-breeding	60%	3%	12.4	10.7
	Annual total	-	-	21.5	19.9
Developer	Breeding	50%	1%	1.5	1.5
	Non-breeding	50%	1%	3.4	3.0
	Annual total	-	-	4.9	4.5

2006. The additional annual mortality of adult guillemot from the Buchan Ness to Collieston Coast SPA population predicted due to displacement from the Proposed Development array represents 0.01% of the current adult breeding population at this colony (i.e. 39,553 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.02 - 0.05% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.073 – see Table 2.9 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.2% for the Developer Approach and of 0.3 – 0.7% for the lower and upper estimates from the Scoping Approach.

2007. The potential levels of impact on the Buchan Ness to Collieston Coast SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

2008. Potential impacts on key prey species for guillemots breeding at the Buchan Ness to Collieston Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the Buchan Ness to Collieston Coast SPA population.

2009. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Buchan Ness to Collieston Coast SPA guillemot population as to the St Abb's Head to Fast Castle SPA guillemot population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2010. Given this, it is considered that there is relatively little potential for the Buchan Ness to Collieston Coast SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population.

Project alone: population-level impacts

2011. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2012. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.141 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2013. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.142: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	113267 (65202 – 184901)	*1.000*	1.000	*50.0*
Scoping A	9.57	9.40	112133 (64551 – 183077)	0.990	1.000	48.4
Scoping B	21.40	20.79	110758 (63761 – 180864)	0.978	0.999	46.4
Developer	4.93	4.76	112686 (64867 – 183966)	0.995	1.000	49.3

2014. The PVA predicted that the Buchan Ness to Collieston Coast SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost three times larger than the current estimate of 39,553 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.142). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. Whilst the predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), the prediction for an increasing trend is consistent with the documented, overall, long-term trend for this SPA population but not with the apparent stability in numbers since the mid-1990s (see above).

2015. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of approximately 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.142). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1%, whilst the centile value of 46.4 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.142).

2016. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA guillemot population, the assessment of the Buchan Ness to Collieston Coast SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by guillemot are equally relevant to the Buchan Ness to Collieston Coast SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by guillemots from the Buchan Ness to Collieston Coast SPA are likely to be low (Cleasby *et al.* 2018).

Project alone: conclusion

2017. It is considered that the predicted levels of impact from the Proposed Development alone on the Buchan Ness to Collieston Coast SPA guillemot population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach) and a population for which the documented, long-term, trend is increasing but with stability over the more recent decades. Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2018. As detailed above, any effects from the Proposed Development alone on the Buchan Ness to Collieston Coast SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2019. Therefore, the potential for effects of the Proposed Development to act on the Buchan Ness to Collieston Coast SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. Following advice from NatureScot provided through the Ornithology Roadmap process (at meeting 3, 8th December 2021), the following sections consider these potential effects for (i) the Proposed Development in-combination with the other Forth and Tay wind farms and (ii) the Proposed Development in-combination with the other UK North Sea wind farms (noting that scenario (ii) includes those plans and projects which comprise scenario (i)).

Displacement/barrier effects – operation and maintenance

2020. As described in annex E of volume 3, appendix 11.6 of the Offshore EIA Report, estimates of displacement mortality during both the breeding and non-breeding periods which had been attributed to the Buchan Ness to Collieston Coast SPA guillemot population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2021. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for both the Forth and Tay wind farms and the UK North Sea wind farms according to both the Scoping Approach and Developer Approach. In addition to effects from the Forth and Tay wind farms, effects on the SPA population also were identified for the Kincardine, Hywind and Moray West wind farms (annex E of Offshore EIA Report, volume 3, appendix 11.6).

Table 5.143: Estimated Annual Mortality of Buchan Ness to Collieston Coast SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other Forth and Tay Wind Farms and other UK North Sea Wind Farms

In-Combination Region	Approach	SEASONAL Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
Forth and Tay	Scoping A	8.4	8.8	4.8	4.3	13.2	13.2
	Scoping B	14.0	14.7	14.5	12.9	28.5	27.7
	Developer	2.3	2.5	4.0	3.6	6.4	6.1
UK North Sea	Scoping A	13.3	12.5	6.2	5.3	19.5	17.8
	Scoping B	22.2	20.8	18.5	15.9	40.6	36.7
	Developer	3.7	3.5	5.1	4.4	8.8	7.9

2022. Incorporating the potential mortality predicted from the displacement effects associated with the other Forth and Tay wind farms leads to an increase of approximately 30 - 40% in the predicted displacement mortality compared to the Proposed Development alone for each of the Developer and Scoping Approaches, whilst for the other UK North Sea wind farms this increase (compared to the Proposed Development alone) is approximately 80 – 100% (Tables 5.141 and 5.143). The effects attributed to the breeding season account for approximately 40 – 65% of the predicted annual mortality for the Proposed Development in-combination with the other Forth and Tay wind farms and approximately 43 – 70% for the Proposed Development in-combination with the other UK North Sea wind farms (with this contribution being lowest for the Developer Approach and highest for the upper range of the Scoping Approach in each case – Table 5.143).

2023. For the Proposed Development in-combination with the other Forth and Tay wind farms, the additional annual mortality of adult guillemots from the Buchan Ness to Collieston Coast SPA population predicted due to displacement represents between 0.02% of the current adult breeding population at this colony (i.e. 39,553 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between 0.03 – 0.07% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.073 – see Table 2.9 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.2% for the Developer Approach and of 0.5 – 1.0% for the lower and upper estimates from the Scoping Approach.

2024. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult guillemots from the Buchan Ness to Collieston Coast SPA population predicted due to displacement represents between 0.02% of the current adult breeding population at this colony (i.e. 39,553 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between 0.05 – 0.10% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.073 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 0.3% for the Developer Approach and of 0.7 – 1.4% for the lower and upper estimates from the Scoping Approach.

2025. The potential levels of impact on the Buchan Ness to Collieston Coast SPA guillemot population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the Forth and Tay or in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

2026. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other Forth and Tay wind farms and the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.143 above).

2027. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.144: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other Forth and Tay Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	113267 (65202 – 184901)	*1.000*	1.000	*50.0*
Scoping A	12.57	13.30	111733 (64323 – 182431)	0.986	1.000	47.7
Scoping B	27.10	28.09	110012 (63336 – 179665)	0.971	0.999	45.6
Developer	6.03	6.16	112540 (64784 – 183731)	0.994	1.000	49.0

Table 5.145: Projected 35 Year Population Sizes and Associated PVA Metrics for the Buchan Ness to Collieston Coast SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	113267 (65202 – 184901)	*1.000*	1.000	*50.0*
Scoping A	18.77	17.91	111079 (63945 – 181383)	0.981	0.999	46.7
Scoping B	39.30	37.09	108753 (62607 – 177640)	0.960	0.999	43.9
Developer	8.53	8.06	112272 (64630 – 183302)	0.991	1.000	48.6

2028. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.142 with Tables 5.144 and 5.145). However, the predicted levels of impact remain relatively small, irrespective of whether these are determined using the Developer or Scoping Approaches.

2029. Focussing on the Proposed Development in-combination with the other UK North Sea wind farms, the CPS values indicate that the SPA population size would be reduced by 1 - 4% after 35 years relative to that in the absence of any wind farm effects, as determined by the Developer and Scoping Approaches (Table 5.145). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1% for the Scoping Approach and is not detectable for the Developer Approach (at least when the CPGR is expressed to three decimal places). The centile values range from 43.9 – 48.6, indicating a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. The PVA metrics for the Proposed Development in-combination with the other Forth and Tay wind farms indicate lower levels of impact, as would be expected from the lower predicted mortalities (Table 5.144).

In-combination: conclusion

2030. On the basis of both the Developer and Scoping Approaches, the potential effects from the Proposed Development in-combination with the other Forth and Tay wind farms or the other UK North Sea wind farms on the Buchan Ness to Collieston Coast SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, for both of these in-combination scenarios, the PVA metrics indicate a high likelihood of the population being of a similar size to that which would occur in the absence of the wind farm effects after 35 years. These levels of impact are considered within the context of the long-term increasing (and more recently stable) population trend and the 'favourable maintained' condition of the SPA population, as well as the high levels of precaution incorporated in the assessment (particularly as determined by the Scoping Approach).

2031. Given the above, it is concluded that the effects from the Proposed Development in-combination with other plans and projects would not result in an adverse effect on the Buchan Ness to Collieston Coast SPA guillemot population, with this conclusion being irrespective of whether the effects are determined by the Developer or Scoping Approaches.

Assessment for the breeding seabird assemblage

2032. The breeding seabird assemblage for the Buchan Ness to Collieston Coast SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supports 95,000 individual seabirds). Guillemot and kittiwake are amongst the species identified in the citation as having nationally important populations which contribute to the Buchan Ness to Collieston Coast SPA breeding seabird assemblage.

2033. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay wind farms or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Proposed Development alone and in-combination with the other Forth and Tay wind farms, no potential for an adverse effect is identified in relation to the SPA populations of kittiwake or guillemot, as determined by either the Developer or Scoping Approaches. However, for the Proposed Development in-combination with the other UK North Sea wind farms the potential for an adverse effect is identified in relation to the SPA kittiwake population, as determined by the Scoping Approach but not as determined by the Developer Approach.

2034. The Buchan Ness to Collieston Coast SPA is currently two to two and half times larger than those at the St Abb's Head to Fast Castle SPA and at the Forth Islands SPA. Therefore, despite the documented long-term decline in this population, it is not considered that the effects from the Proposed Development in-combination with the other UK North Sea wind farms (as determined by the Scoping Approach) are likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Buchan Ness to Collieston Coast SPA (in contrast to the conclusions reached for the St Abb's Head to Fast Castle SPA and Forth Islands SPA). Also, given the range of species present within the SPA seabird assemblage and their relative abundances, together with the predicted level of impact on the SPA kittiwake population, it is considered that this potential adverse effect on the SPA kittiwake population would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

2035. Therefore, it is concluded that there is no potential for an adverse effect on the breeding seabird assemblage feature of the Buchan Ness to Collieston Coast SPA either as a result of the effects from the Proposed Development alone or in-combination with other plans and projects. This conclusion is irrespective of whether the effects are determined by the Scoping or Developer Approach.

Site conclusion

Developer approach

2036. It is concluded that there is no potential for an adverse effect on the breeding seabird assemblage qualifying feature of the Buchan Ness to Collieston Coast SPA or on the named component species of this feature due to the effects from the Proposed Development alone or in-combination with other plans and projects. Consequently, it is concluded that there is no potential for an Adverse Effects on Integrity of the Buchan Ness to Collieston Coast SPA.

Scoping approach

2037. It is concluded that the possibility of an adverse effect cannot be discounted for the Buchan Ness to Collieston Coast SPA population of breeding kittiwake (noting this species is a named component of the seabird assemblage feature only). For the kittiwake population, the potential for an adverse effect arises from the Proposed Development in-combination with the other UK North Sea wind farms (but not from the Proposed Development alone or in-combination with the other Forth and Tay wind farms). The predicted impacts on the SPA kittiwake population are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature.

2038. Consequently, it is concluded that an Adverse Effects on Integrity of the Buchan Ness to Collieston Coast SPA cannot be excluded due to effects of the Proposed Development in-combination with the other UK North Sea wind farms.

5.7.6. TROUP, PENNAN AND LION'S HEAD SPA

European site information and conservation objectives

2039. The Troup, Pennan and Lion's Heads SPA is a 9 km stretch of sea cliffs along the Aberdeenshire coast, situated approximately 135 km from the Proposed Development. The boundary of the SPA overlaps with the boundary of Gamrie and Pennan coast SSSI and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1997, with the marine extension classified in 2009.

2040. The site qualifies under Article 4.2 by regularly supporting two migratory seabird species and in excess of 20,000 breeding seabirds, including three named component species (Table 5.146). The potential for LSE has been identified in relation to three of these five species (Table 5.146), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

2041. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

2042. Further information on this European site is presented in appendix 3A.

Table 5.146: Details on the Qualifying Features of the Troup, Pennan and Lion's Heads SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Unfavourable declining	150,000 individuals	Yes
Kittiwake	Breeding	Unfavourable no change	31,600 pairs	Yes
Herring gull*	Breeding	Unfavourable declining	4,200 pairs	No
Guillemot	Breeding	Unfavourable declining	44,600 individuals	Yes
Razorbill*	Breeding	Unfavourable declining	4,800 individuals	Yes
Fulmar*	Breeding	Unfavourable no change	4,400 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

2043. The Troup, Pennan and Lion's Head SPA kittiwake population is currently estimated to number 21,232 individuals, based upon the most recently available count data from 2017 (Offshore EIA Report, volume 3, appendix 11.5). This is substantially below the citation level (which is equivalent to 63,200 individuals - Table 5.146). Based on the data available on the SMP, the peak count is 63,328 individuals from 1995, which represented a substantial increase compared to the earliest available estimate of 33,188 individuals from 1986. However, since 1995 the population has undergone a progressive decline to its current level.

The potential for impacts on the kittiwake population

2044. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Troup, Pennan and Lion's Head SPA, so that potential impacts on its kittiwake population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

2045. From published information on kittiwake foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is apparent that during the breeding period kittiwakes from the Troup, Pennan and Lion's Head SPA could occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array. This is reflected in the findings of the apportioning exercise, which estimates that less than 1% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (volume 3, appendix 11.5 of the Offshore EIA Report). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

2046. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Troup, Pennan and Lion's Head SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Troup, Pennan and Lion's Head SPA kittiwake population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

2047. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2048. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - volume 2, chapter 13 of the Offshore EIA Report).

2049. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2050. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Troup, Pennan and Lion's Head SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

2051. Tracking data (and associated modelling of foraging distributions) for kittiwake suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are heavily used by birds from the Troup, Pennan and Lion's Head SPA during the breeding season (Cleasby *et al.* 2018).

2052. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015). Thus, the potential for effects of construction-related disturbance is generally lower than during the breeding season (but noting that in the case of the Troup, Pennan and Lion's Head SPA, the distance of the SPA from the Proposed Development means that the likelihood of usage of the Proposed Development by the SPA birds during the breeding season is also low and, hence, any such seasonal effect will be less marked).

2053. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2054. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2055. Given the low sensitivity of kittiwake to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated kittiwake breeding season foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

2056. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Troup, Pennan and Lion's Head SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2057. Therefore, based upon the above, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

2058. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Troup, Pennan and Lion's Head SPA kittiwake population in the short-term.

2059. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Troup, Pennan and Lion's Head SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population. Additionally, the relatively large distance of the Proposed Development from the Troup, Pennan and Lion's Head SPA is relevant because it reduces the likelihood that kittiwakes from this SPA will use the Proposed Development during the breeding season (volume 3, appendix 11.5 of the Offshore EIA Report).

2060. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2061. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Troup, Pennan and Lion's Head SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2062. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2063. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2064. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2065. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population.

Displacement/barrier effects

2066. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2067. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

2068. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

2069. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Troup, Pennan and Lion's Head SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.147). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.147: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to Be from the Troup, Pennan and Lion's Head SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals during the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	0.005	0.005	*0.10*
Autumn migration	*11,190*	*N/A*	0.022	0.013	*N/A*
Spring migration	*13,766*	*N/A*	0.028	0.013	*N/A*

2070. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as two adult and one immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as seven adult and three immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.148). The displacement effects predicted by the Scoping Approach are attributable mainly to the non-breeding season (which accounts for approximately 90% of the overall potential annual mortality – Table 5.148), reflecting the fact that this SPA is distant from the Proposed Development with a low likelihood of use by the SPA kittiwake population during the breeding season.

2071. The annual mortality from displacement as determined using the Developer Approach is predicted to be less than a single adult bird, which (in contrast to the estimates from the Scoping Approach) is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.148: Estimated Potential Annual Mortality of Troup, Pennan and Lion's Head SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.3	0.0
	Autumn migration	30%	1%	0.7	0.4
	Spring migration	30%	1%	1.1	0.5
	Annual total	-	-	2.2	1.0
Scoping B	Breeding	30%	3%	0.8	0.0
	Autumn migration	30%	3%	2.2	1.3

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
	Spring migration	30%	3%	3.5	1.6
	Annual total	-	-	6.5	2.9
Developer	Breeding	30%	2%	0.5	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.5	0.0

2072. The additional annual mortality of adult kittiwakes from the Troup, Pennan and Lion's Head SPA population predicted due to displacement from the Proposed Development array represents considerably less than 0.01% of the current adult breeding population at this colony (i.e. 21,232 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and of approximately 0.01 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of considerably less than 0.1% for the Developer Approach and of approximately 0.1 – 0.2% for the lower and upper estimates from the Scoping Approach.

2073. The potential levels of impact on the Troup, Pennan and Lion's Head SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

2074. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

2075. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Troup, Pennan and Lion's Head SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

2076. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

2077. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of Offshore EIA Report, volume 3, appendix 11.3.

2078. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (volume 3, appendix 11.5 of the Offshore EIA Report). Estimates were apportioned to the Troup, Pennan and Lion's Head SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report volume 3, appendix 11.5, Table 5.147). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.147).

2079. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Troup, Pennan and Lion's Head SPA is predicted to be approximately 12 adults and five immatures as determined by the Scoping Approach, and approximately nine adults and four immatures as determined by the Developer Approach (Table 5.149). The majority of this mortality (i.e. at least 80%) is predicted to occur during the non-breeding periods (for the same reasons as outlined above for the displacement effects on this SPA population, as determined by the Scoping Approach).

Table 5.149: Predicted Collision Effects from the Proposed Development on the Troup, Pennan and Lion's Head SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for The Maximum Design Scenarioand are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Scoping	Breeding	2.7	0.1
	Autumn migration	3.9	2.3
	Spring migration	5.3	2.5
	Annual total	11.9	4.9
Developer	Breeding	1.9	0.6
	Autumn migration	2.3	1.4
	Spring migration	4.3	2.0
	Annual total	8.5	4.0

2080. The additional annual mortality of adult kittiwakes from the Troup, Pennan and Lion's Head SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 21,232 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 0.06% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 0.3% and 0.4% for the Developer and Scoping Approaches, respectively.

2081. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Troup, Pennan and Lion's Head SPA kittiwake population that are at least 50% lower than those presented in Table 5.149 above (and on which the assessment is based).

2082. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.149 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

2083. Potential impacts on key prey species for kittiwakes breeding at the Troup, Pennan and Lion's Head SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Troup, Pennan and Lion's Head SPA kittiwake population.

2084. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Troup, Pennan and Lion's Head SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2085. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population.

Project alone: population-level impacts

2086. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Troup, Pennan and Lion's Head SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2087. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.148 and 5.149 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report volume 3, appendix 11.6).

2088. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.150: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	39032 (18949 – 77565)	*1.000*	1.000	*50.0*
	Scoping A	14.07	5.69	38232 (18555 – 75985)	0.980	0.999	47.9
	Scoping B	18.42	7.59	37983 (18431 – 75496)	0.973	0.999	47.4
	Developer	*9.01*	3.34	38542 (18707 – 76598)	0.987	1.000	48.6

2089. The PVA predicted that the Troup, Pennan and Lion's Head SPA kittiwake population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost twice the current estimate of 21,232 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.150). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small.

2090. The prediction of an increasing trend is in contrast to the predicted trends for other SPA kittiwake populations included in the Stage Two assessment and for which population models have been developed (see above and also Offshore EIA Report volume 3, appendix 11.3). This presumably results from the higher level of breeding productivity that is estimated for the Troup, Pennan and Lion's Head SPA population than for other populations because the annual survival rates that have been assumed for the different population age classes are equivalent to those for the likes of the Forth Islands SPA and Fowlsheugh SPA kittiwake populations (see Table 2.13 in Offshore EIA Report volume 3, appendix 11.3). However, the prediction of an increasing trend for the Troup, Pennan and Lion's Head SPA population does not reflect the documented long-term population trend which, in common with most of the other kittiwake populations, is declining (see above).

2091. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of less than 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.150). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1%, whilst the centile value of 47.4 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.150).

2092. The PVA outputs described above, and detailed in Table 5.150, need to be considered within the context of the documented long-term decline in the size of this population (see above). As described in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population, the available evidence suggests that the long-term decline of kittiwake populations in the North Sea (including the Troup, Pennan and Lion's Head SPA) is associated with fisheries management and climate change (Frederiksen *et al.* 2004). Therefore, without appropriate management to mitigate these effects, it is likely that the Troup, Pennan and Lion's Head SPA population will continue to decline and that the predicted effects from the Proposed Development may be of limited importance relative to these broader-scale effects. Furthermore, it is also relevant to consider the high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach (with this also detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

<u>Project alone: conclusion</u>

2093. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

<u>Effects in-combination</u>

<u>Effects of relevance to the in-combination assessment</u>

2094. As detailed above, any effects from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2095. Therefore, the potential for effects of the Proposed Development to act on the Troup, Pennan and Lion's Head SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the offshore wind farms in the UK North Sea.

<u>Displacement/barrier effects – operation and maintenance</u>

2096. As described in Offshore EIA Report, annex A of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Troup, Pennan and Lion's Head SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2097. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (Offshore EIA Report, annex A in volume 3, appendix 11.6), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in- combination *Displacement/Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

2098. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates according to both the Scoping Approach and Developer Approach (Table 5.151).

Table 5.151: **Estimated Annual Mortality of Troup, Pennan and Lion's Head SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other UK North Sea Wind Farms**

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	3.8	0.3	3.9	2.3	5.9	2.6	13.5	5.2
	Scoping B	11.3	1.0	11.6	6.8	17.6	7.8	40.6	15.7
	Developer	7.6	0.7	N/A	N/A	N/A	N/A	7.6	0.7

2099. The incorporation of the potential mortality from the predicted displacement effects associated with other plans and projects results in near sixfold (for the Scoping Approach) and seventeen-fold increases in the levels predicted for the Proposed Development alone (Tables 5.148 and 5.151). For the Scoping Approach, the vast majority (i.e. almost 80%) of the predicted mortality from displacement is attributed to effects during the non-breeding periods (as for the Proposed Development alone), whilst for the Developer Approach all mortality is attributed to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

2100. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Troup, Pennan and Lion's Head SPA population predicted due to displacement represents 0.04% of the current adult breeding population at this colony (i.e. 21,232 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and of approximately 0.06 – 0.19% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.2% for the Developer Approach and of 0.4 – 1.3% for the lower and upper estimates from the Scoping Approach.

2101. The potential levels of impact on the Troup, Pennan and Lion's Head SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

2102. As for displacement, breeding season collision estimates attributed to the Troup, Pennan and Lion's Head SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (Offshore EIA Report, Offshore EIA Report annex A of volume 3, appendix 11.6). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (Offshore EIA Report, annex D of volume 3, appendix 11.6). The non-breeding season collision estimates were apportioned to the Troup, Pennan and Lion's Head SPA population according to the BDMPS approach (Furness 2015).

2103. Collision estimates based on consented and 'as-built'[11] designs were also considered. For the current SPA population this had a small effect on the totals for the other UK North Sea wind farms (with use of the 'as-built' designs reducing the totals for the consented designs by almost six adult and three immature birds).

2104. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

2105. As for displacement, the potential mortality estimates derived for the other plans and projects were combined with those for the Proposed Development to give estimates for the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.152).

Table 5.152: **Predicted Collision Effects on the Troup, Pennan and Lion's Head SPA Kittiwake Population due to the Proposed Development In-Combination with Other Projects in the UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach**

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	9.4	0.7
		Autumn migration	22.7	13.4
		Spring migration	29.9	13.3
		Annual total	62.0	27.4
	Developer	Breeding	8.5	1.3
		Autumn migration	21.1	12.4
		Spring migration	28.9	12.8
		Annual total	58.5	26.5

2106. The incorporation of the predicted collisions associated with other plans and projects results in an approximate fivefold and sevenfold increase in collision mortality compared to that predicted for the Proposed Development alone for the Scoping Approach and Developer Approach, respectively (Tables 5.149 and 5.152). As for the Proposed Development alone, the majority of the mortality from the in-combination scenario (i.e. almost 90%) is predicted to occur during the non-breeding periods.

2107. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Troup, Pennan and Lion's Head SPA population predicted due to collisions represents 0.28% of the current adult breeding population at this colony (i.e. 21,232 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.29% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 in volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 2.0% for both the Developer and Scoping Approaches.

2108. Using the collision estimates for the 'as-built' (as opposed to the consented) designs reduces the total annual collision estimates for the Proposed Development in-combination with the other UK North Sea wind farms to 56.4 adult and 24.4 immature birds for the Scoping Approach and to 52.9 adult and 23.5 immature birds for the Developer Approach. These potential mortalities would give estimates of the additional annual collision mortality as a percentage of the current adult population and as a percentage increase to the baseline annual adult mortality which are slightly lower than those given in the paragraph above for the Developer Approach.

2109. The potential levels of impact on the Troup, Pennan and Lion's Head SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>In-combination: population-level impacts</u>

2110. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.151 and 5.152 above).

2111. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above.

Table 5.153: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the Other UK North Sea Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	39032 (18949 – 77565)	*1.000*	1.000	*50.0*
	Scoping A	75.47	32.39	34871 (16903 – 69354)	0.894	0.997	38.4
	Scoping B	102.52	42.79	33525 (16237 – 66684)	0.859	0.996	34.1
	Developer	65.66	26.44	35434 (17177 – 70461)	0.908	0.997	40.0

2112. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.153 with Table 5.150). Thus, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by 9% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 11 – 14% (Table 5.153). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.3% for the Developer Approach and 0.3 – 0.4% for the Scoping Approach. The values for the centile metric are estimated as 40.0 after 35 years for the Developer Approach and as 34.1 – 38.4 for the Scoping Approach. For the Scoping Approach these suggest at least moderate levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being similar in size to the un-impacted population after 35 years, whilst for the Developer Approach this likelihood is higher.

2113. Undertaking the PVAs on the basis of the collision estimates for the 'as-built' (as opposed to the consented) designs for the Proposed Development in-combination with the other UK North Sea wind farms has a small effect only on the values for the resulting PVA metrics (see Tables 3.1 and 3.3 in volume 3, appendix 11.6 in the Offshore EIA Report). Therefore, no further consideration is given to the outputs produced using the 'as-built' collision estimates.

2114. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-level impacts* section for this SPA population.

<u>In-combination: conclusion</u>

2115. For the Developer Approach, the predicted levels of impact associated with the Proposed Development in-combination with the other UK North Sea wind farms remain relatively small, whilst the likelihood of the impacted population being similar in size to the un-impacted population after 35 years remains reasonably high. This is within the context of a population which has undergone a long-term decline, with the potential wind farm effects likely to be of minor importance in determining population status compared to other management and environmental factors. In addition, the assessment incorporates high levels of precaution. Consequently, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on this SPA population, as determined by the Developer Approach.

2116. For the Scoping Approach, the predicted levels of impact for the Proposed Development in-combination with the other UK North Sea wind farms are inevitably greater than as determined by the Developer Approach. It is considered that these may, potentially, be sufficient to result in an adverse effect on this SPA population. However, as has been detailed above (and in Offshore EIA Report, volume 3, appendix 11.3), it is considered that the level of effects on kittiwakes assumed by the Scoping Approach are overly precautionary and without any reasonable basis or support from the available evidence. Given this, it is considered that greater weight should be given to the conclusions as determined by the Developer Approach.

Assessment for the guillemot population

2117. The Troup, Pennan and Lion's Head SPA guillemot population is currently estimated to number 31,893 individuals, based upon the most recently available count data from 2017 (Offshore EIA Report, volume 3, appendix 11.5). This is substantially below the citation level of 44,600 individuals (Table 5.146). Count data for the population are sporadic but indicate that numbers increased markedly between the mid-1980s and early 2000s (with population estimates of 21,688 and 64,257 individuals for 1986 and 2001, respectively) before declining to the current levels. The SPA population is considered to be in 'unfavourable, declining' condition.

The potential for impacts on the guillemot population

2118. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Troup, Pennan and Lion's Head SPA, so that potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

2119. From published information on guillemot foraging ranges generally (Woodward *et al.* 2019) and tracking from the SPA specifically (Wakefield *et al.* 2017), it is possible that during the breeding period guillemots from the Troup, Pennan and Lion's Head SPA may occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that less than 1% of the guillemot occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for guillemots is defined as April to mid-August, following the NatureScot (2020) guidance.

2120. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), during the non-breeding period guillemots are assumed to remain largely within the waters in the region of the breeding colony, as defined by the mean maximum foraging range plus 1 SD (Woodward *et al.* 2019, Buckingham *et al.* 2022, volume 3, appendix 11.5 of the Offshore EIA Report). Therefore, on this basis, the Proposed Development has a similar potential to have effects on the Troup, Pennan and Lion's Head SPA guillemot population during the non-breeding period as during the breeding season, with approximately 3% of the guillemots occurring on the Proposed Development array area during the non-breeding period estimated to derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

2121. Direct disturbance to guillemots during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2122. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - volume 2, chapter 13 of the Offshore EIA Report).

2123. When using the marine environment (and not at the breeding colony), guillemots are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign guillemot as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2124. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to guillemots from the Troup, Pennan and Lion's Head SPA. Thus, the Proposed Development array area encompasses 1,010 km², whilst the Proposed Development export cable corridor encompasses 168 km². Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA guillemot population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 73.2±80.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 14% of the breeding season foraging area if considering the mean maximum foraging range only. Additionally, modelling of guillemot foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area and Proposed Development export cable corridor have minimal, if any, overlap with waters that are predicted to be used by birds from the Troup, Pennan and Lion's Head SPA and exclude those areas of predicted greatest usage (Cleasby *et al.* 2018).

2125. During the non-breeding period, guillemot distribution is less constrained by the location of the breeding colonies but (as detailed above), for the purposes of the current assessment, it is assumed that the area occupied by the SPA population is defined by the mean maximum breeding season foraging range plus 1SD. Thus, the potential for effects of construction-related disturbance is assumed to be similar to that during the breeding season.

2126. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2127. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2128. Given the moderate sensitivity of guillemot to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated guillemot foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population.

Displacement

2129. As detailed above, guillemot is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Troup, Pennan and Lion's Head SPA guillemot population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of guillemots from this SPA will be limited to relatively small areas (which, relative to guillemot foraging range, are distant to the SPA), with the potential effects also being of a temporary nature.

2130. Based upon the above, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA guillemot population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population.

Changes to prey availability

2131. Sandeels are key prey for guillemots, with a range of other species taken including clupeids (sprat and juvenile herring; del Hoyo *et al*., 1996). Indirect effects on guillemots may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Troup, Pennan and Lion's Head SPA guillemot population in the short-term.

2132. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Troup, Pennan and Lion's Head SPA guillemot population are as for the St Abb's Head to Fast Castle SPA guillemot population (and are detailed above in the equivalent section for that SPA population). Additionally, the relatively large distance of the Proposed Development from the Troup, Pennan and Lion's Head SPA is relevant because it reduces the likelihood that guillemots from this SPA will use the Proposed Development (Offshore EIA Report, volume 3, appendix 11.5).

2133. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA guillemot population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population.

Project alone: operation and maintenance

Disturbance

2134. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of guillemots from Troup, Pennan and Lion's Head SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, guillemots are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2135. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2136. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2137. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2138. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population.

Displacement/barrier effects

2139. As outlined above, displacement effects on the Troup, Pennan and Lion's Head SPA guillemot population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2140. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on guillemot are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for guillemot are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

2141. As with other species for which displacement effects are assessed (see above), the approach to estimating guillemot displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2142. Based upon a consideration of the available evidence for guillemot displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

2143. Estimates of guillemot mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Troup, Pennan and Lion's Head SPA guillemot population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the NatureScot (2018) approach, respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.154). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Troup, Pennan and Lion's Head SPA guillemot PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.154: The Mean Peak Abundance Estimates of Guillemot in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Troup, Pennan and Lion's Head SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	74,154	0.536	0.005	0.005	0.07
Non-breeding	44,171	0.536	0.026	0.026	N/A

2144. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA guillemot population as a result of displacement is estimated as five adult and five immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 11 adult and 10 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.155). These effects are relatively evenly split between the breeding and non-breeding periods (Table 5.155).

2145. The annual mortality from displacement as determined using the Developer Approach is predicted to be two adult and two immature birds, equating to 47% and 22% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.155). The breeding season effects represent approximately 40% of the total annual mortality, as determined by the Developer Approach.

Table 5.155: Estimated Potential Annual Mortality of Troup, Pennan and Lion's Head SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	3.3	3.1
	Non-breeding	60%	1%	1.9	1.6
	Annual total	-	-	5.2	4.7
Scoping B	Breeding	60%	5%	5.6	5.2
	Non-breeding	60%	3%	5.5	4.8
	Annual total	-	-	11.1	10.0
Developer	Breeding	50%	1%	0.9	0.9
	Non-breeding	50%	1%	1.5	1.3
	Annual total	-	-	2.4	2.2

2146. The additional annual mortality of adult guillemot from the Troup, Pennan and Lion's Head SPA population predicted due to displacement from the Proposed Development array represents 0.01% of the current adult breeding population at this colony (i.e. 31,893 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and of approximately 0.02 - 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.060 – see Table 2.9 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.1% for the Developer Approach and of 0.3 – 0.6% for the lower and upper estimates from the Scoping Approach.

2147. The potential levels of impact on the Troup, Pennan and Lion's Head SPA guillemot population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

Changes to prey availability

2148. Potential impacts on key prey species for guillemots breeding at the Troup, Pennan and Lion's Head SPA during the operation and maintenance phase have been assessed in the volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased

SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect guillemot survival and productivity in the Troup, Pennan and Lion's Head SPA population.

2149. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Buchan Ness to Collieston Coast SPA guillemot population as to the St Abb's Head to Fast Castle SPA guillemot population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2150. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA guillemot population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population.

Project alone: population-level impacts

2151. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2152. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.155 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.9 of volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2153. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.156: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development Alone.

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	124264 *(81479 – 185271)*	*1.000*	1.000	*50.0*
Scoping A	5.19	4.70	123153 *(80743 – 183625)*	0.991	1.000	48.3
Scoping B	11.10	9.97	121665 *(79757 – 181415)*	0.979	0.999	46.3
Developer	2.47	2.19	123648 *(81071 – 184359)*	0.995	1.000	49.0

2154. The PVA predicted that the Troup, Pennan and Lion's Head SPA guillemot population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be almost four times larger than the current estimate of 31,893 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.156). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted trend does not reflect the decline that has been documented in the size of this SPA population over the past 15 – 20 years (see above).

2155. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.156). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1%, whilst the centile value of 46.3 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.156).

2156. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA guillemot population, the assessment of the Troup, Pennan and Lion's Head SPA guillemot population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by guillemot are equally relevant to the Troup, Pennan and Lion's Head SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by guillemots from the Troup, Pennan and Lion's Head SPA are likely to be low (Cleasby *et al.* 2018).

Project alone: conclusion

2157. It is considered that the predicted levels of impact from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA guillemot population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach). Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2158. As detailed above, any effects from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA guillemot population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2159. Therefore, the potential for effects of the Proposed Development to act on the Troup, Pennan and Lion's Head SPA guillemot population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) pathway during operation and maintenance. The following sections consider these potential effects for (the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

2160. As described in Offshore EIA Report annex A of volume 3, appendix 11.6, estimates of displacement mortality during both the breeding and non-breeding periods which had been attributed to the Troup, Pennan and Lion's Head SPA guillemot population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2161. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farms according to both the Scoping Approach and Developer Approach.

Table 5.157: Estimated Annual Mortality of Troup, Pennan and Lion's Head SPA Guillemots as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period					
		Breeding		Non-Breeding		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	14.5	11.3	7.8	6.2	22.3	17.6
	Scoping B	24.1	18.9	23.4	18.7	47.5	37.6
	Developer	4.0	3.1	6.5	5.2	10.5	8.3

2162. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to a fourfold increase in the predicted displacement mortality compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.155 and 5.157). The effects attributed to the breeding season account for 38 – 65% of the predicted annual mortality for the Proposed Development in-combination with the other UK North Sea wind farms (with this contribution being lowest for the Developer Approach and highest for the upper range of the Scoping Approach – Table 5.157).

2163. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult guillemots from the Troup, Pennan and Lion's Head SPA population predicted due to displacement represents between 0.03% of the current adult breeding population at this colony (i.e. 31,893 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between 0.07 – 0.15% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.060 – see Table 2.9 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 0.6% for the Developer Approach and of 1.2 – 2.5% for the lower and upper estimates from the Scoping Approach.

2164. The potential levels of impact on the Troup, Pennan and Lion's Head SPA guillemot population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

2165. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.157 above).

2166. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.158: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Guillemot Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	124264 (81479 – 185271)	*1.000*	1.000	*50.0*
Scoping A	22.34	17.61	120932 (79274 – 180339)	0.973	0.999	44.9
Scoping B	47.55	37.57	117274 (76851 – 174917)	0.944	0.998	39.5
Developer	10.36	8.33	122695 (80441 – 182950)	0.987	1.000	47.5

2167. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.158 with Table 5.156). However, the predicted levels of impact remain relatively small, irrespective of whether these are determined using the Developer or Scoping Approaches.

2168. The CPS values indicate that the SPA population size would be reduced by approximately 1 - 6% after 35 years relative to that in the absence of any wind farm effects, as determined by the Developer and Scoping Approaches (Table 5.158). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1 – 0.2% for the Scoping Approach and is not detectable for the Developer Approach (at least when the CPGR is expressed to three decimal places). The centile values range from 39.5 – 47.5, indicating a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, at least a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.158).

In-combination: conclusion

2169. On the basis of both the Developer and Scoping Approaches, the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms on the Troup, Pennan and Lion's Head SPA guillemot population are predicted to be relatively small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate at least a reasonably high likelihood of the population being of a similar size to that which would occur in the absence of the wind farm effects after 35 years. These levels of impact are considered within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach).

2170. Given the above, it is concluded that the effects from the Proposed Development in-combination with other plans and projects would not result in an adverse effect on the Troup, Pennan and Lion's Head SPA guillemot population, with this conclusion being irrespective of whether the effects are determined by the Developer or Scoping Approaches.

Assessment for the razorbill population

2171. The Troup, Pennan and Lion's Head SPA razorbill population is currently estimated to number 6,054 individuals, based upon the most recently available count data from 2017 (Offshore EIA Report, volume 3, appendix 11.5). This is higher than the citation level of 4,800 individuals (Table 5.146). Count data for the population are sporadic but indicate that numbers increased markedly between the mid-1980s and early 2000s (with population estimates of 1,647 and 6,644 individuals for 1986 and 2001, respectively) before undergoing a slight decline to the current levels. Despite the fact that numbers are currently above the citation level and that the overall, long-term, trend is increasing, the SPA population is considered to be in 'unfavourable, declining' condition.

The potential for impacts on the razorbill population

2172. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Troup, Pennan and Lion's Head SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective *to maintain, in the long term, the population of the species as a viable component of the site* because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for *the maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

2173. From published information on razorbill foraging ranges generally (Woodward *et al.* 2019) and evidence from tracking data (Wakefield *et al.* 2017), it is possible that during the breeding period razorbills from the Troup, Pennan and Lion's Head SPA occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area. This is supported by the findings of the apportioning exercise, which estimates that approximately 2% of the razorbills occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

2174. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the Troup, Pennan and Lion's Head SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the Troup, Pennan and Lion's Head SPA razorbill population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

2175. Direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2176. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer – Offshore EIA Report, volume 2, chapter 13).

2177. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as ‘3’ on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2178. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to razorbills from the Troup, Pennan and Lion’s Head SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species’ mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 10% of the breeding season foraging area if considering the mean maximum foraging range only. Additionally, modelling of razorbill foraging distributions, as derived from tracking data from the chick-rearing period, indicates that the Proposed Development array area and Proposed Development export cable corridor have minimal, if any, overlap with waters that are predicted to be used by birds from the Troup, Pennan and Lion’s Head SPA and exclude those areas of predicted greatest usage (Cleasby *et al.* 2018).

2179. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

2180. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2181. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2182. Given the moderate sensitivity of razorbill to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated razorbill foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Troup, Pennan and Lion’s Head SPA razorbill population.

Displacement

2183. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Troup, Pennan and Lion’s Head SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2184. Based upon the above, it is considered that there is relatively little potential for the Troup, Pennan and Lion’s Head SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Troup, Pennan and Lion’s Head SPA razorbill population.

Changes to prey availability

2185. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Troup, Pennan and Lion’s Head SPA razorbill population in the short-term.

2186. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb’s Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Troup, Pennan and Lion’s Head SPA razorbill population are as for the St Abb’s Head to Fast Castle SPA razorbill population (and are detailed above in the equivalent section for that SPA population). Additionally, the relatively large distance of the Proposed Development from the Troup, Pennan and Lion’s Head SPA is relevant because it reduces the likelihood that razorbills from this SPA will use the Proposed Development (Offshore EIA Report, volume 3, appendix 11.5).

2187. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA razorbill population.

Project alone: operation and maintenance

Disturbance

2188. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from Troup, Pennan and Lion's Head SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2189. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2190. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2191. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2192. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA razorbill population.

Displacement/barrier effects

2193. As outlined above, displacement effects on the Troup, Pennan and Lion's Head SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2194. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

2195. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2196. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

2197. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Troup, Pennan and Lion's Head SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.159). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Troup, Pennan and Lion's Head SPA razorbill PVAs in this assessment (Offshore EIA Report, volume 3, appendix 11.6). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.159: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Troup, Pennan and Lion's Head SPA Population in each Period. The proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	4,040	0.580	0.021	0.021	0.07
Autumn migration	8,849	N/A	0.006	0.004	N/A
Winter	1,399	N/A	0.005	0.001	N/A
Spring Migration	7,480	N/A	0.006	0.004	N/A

2198. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 1.4 adult and one immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as approximately three adult and two immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.160). These effects are relatively evenly split between the breeding and non-breeding periods (Table 5.160).

2199. The annual mortality from displacement as determined using the Developer Approach is predicted to approximate to a single individual (adults and immatures combined, equating to 50% and 22% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.160). The breeding season effects represent 33% of the total annual mortality, as determined by the Developer Approach.

Table 5.160: Estimated Potential Annual Mortality of Troup, Pennan and Lion's Head SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.8	0.6
	Autumn migration	60%	1%	0.3	0.2
	Winter	60%	1%	0.0	0.0
	Spring migration	60%	1%	0.3	0.2
	Annual total	-	-	1.4	1.0
Scoping B	Breeding	60%	5%	1.4	1.1
	Autumn migration	60%	3%	1.0	0.6
	Winter	60%	3%	0.1	0.0
	Spring migration	60%	3%	0.8	0.5
	Annual total	-	-	3.3	2.2
Developer	Breeding	50%	1%	0.2	0.2
	Autumn migration	50%	1%	0.3	0.2
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	0.2	0.1
	Annual total	-	-	0.7	0.5

2200. The additional annual mortality of adult razorbill from the Troup, Pennan and Lion's Head SPA population predicted due to displacement from the Proposed Development array represents 0.01% of the current adult breeding population at this colony (i.e. 6,054 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.02 – 0.05% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.1% for the Developer Approach and of 0.3 – 0.6% for the lower and upper estimates from the Scoping Approach.

2201. The potential levels of impact on the Troup, Pennan and Lion's Head SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

2202. Potential impacts on key prey species for razorbills breeding at Troup, Pennan and Lion's Head SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the Troup, Pennan and Lion's Head SPA population.

2203. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Troup, Pennan and Lion's Head SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2204. Given this, it is considered that there is relatively little potential for the Troup, Pennan and Lion's Head SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Troup, Pennan and Lion's Head SPA razorbill population.

Project alone: population-level impacts

2205. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Troup, Pennan and Lion's Head SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2206. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.160 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2017 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in Offshore EIA Report, volume 3, appendix 11.6).

2207. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.161: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	adults	immatures				
Baseline	*0*	*0*	10168 *(4258 – 22231)*	*1.000*	1.000	*50.0*
Scoping A	1.46	1.05	10069 *(4217 – 22021)*	0.990	1.000	48.8
Scoping B	3.25	2.29	9951 *(4166 – 21768)*	0.979	0.999	48.1
Developer	0.75	0.52	10118 *(4237 – 22125)*	0.995	1.000	49.4

2208. The PVA predicted that the Troup, Pennan and Lion's Head SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be 64 – 68% larger than the current estimate of 6,054 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.161). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), whilst it is also notable that the predicted increase differs from the documented relative stability (albeit on the basis of sparse data) in the size of this SPA population over the last 15 years or so (see above).

2209. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the higher mortality rates for the Scoping Approach (B), the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 2% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.161). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 48.1 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics as determined from either the lower mortality rates of the Scoping Approach or the Developer Approach suggest even smaller levels of impact (Table 5.161).

2210. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the Troup, Pennan and Lion's Head SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are equally relevant to the Troup, Pennan and Lion's Head SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by razorbills from the Troup, Pennan and Lion's Head SPA are likely to be low (Cleasby *et al.* 2018).

Project alone: conclusion

2211. It is considered that the predicted levels of impact from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA razorbill population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach). Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2212. As detailed above, any effects from the Proposed Development alone on the Troup, Pennan and Lion's Head SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2213. Therefore, the potential for effects of the Proposed Development to act on the Troup, Pennan and Lion's Head SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

2214. As described in Offshore EIA Report annex A of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Troup, Pennan and Lion's Head SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2215. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report, annex E of volume 3, appendix 11.6 for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the Troup, Pennan and Lion's Head SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.160).

Table 5.162: Estimated Annual Mortality of Troup, Pennan and Lion's Head SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period									
		Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	1.8	1.4	1.9	1.3	0.8	0.2	1.5	1.0	6.0	3.9
	Scoping B	3.1	2.4	5.8	3.9	2.4	0.6	4.4	3.0	15.7	9.8
	Developer	0.5	0.4	1.6	1.1	0.6	0.2	1.2	0.8	4.0	2.5

2216. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to a four to fivefold increase in the predicted displacement mortality compared to the Proposed Development alone for each of the Developer and Scoping Approaches (Tables 5.160 and 5.162). The non-breeding periods account for the majority (i.e. approximately 70 – 85%) of the predicted annual mortality for the Proposed Development in-combination with the other UK North Sea wind farms (with this contribution being highest for the Developer Approach and least for the upper range of the Scoping Approach – Table 5.162).

2217. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult razorbills from the Troup, Pennan and Lion's Head SPA population predicted due to displacement represents between 0.07% of the current adult breeding population at this colony (i.e. 6,054 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between 0.09 – 0.26% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.7% for the Developer Approach and of 1.1 – 2.9% for the lower and upper estimates from the Scoping Approach.

2218. The potential levels of impact on the Troup, Pennan and Lion's Head SPA razorbill population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

2219. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.162 above).

2220. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.163: Projected 35 Year Population Sizes and Associated PVA Metrics for the Troup, Pennan and Lion's Head SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	10168 (4258 – 22231)	*1.000*	1.000	*50.0*
Scoping A	6.06	3.95	9777 (4094 – 21395)	0.962	0.999	46.9
Scoping B	15.65	9.79	9201 (3851 – 20160)	0.905	0.997	41.1
Developer	4.05	2.50	9909 (4150 – 21679)	0.975	0.999	47.8

2221. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.163 with Table 5.161). However, overall, the predicted levels of impact remain relatively small.

2222. The CPS value for the Developer Approach indicates that the in-combination displacement effects would result in a reduction of less than 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 4 – 10% after 35 years, relative to that in the absence of any wind farm effects (Table 5.163). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1% for the Developer Approach and 0.1 – 0.3% for the Scoping Approach. The centile values of 41.1 (for the higher mortality rates of the Scoping Approach) to 47.8 (for the Developer Approach) indicate considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, at least a reasonably high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.163).

In-Combination: Conclusion

2223. It is considered that the predicted levels of impact from the Proposed Development in-combination with the other UK North Sea wind farms on the Troup, Pennan and Lion's Head SPA razorbill population are of a relatively small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates at least a reasonably high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. Furthermore, in relation to the Scoping Approach the predicted levels of impact should be considered within the context of the overly precautionary displacement and mortality rates used (volume 3, appendix 11.4, annex G of the Offshore EIA Report).

2224. Given this, it is concluded that the effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on this SPA population. This conclusion applies to both the Scoping and Developer Approaches.

Assessment for the Breeding Seabird Assemblage

2225. The breeding seabird assemblage for the Troup, Pennan and Lion's Head SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA supported approximately 150,000 individual seabirds of nine species in 1995). Razorbill is one of the species identified in the citation as contributing to the Troup, Pennan and Lion's Head SPA breeding seabird assemblage, whilst kittiwake and guillemot are qualifying features in their own right.

2226. Potential impacts of the Proposed Development alone and in-combination with the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Proposed Development alone, no potential for an adverse effect is identified in relation to the SPA populations of kittiwake, guillemot or razorbill, as determined by either the Developer or Scoping Approaches. For the Proposed Development in-combination with the other UK North Sea wind farms this is also the case for guillemot and razorbill. However, for the in-combination scenario the potential for an adverse effect is identified in relation to the SPA kittiwake population, as determined by the Scoping Approach (but not as determined by the Developer Approach).

2227. The Troup, Pennan and Lion's Head SPA is currently two to (almost) two and half times larger than those at the St Abb's Head to Fast Castle SPA and at the Forth Islands SPA. Therefore, despite the documented long-term decline in this population, it is not considered that the effects from the Proposed Development in-combination with the other UK North Sea wind farms (as determined by the Scoping Approach) are likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Troup, Pennan and Lion's Head SPA (in contrast to the conclusions reached for the St Abb's Head to Fast Castle SPA and Forth Islands SPA). Also, given the range of species present within the SPA seabird assemblage and their relative abundances, together with the predicted level of impact on the SPA kittiwake population, it is considered that this potential adverse effect on the SPA kittiwake population would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

2228. Therefore, it is concluded that there is no potential for an adverse effect on the breeding seabird assemblage feature of the Troup, Pennan and Lion's Head SPA either as a result of the effects from the Proposed Development alone or in-combination with other plans and projects. This conclusion is irrespective of whether the effects are determined by the Scoping or Developer Approach.

Site conclusion

Developer approach

2229. It is concluded that there is no potential for an adverse effect on the qualifying features of the Troup, Pennan and Lion's Head SPA or on the named component species of the breeding seabird assemblage qualifying feature due to the effects from the Proposed Development alone or in-combination with other plans and projects. Consequently, it is concluded that there is no potential for an Adverse Effects on Integrity of the Troup, Pennan and Lion's Head SPA.

Scoping approach

2230. It is concluded that the possibility of an adverse effect cannot be excluded for the Troup, Pennan and Lion's Head SPA breeding kittiwake population. For the kittiwake population, the potential for an adverse effect arises from the Proposed Development in-combination with the other UK North Sea wind farms but not from the Proposed Development alone. The predicted impacts on the SPA kittiwake qualifying feature are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature.

2231. Consequently, it is concluded that an Adverse Effects on Integrity of the Troup, Pennan and Lion's Head SPA cannot be excluded due to effects of the Proposed Development in-combination with the other UK North Sea wind farms.

5.7.7. EAST CAITHNESS CLIFFS SPA

European Site Information and Conservation Objectives

2232. East Caithness Cliffs SPA includes most of the sea-cliff areas between Wick and Helmsdale on the north-east coast of the Scottish mainland. The SPA is located approximately 274 km from the Proposed Development. The boundary of the SPA overlaps either partly or wholly with Castle of Old Wick to Craig Hammel SSSI, Craig Hammel to Sgaps Geo SSSI, Dunbeath to Sgaps Geo SSSI, Berriedale Cliffs SSSI, Ousdale Burn SSSI and Helmsdale Coast SSSI. The SPA was classified in 1996, with a marine extension classified in 2009. The seaward extension extends approximately 2 km into the marine environment.

2233. The site qualifies under Article 4.2 by regularly supporting five migratory seabird species and in excess of 20,000 breeding seabirds, including eight named component species (Table 5.164). The potential for LSE has been identified in relation to three of the nine qualifying features (Table 5.164), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

2234. The Conservation Objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

2235. Further information on this European site is presented in Appendix A.

Table 5.164: Details on the qualifying features of the East Caithness Cliffs SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential LSE
Seabird assemblage	Breeding	Favourable maintained	300,000 individuals	Yes
Kittiwake	Breeding	Favourable maintained	32,500 pairs	Yes
Great black-backed gull*	Breeding	Unfavourable no change	800 pairs	No
Herring gull	Breeding	Unfavourable no change	9,400 pairs	No
Guillemot	Breeding	Favourable maintained	106,700 individuals	No
Razorbill	Breeding	Favourable maintained	15,800 individuals	Yes
Fulmar*	Breeding	Favourable maintained	15,000 pairs	No
Cormorant*	Breeding	Unfavourable declining	230 pairs	No
Shag	Breeding	Unfavourable no change	2,300 pairs	No

*Named components of the assemblage only.

Assessment for the Kittiwake Population

2236. The East Caithness Cliffs SPA kittiwake population is currently estimated to number 24,460 breeding pairs based upon the most recently available count data from 2015 (Offshore EIA Report, volume 3, appendix 11.5; Swann 2016), representing a 39.5% decline since it was last counted in 1999 (when the population was estimated to be 40,450 breeding pairs; Swann 2016).

The Potential for Impacts on the Kittiwake Population

2237. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the East Caithness Cliffs SPA, so that potential impacts on its kittiwake population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective to *maintain, in the long term, the population of the species as a viable component of the site*, because the other Conservation Objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for the *maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

2238. From published information on kittiwake foraging ranges generally (Woodward *et al.,* 2019) and inference from tracking data (Wakefield *et al.*, 2017), it is apparent that during the breeding period, a relatively small proportion of kittiwakes from the East Caithness Cliffs SPA may occur within the area of the Proposed Development and two kilometre buffer. This is reflected in the findings of the apportioning exercise, which estimates that approximately 0.1% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

2239. During the non-breeding season there is likely to be the potential for kittiwake from the East Caithness Cliffs SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot; Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the East Caithness Cliffs SPA kittiwake population during breeding and non-breeding periods.

Project Alone: Construction and Decommissioning

Disturbance

2240. Direct disturbance to kittiwakes during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities directly associated with the installation of the turbine foundations and other infrastructure (see Table 4.1).

2241. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2242. The total area to be affected by such disturbance over the assumed eight years of the construction phase represents a small proportion of the total area of marine habitat available to kittiwakes from the East Caithness Cliffs SPA. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development offshore export cable encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al*., 2019), and assuming that this range is represented by a semicircle to the (main) seaward side of the colony. The Proposed Development is beyond the breeding season foraging area of kittiwakes from the East Caithness Cliffs SPA if considering the mean maximum foraging range only.

2243. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015) and the potential for effects of construction-related disturbance is lower than during the breeding season.

2244. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects.

2245. Given the low sensitivity of kittiwake to disturbance effects at sea (Garthe and Hüppop 2004, Furness *et al*., 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Offshore EIA Report, volume 2, chapter 11).

Displacement

2246. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the East Caithness Cliffs SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2247. Therefore, based upon the above, it is considered that there is relatively little potential for the East Caithness Cliffs SPA kittiwake population to be affected by displacement during the construction or decommissioning phases. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (Offshore EIA Report, volume 2, chapter 11).

Changes to Prey Availability

2248. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the East Caithness Cliffs SPA kittiwake population in the short-term.

2249. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the East Caithness Cliffs SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2250. Given this, it is considered that there is relatively little potential for the East Caithness Cliffs SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population.

Project Alone: Operation and Maintenance

Disturbance

2251. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from East Caithness Cliffs SPA for the reasons given in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population.

2252. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2253. Based on information presented in the *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual turbines over a period of days to weeks.

2254. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operational and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2255. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population.

Displacement/Barrier Effects

2256. For the reasons given in Table 2.1 and Section 5.4, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the Offshore EIA Report, volume 3, appendix 11.4 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population.

2257. On the basis of the advice provided in the Scoping Opinion (Table 2.1), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

2258. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in the Offshore EIA Report, volume 3, appendix 11.4, annex G. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2259. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (Offshore EIA Report, volume 3, appendix 11.4, annex G). The rates adopted for kittiwake by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: no measurable effects of displacement on mortality.

2260. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the East Caithness Cliffs SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.,* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.165: The mean peak abundance estimates of kittiwake in the Proposed Development array area and 2 km buffer for each seasonal period, together with the proportion of birds estimated to belong to the breeding adult age class and to be from the East Caithness Cliffs SPA population in each period. The proportion of adults assumed to be sabbaticals during the breeding season is also presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.001	0.001	0.10
Autumn migration	11,190	N/A	0.058	0.034	N/A
Spring migration	13,766	N/A	0.077	0.034	N/A

Table 5.166: Estimated potential annual mortality of East Caithness Cliffs SPA kittiwakes as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	*Breeding*	30%	1%	0.0	0.0
	Autumn migration	30%	1%	2.0	1.2
	Spring migration	30%	1%	3.2	1.4
	Annual total	-	-	5.2	2.6
Scoping B	*Breeding*	30%	3%	0.1	0.0
	Autumn migration	30%	3%	5.9	3.4
	Spring migration	30%	3%	9.5	4.2
	Annual total	-	-	15.6	7.7
Developer	*Breeding*	30%	2%	0.1	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.1	0.0

2261. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as 5.2 adult and 2.6 immature birds based on the lower mortality rates of Scoping Approach A, and 15.6 adult and 7.7 immature birds based upon the higher mortality rates of Scoping Approach B (Table 5.166). The displacement effects predicted by the Scoping Approach are largely attributable to the non-breeding season (with the potential non-breeding season mortality accounting for >99% of the overall annual mortality – Table 5.166).

2262. The annual mortality from displacement as determined using the Developer Approach is predicted to be 0.1 adult bird which is attributable to the breeding season, on the basis that displacement effects on kittiwake during the non-breeding periods are considered unlikely to result in detectable impacts on the population (Offshore EIA, volume 3, appendix 11.4, annex G).

2263. The additional annual mortality of adult kittiwakes from the East Caithness Cliffs SPA population predicted due to displacement from the Proposed Development represents 0.0002% of the current adult breeding population at this colony (i.e. 48,920 individuals – Table 3.3 of the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.01 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.001% for the Developer Approach and of 0.07 – 0.22% for the lower and upper estimates from the Scoping Approach.

2264. The potential levels of impact on the East Caithness Cliffs SPA kittiwake population resulting from the mortality predicted from displacement/barrier effects associated with the Proposed Development array area during the operation and maintenance phase are considered in further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>*Collision Risk*</u>

2265. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (Table 2.1), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.,* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution; Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

2266. Guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012) and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the Proposed Development array area. Further details on these approaches are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes and in the Offshore EIA Report, volume 3, appendix 11.3. The CRMs for East Caithness Cliffs SPA kittiwakes were therefore undertaken following:

- The Scoping Approach of using the maximum monthly densities; and
- The Developer Approach of using the mean monthly densities.

2267. Collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area (as opposed to the generic flight height data of Johnston *et al.* 2014a,b; Offshore EIA Report, volume 3, appendix 11.3. annex B); and
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.,* 2018; volume 3, Offshore EIA Report, appendix 11.3. annex C) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

2268. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in the Offshore EIA Report, volume 3, appendix 11.3. annexes B and C.

2269. As for predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the East Caithness Cliffs SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.165).

Table 5.167: Predicted collision effects from the Proposed Development on the East Caithness Cliffs SPA kittiwake population, as determined by the Scoping Approach and Developer Approach. Estimates are for the worst-case design and are based on option 2 of the deterministic CRM using a 98.9% avoidance rate (see text).

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.5	0.0
	Autumn migration	10.4	6.1
	Spring migration	14.6	6.5
	Annual total	25.5	12.6
Developer	Breeding	0.4	0.0
	Autumn migration	6.1	3.6
	Spring migration	11.9	5.3
	Annual total	18.4	8.9

2270. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the East Caithness Cliffs SPA is predicted to be approximately 25.5 adults and 12.6 immatures as determined by the Scoping Approach, and approximately 18.4 adults and 8.9 immatures as determined by the Developer Approach (Table 5.167). As for displacement, the vast majority of this mortality (i.e. >98%) is predicted to occur during the non-breeding season.

2271. The additional annual mortality of adult kittiwakes from the East Caithness Cliffs SPA population predicted due to collisions with turbines in the Proposed Development array area represents approximately 0.04% of the number of adults currently estimated to breed at this colony (i.e. 48,920 individuals – Table 3.3 of the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 0.05% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 0.26% and 0.36% for the Developer and Scoping Approaches, respectively.

2272. Using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the East Caithness Cliffs SPA kittiwake population that are at least 50% lower than those presented in Table 5.167above (upon which the assessment is based).

2273. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in As for predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the East Caithness Cliffs SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.165).

2274. Table 5.167is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>*Changes to Prey Availability*</u>

2275. Potential impacts on key prey species for kittiwakes breeding at the East Caithness Cliffs SPA during the operational and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the East Caithness Cliffs SPA kittiwake population.

2276. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the East Caithness Cliffs SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2277. Given this, it is considered that there is relatively little potential for the East Caithness Cliffs SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population.

<u>Project Alone: Population-Level Impacts</u>

2278. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the East Caithness Cliffs SPA kittiwake population are displacement/barrier effects and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2279. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.166 and Table 5.167 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2015 count for the SPA, with the projected population trends considered over a 35-year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above, with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2280. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.168: Projected 35-year population sizes and associated PVA metrics for the East Caithness Cliffs SPA kittiwake population under different impact scenarios for the Proposed Development alone.

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	73,730 *(26,112 – 193,756)*	*1.000*	1.000	*50.0*
	Scoping A	*30.71*	*15.17*	*72,214 (25,567 – 189,858)*	*0.980*	*0.999*	*48.5*
	Scoping B	*41.12*	*20.30*	*71,707 (25,386 – 188,554)*	*0.973*	*0.999*	*47.8*
	Developer	*18.39*	*8.85*	72,825 *(25,786 – 191,428)*	*0.988*	*1.000*	*49.1*

2281. The PVA predicted a population increase for the East Caithness Cliffs SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, the population is predicted to be 1.5 times larger than the current estimate of 48,920 breeding adults under all scenarios, including baseline which assumes no wind farm effects (Table 5.168). Although the predicted increases are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small.

2282. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 2.7% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.168). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.1%, whilst the centile value of 47.8 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest even smaller levels of impact (Table 5.168).

<u>Project Alone: Conclusion</u>

2283. Overall, it is considered that the predicted levels of impact from the Proposed Development alone on the East Caithness Cliffs SPA kittiwake population are of a relatively small scale. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the unimpacted population after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

<u>Effects In-Combination</u>

<u>*Effects of relevance to the in-combination assessment*</u>

2284. For the same reasons as described in *Effects In-Combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, any effects from the Proposed Development alone on the East Caithness Cliffs SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2285. Therefore, the potential for effects of the Proposed Development to act on the East Caithness Cliffs SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the offshore wind farms in the UK North Sea.

<u>*Displacement/Barrier Effects – Operation and Maintenance*</u>

2286. As described in Offshore EIA report, volume 3, appendix 11.6, annex E, estimates of breeding season displacement mortality which had been attributed to the East Caithness Cliffs SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development Table 5.166), the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2287. No displacement mortality estimates from other projects were available for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (Offshore EIA Report, volume 3, appendix 11.6, annex E), with the in-combination estimates derived according to the Scoping and Developer Approaches as described in the section on the *In-Combination Displacement / Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

2288. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates according to both the Scoping Approach and Developer Approach (Table 5.169).

Table 5.169: Estimated annual mortality of East Caithness Cliffs SPA kittiwakes as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach, in-combination with other UK North Sea wind farms.

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	32.6	3.0	10.5	6.1	16.0	7.0	59.0	16.2
	Scoping B	97.7	9.1	31.4	18.4	48.0	21.1	177.0	48.6
	Developer	65.1	6.0	N/A	N/A	N/A	N/A	65.1	6.0

2289. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the East Caithness Cliffs SPA population predicted due to displacement represents 0.12 – 0.36% of the current adult breeding population at this colony (i.e. 48,920 individuals – Table 3.3 of volume 3, appendix 11.5) as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 0.8 – 2.5% for the lower and upper estimates from the Scoping Approach. For the Developer Approach, the additional annual mortality represents 0.13% of the current adult breeding population at East Caithness Cliffs SPA, representing a 0.9% increase in baseline annual mortality.

2290. The potential levels of impact on the East Caithness Cliffs SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision Risk - Operation and Maintenance

2291. As for displacement, breeding season collision estimates attributed to the East Caithness Cliffs SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation (Offshore EIA Report, volume 3, appendix 11.6, annex E). Kittiwake collision estimates for the non-breeding periods were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (Offshore EIA Report, volume 3, appendix 11.6, annex E). Options based on consented and 'as-built' designs were also considered but for the current SPA population this had minimal effects, with the respective totals differing by approximately one adult bird. Therefore, only the estimates for the consented designs are considered in this case. The non-breeding season collision estimates were apportioned to the East Caithness Cliffs SPA population according to the BDMPS approach (Furness 2015).

2292. In contrast to the displacement estimates derived for the other projects, existing collision estimates for these projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

2293. As for displacement, the potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give estimates the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (Table 5.170).

Table 5.170: Predicted collision effects on the East Caithness Cliffs SPA kittiwake population due to the Proposed Development in-combination with other projects in the UK North Sea waters. Estimates are presented for both the Scoping Approach and Developer Approach.

In-combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	91.5	8.5
		Autumn migration	61.4	36.0
		Spring migration	81.2	35.8
		Annual total	234.1	80.3
	Developer	Breeding	91.3	8.5
		Autumn migration	57.1	33.5
		Spring migration	78.5	34.6
		Annual total	226.9	76.6

2294. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the East Caithness Cliffs SPA population predicted due to collisions represents 0.46% of the current adult breeding population at this colony (i.e. 48,920 individuals – Table 3.3 of the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.48% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 3.18% for the Developer Approach and of 3.28% for the Scoping Approach.

2295. The potential levels of impact on the East Caithness Cliffs SPA kittiwake population resulting from the mortality predicted from collisions associated with the Proposed Development in-combination with other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-Combination: Population-Level Impacts

2296. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.169 and Table 5.170 above).

2297. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.171: **Projected 35-year population sizes and associated PVA metrics for the East Caithness Cliffs SPA kittiwake population under different impact scenarios for the Proposed Development in-combination with the other UK North Sea wind farms.**

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
	adults	immatures				
Baseline	*0*	*0*	*73,730 (26,112 – 193,756)*	*1.000*	1.000	*50.0*
Scoping A	*293.11*	*96.47*	*61,467 (21,745 – 162,305)*	*0.834*	*0.995*	*36.0*
Scoping B	*411.12*	*128.90*	*57,257 (20,269 – 151,428)*	*0.777*	*0.993*	*31.6*
Developer	*291.92*	*82.55*	*61,805 (21,869 – 163,209)*	*0.838*	*0.995*	*36.4*

2298. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.163 with Table 5.171). The CPS value for the Developer Approach indicates that the SPA population size would be reduced by 16.2% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 16.6 – 22.3% (Table 5.171). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.5% for the Developer Approach and 0.5 – 0.7% for the Scoping Approach. The values for the centile metric are estimated as 36.4 after 35 years for the Developer Approach and as 31.6 – 36.0 for the Scoping Approach, suggesting moderate levels of overlap in the distribution of the predicted impacted and unimpacted population sizes and, hence, a reasonable likelihood of the impacted population being smaller than the unimpacted population after 35 years.

2299. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

In-Combination: Conclusion

2300. For both the Scoping and Developer Approaches, the predicted levels of impact associated with the in-combination scenario represent a marked increase compared to those associated with the Proposed Development alone. These levels of impact suggest the potential for the in-combination effects to lead to a marked reduction in the size of the East Caithness Cliffs SPA population after 35 years relative to that which would occur in the absence of these effects. The predicted levels of impact are such that for the Developer Approach (which predicts lower levels of impact than the Scoping Approach), this potential reduction in population size is c.16% for the Proposed Development in-combination with the other UK North Sea wind farms.

2301. The centile values indicate a moderate likelihood of the impacted population being similar in size to the un-impacted population after 35 years whilst the context that has been outlined for both St. Abb's Head to Fast Castle SPA and Forth Islands SPA in relation to (i) the high levels of precaution incorporated in the assessment and (ii) the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population, remains highly relevant. However, despite this, it is considered that the scale of the potential reduction in the size of the SPA population associated with the in-combination effects means that the possibility of adverse effects on the SPA population cannot be excluded.

2302. Consequently, it is concluded that there is the potential for an adverse effect on the East Caithness Cliffs SPA kittiwake population as a result of the predicted effects from the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the Razorbill Population

2303. The East Caithness Cliffs SPA razorbill population is currently estimated to number 40,117 individuals based upon the most recently available count data from 2015 (Offshore EIA Report, volume 3, appendix 11.5), which represents a 69.5% increase since the last count in 1999 (when the population was estimated at 17,727 individuals).

The Potential for Impacts on the Razorbill Population

2304. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the East Caithness Cliffs SPA, so that potential impacts on its razorbill population will only arise as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective to *maintain, in the long term, the population of the species as a viable component of the site*, because the other Conservation Objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this first Conservation Objective (as for the *maintain in the long term no significant disturbance of the species*, because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features).

2305. From published information on razorbill foraging ranges generally (Woodward *et al.,* 2019) and inference from tracking data (Wakefield *et al.,* 2017), it is apparent that during the breeding period, a relatively small proportion of razorbills from the East Caithness Cliffs SPA may occur within the area of the Proposed Development and two kilometre buffer. This is reflected in the findings of the apportioning exercise, which estimates that approximately 2.3% of the razorbills occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for razorbill is defined as April to mid-August, following the NatureScot (2020) guidance.

2306. Based on NatureScot advice received following Roadmap Meeting 6 (K. Taylor, email 20/05/2022), which draws upon the findings from Buckingham *et al.*, (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the East Caithness Cliffs SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the East Caithness Cliffs SPA razorbill population during breeding and non-breeding periods.

Project Alone: Construction and Decommissioning

Disturbance

2307. Direct disturbance to razorbills during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities directly associated with the installation of the turbine foundations and other infrastructure (see Table 4.1).

2308. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2309. Tracking data (and associated modelling of foraging distributions) for razorbill suggest that the Proposed Development array area and offshore export cable corridor are beyond waters that are heavily used by birds from the East Caithness Cliffs SPA during the breeding season (Wakefield *et al.,* 2017).

2310. Indeed, the Proposed Development is situated at the very edge of the breeding season foraging area of razorbills from the East Caithness Cliffs SPA (i.e. 88.7±75.9 km - Woodward *et al.,* 2019). For those razorbills foraging beyond their core range during the breeding period, the total area to be affected by such disturbance over the assumed eight years of the construction phase represents a small proportion of the total area of marine habitat available to razorbills from the East Caithness Cliffs SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development offshore export cable encompasses 168 km^2. Together these areas represent approximately 3% of the total breeding season foraging area that is potentially available to the SPA razorbill population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 88.7±75.9 km - Woodward *et al.,* 2019) and assuming that this range is represented by a semicircle to the main seaward side of the colony.

2311. During the non-breeding periods, razorbill distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large parts of the North Sea (Furness 2015, Buckingham *et al.,* 2022) so that the potential for effects of construction-related disturbance is lower than during the breeding season.

2312. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects.

2313. Given the moderate sensitivity of razorbill to disturbance effects at sea (Garthe and Hüppop 2004, Furness *et al*., 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (relative to the foraging range of razorbills breeding at East Caithness Cliffs SPA), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the East Caithness Cliffs SPA razorbill population.

Displacement

2314. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the East Caithness Cliffs SPA razorbill population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2315. Therefore, based upon the above, it is considered that there is relatively little potential for the East Caithness Cliffs SPA razorbill population to be affected by displacement during the construction or decommissioning phases. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the East Caithness Cliffs SPA razorbill population.

Changes to Prey Availability

2316. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the East Caithness Cliffs SPA razorbill population in the short-term.

2317. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA razorbill population. The evidence base and context for assessing the potential for such effects to have impacts on the East Caithness Cliffs SPA razorbill population is as for the St Abb's Head to Fast Castle SPA razorbill population (which is detailed above in the equivalent section for this SPA population).

2318. Given this, it is considered that there is relatively little potential for the East Caithness Cliffs SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the East Caithness Cliffs SPA razorbill population.

Project Alone: Operation and Maintenance

Disturbance

2319. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from East Caithness Cliffs SPA for the reasons given in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population.

2320. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2321. Based on information presented in the *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA razorbill population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual turbines over a period of days to weeks.

2322. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operational and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2323. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the East Caithness Cliffs SPA razorbill population.

Displacement / Barrier Effects

2324. For the reasons given in Table 2.1 and section 5.4, displacement effects on the East Caithness Cliffs SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the Offshore EIA Report, volume 3, appendix 11.4 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA razorbill population.

2325. On the basis of the advice provided in the Scoping Opinion (Table 2.1), displacement effects on razorbill are estimated for the breeding and non-breeding periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding period: 60% displacement with lower and upper mortality rates of 1% and 3%.

2326. However, the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, as detailed in the Offshore EIA Report, volume 3, appendix 11.4, annex G. In particular, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2327. Thus, based on a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (Offshore EIA Report, volume 3, appendix 11.4, annex G). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

2328. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the East Caithness Cliffs SPA razorbill population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.,* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5). The resulting mortality estimates for the breeding and non-breeding periods were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the East Caithness Cliffs SPA razorbill PVAs in this assessment (as presented in the Offshore EIA Report, volume 3, appendix 11.6, annex F). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.172: The mean peak abundance estimates of razorbill in the Proposed Development array area and 2 km buffer for each seasonal period, together with the proportion of birds estimated to belong to the breeding adult age class and to be from the East Caithness Cliffs SPA population in each period. The proportion of adults assumed to be sabbaticals during the breeding season is also presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,040	0.580	0.023	0.023	0.07
Autumn migration	8,849	N/A	0.042	0.029	N/A
Winter	1,399	N/A	0.034	0.009	N/A
Spring Migration	7,480	N/A	0.042	0.029	N/A

Table 5.173: Estimated potential annual mortality of East Caithness Cliffs SPA razorbills as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.9	0.7
	Autumn migration	60%	1%	2.2	1.5
	Winter	60%	1%	0.3	0.1
	Spring migration	60%	1%	1.9	1.3
	Annual total	-	-	5.3	3.6
Scoping B	Breeding	60%	5%	1.5	1.2
	Autumn migration	60%	3%	6.7	4.6
	Winter	60%	3%	0.9	0.2
	Spring migration	60%	3%	5.7	3.9
	Annual total	-	-	14.8	9.9
Developer	Breeding	50%	1%	0.3	0.2
	Autumn migration	50%	1%	1.8	1.3
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	1.6	1.1
	Annual total	-	-	3.7	2.6

2329. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 5.3 adult and 3.6 immature birds based on the lower mortality rates of Scoping Approach A, and 14.8 adult and 9.9 immature birds based upon the higher mortality rates of Scoping Approach B (Table 5.173). The displacement effects predicted by the Scoping Approach are largely attributable to the passage periods (with the potential passage period mortality accounting for approximately 85% of the overall annual mortality – Table 5.173).

2330. The annual mortality from displacement as determined using the Developer Approach is predicted to be 3.7 adult and 2.6 immature birds, again largely attributable to the passage periods (Offshore EIA Report, volume 3, appendix 11.4, annex G).

2331. The additional annual mortality of adult razorbill from the East Caithness Cliffs SPA population predicted due to displacement from the Proposed Development array represents 0.01% of the current adult breeding population at this colony (i.e. 40,117 individuals – Table 3.3 of the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.01 – 0.04% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.09 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.10% for the Developer Approach and of 0.15 – 0.41% for the lower and upper estimates from the Scoping Approach.

2332. The potential levels of impact on the East Caithness SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>*Changes to Prey Availability*</u>

2333. Potential impacts on key prey species for razorbills breeding at East Caithness Cliffs SPA during the operational and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the East Caithness Cliffs SPA population.

2334. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the East Caithness Cliffs SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2335. Given this, it is considered that there is relatively little potential for the East Caithness Cliffs SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the East Caithness Cliffs SPA razorbill population.

<u>Project Alone: Population-level Impacts</u>

2336. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the East Caithness Cliffs SPA razorbill population are limited to displacement/barrier effects during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2337. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.173 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2015 count for the SPA, with the projected population trends considered over a 35-year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA razorbill population above, with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2338. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (Offshore EIA Report, volume 3, appendix 6.2) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and

- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.174: Projected 35-year population sizes and associated PVA metrics for the East Caithness Cliffs SPA razorbill population under different impact scenarios for the Proposed Development alone.

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
	adults	immatures				
Baseline	*0*	*0*	65,650 (29,085 – 143,345)	*1.000*	1.000	*50.0*
Scoping A	*5.30*	*3.51*	65,311 (28,932 – 142,614)	*0.995*	1.000	*49.4*
Scoping B	*14.78*	*9.77*	64,709 (28,661 – 141,317)	*0.986*	1.000	*48.7*
Developer	*3.92*	*2.57*	65,400 (28,972 – 142,807)	*0.996*	1.000	*49.6*

2339. The PVA predicted that the East Caithness Cliffs SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be nearly twice as large than the current estimate of 40,117 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.174). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. The predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – see the explanatory text under *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population).

2340. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the higher mortality rates for Scoping Approach B, the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 1.4% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.174). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be zero, whilst the centile value of 48.7 indicates a high degree of overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics as determined from either the lower mortality rates of the Scoping Approach or the Developer Approach suggest even smaller levels of impact (Table 5.174).

2341. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the East Caithness Cliffs SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are equally relevant to the East Caithness Cliffs SPA population as to the St Abb's Head to Fast Castle SPA population. The evidence available from tracking data suggests that levels of usage of the Proposed Development array area and two kilometre buffer during the breeding season by razorbills from the East Caithness Cliffs SPA are likely to be very low (Wakefield *et al.* 2017).

Project Alone: Conclusion

2342. It is considered that the predicted levels of impact from the Proposed Development alone on the East Caithness Cliffs SPA razorbill population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach). Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects In-Combination

Effects of relevance to the in-combination assessment

2343. As detailed above, any effects from the Proposed Development alone on the East Caithness Cliffs SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2344. Therefore, the potential for effects of the Proposed Development to act on the East Caithness Cliffs SPA razorbill population in-combination with other plans and projects is limited to the displacement/barrier effect pathway during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/Barrier Effects – Operation and Maintenance

2345. As described in the Offshore EIA Report, volume 3, appendix 11.6, annex E, estimates of breeding season displacement mortality which had been attributed to the East Caithness Cliffs SPA razorbill population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development (Table 5.173), the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2346. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report, volume 3, appendix 11.6, annex E for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the East Caithness Cliffs SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.175).

Table 5.175: Estimated annual mortality of East Caithness Cliffs SPA razorbills as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach, in-combination with the other UK North Sea wind farms.

In-combination Region	Approach	Seasonal Period									
		Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	83.1	62.4	13.7	9.3	5.6	1.4	10.6	7.2	113.0	80.3
	Scoping B	138.5	104.1	41.2	27.9	17.0	4.3	31.8	21.5	228.4	157.7
	Developer	23.1	17.4	11.4	7.7	4.5	1.1	8.8	6.0	47.8	32.2

2347. The additional annual mortality of adult razorbills from the East Caithness Cliffs SPA population predicted due to displacement from the Proposed Development in-combination with the other UK North Sea wind farms represents 0.12% of the current adult breeding population at this colony (i.e. 40,117 individuals – Table 3.3 of the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.28 – 0.57% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.09 – see Table 2.19 in he Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 1.3% for the Developer Approach and of 3.1 – 6.3% for the lower and upper estimates from the Scoping Approach.

2348. The potential levels of impact on the East Caithness SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-Combination: Population-Level Impacts

2349. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.175 above).

2350. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.176: Projected 35-year population sizes and associated PVA metrics for the East Caithness Cliffs SPA razorbill population under different impact scenarios for the Proposed Development in-combination with the other UK North Sea wind farms.

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of impacted Population
	adults	immatures				
Baseline	*0*	*0*	65,650 (29,085 – 143,345)	*1.000*	1.000	*50.0*
Scoping A	*113.0*	*80.21*	58,617 (25,920 – 128,166)	0.893	0.997	39.2
Scoping B	*228.38*	*157.57*	52,316 (23,087 – 114,547)	0.797	0.994	29.4
Developer	*48.02*	*31.17*	*62,627 (27,723 – 136,825)*	0.954	0.999	45.6

2351. For the Proposed Development in-combination with the other UK North Sea wind farms, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by approximately 4.6% relative to that in the absence of any wind farm effects (Table 5.176). The reduction in annual population growth rate (relative to that predicted under baseline conditions) remains small, whilst the centile value continues to indicate a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years.

2352. The metrics associated with the Scoping Approach for the Proposed Development in-combination with the other UK North Sea wind farms inevitably suggest greater levels of effect. However, at the lower range of effects (i.e. Scoping Approach A) they continue to indicate a relatively small effect and a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. At the upper range of effects (i.e. Scoping Approach B), the CPS value indicates that the SPA population size would be reduced by approximately 20% relative to that in the absence of any wind farm effects (Table 5.176), whilst the reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated as 0.6%. The centile value of 29.4 suggests a reasonably high likelihood of the impacted population being smaller than the un-impacted population after 35 years.

In-Combination: Conclusion

2353. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms would not result in an adverse effect on the East Caithness Cliffs SPA razorbill population. The population-level impacts predicted to arise from these in-combination effects represent a small increase to those predicted due to the Proposed Development alone. As such, it is considered that the conclusions reached in relation to the Proposed Development alone are also valid for the in-combination scenarios.

2354. In terms of the Scoping Approach, it is considered that the lower range of the predicted impacts (i.e. Scoping Approach A) would not represent an adverse effect on the SPA population but that it is possible the upper range would (i.e. Scoping Approach B). Consequently, it is concluded that the effects of the Proposed Development in-combination with the other UK North Sea wind farms could result in an adverse effect on the East Caithness Cliffs SPA razorbill population.

Assessment for the Breeding Seabird Assemblage

2355. The breeding seabird assemblage for the East Caithness Cliffs SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supports 300,000 seabirds). Kittiwake and razorbill comprise two of the eight species identified in the citation as having populations which are considered to be of European or national importance and which contribute to the East Caithness Cliffs SPA breeding seabird assemblage (no LSE was determined for the other six species in relation to the Proposed Development (HRA Stage One Screening Report; SSE Renewables, 2021b).

2356. Potential impacts of the Proposed Development in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach, the assessments undertaken above identify the potential for adverse effects only on the SPA kittiwake population in relation to the in-combination scenario. For the Scoping Approach, the assessments undertaken above identify the potential for adverse effects on the SPA kittiwake and razorbill populations in relation the in-combination scenario.

2357. For the in-combination scenario as determined by the Developer Approach, the potential for adverse effects is identified only in relation to the SPA kittiwake population., Given the range of species present within the SPA seabird assemblage and their relative abundances, it is considered that the potential adverse effect on the SPA kittiwake population would not be sufficient to result in a subsequent adverse effect on the seabird assemblage.

2358. For the in-combination scenario as determined by Scoping Approach, it is also the case that the predicted impacts on the SPA kittiwake are not considered likely to lead to a risk of this population being lost from the breeding seabird assemblage at the East Caithness Cliffs SPA. However, it is considered conceivable that the combined predicted in-combination impacts on the SPA kittiwake and razorbill populations are such as to represent a risk of reducing the total number of individual seabirds present in the assemblage to a level that could represent an adverse effect on this qualifying feature. This conclusion should be considered within the context of the high levels of precaution incorporated within the assessment for Scoping Approach (volume 3, appendix 11.3 and volume 3, appendix, 11.4, annex G of the Offshore EIA Report).

2359. Given the above, it is concluded that there is the potential for an adverse effect on the East Caithness Cliffs SPA breeding seabird assemblage in relation to the Proposed Development in-combination with other UK North Sea wind farms, as determined by Scoping Approach. No potential for adverse effects on the SPA breeding seabird assemblage is identified in relation to the Proposed Development alone (irrespective of whether determined by the Developer or Scoping Approaches) or in relation to the Proposed Development in-combination with other UK North Sea wind farms, as determined by the Developer Approach.

Site Conclusion

<u>Developer Approach</u>

2360. It is concluded that the possibility of adverse effects cannot be discounted for the East Caithness Cliffs SPA population of breeding kittiwake. The potential for adverse effects arises from the Proposed Development in-combination with the other UK North Sea wind farms. The predicted impacts on the SPA kittiwake population are not considered to be sufficient to lead to a potential adverse effect on the breeding seabird assemblage feature.

2361. Consequently, it is concluded that an AEoI in respect of the kittiwake feature of the East Caithness Cliffs SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects. However, the effects from the Proposed Development would not result in an adverse effect on the razorbill population.

<u>Scoping Approach</u>

2362. It is concluded that the possibility of adverse effects cannot be discounted for the East Caithness Cliffs SPA populations of breeding kittiwake and razorbill, as well as the breeding seabird assemblage qualifying feature (due to the impacts on kittiwake and razorbill components only). For the kittiwake and razorbill populations, and the breeding seabird assemblage feature, the potential for adverse effects is in relation to the effects of the Proposed Development in-combination with other UK North Sea wind farms.

2363. Consequently, it is concluded that an AEoI in respect of the East Caithness Cliffs SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects.

5.7.8. FLAMBOROUGH AND FILEY COAST SPA

European site information and conservation objectives

2364. The coastal section of the Flamborough and Filey Coast SPA covers a slender strip of cliffs and hinterland along the coastline of the counties of North Yorkshire and the East Riding of Yorkshire, located approximately 215 km from the Proposed Development. The SPA is in two sections: the southern section extends north from South Landing around Flamborough Head to Speeton; the northern section covers the peninsula of Filey Brigg before extending northwest to Cunstone Nab. The seaward boundary extends 2 km into the marine environment throughout the two sections of the site. Flamborough Head and Bempton Cliffs was classified as an SPA in 1993, with the site extended and renamed as the Flamborough and Filey Coast SPA in 2018.

2365. The site qualifies under Article 4.2 by regularly supporting four migratory seabird species and in excess of 20,000 breeding seabirds, including five named component species (Table 5.177). The potential for LSE has been identified in relation to four of these nine species (Table 5.177), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

2366. The conservation objectives of this SPA (as determined through Natural England Access to Evidence) are to:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

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

2367. Further information on this European site, including the SACOs, is presented in appendix 3A.

Table 5.177: Details of the Qualifying Features of the Flamborough and Filey Coast SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential Lse
Seabird assemblage	Breeding	Not available	216,730 individuals	Yes
Kittiwake	Breeding	Not available	89,040 individuals	Yes
Herring gull*	Breeding	Not available	Not available	No
Guillemot	Breeding	Not available	83,214 individuals	No
Razorbill	Breeding	Not available	21,140 individuals	Yes
Puffin*	Breeding	Not available	Not available	Yes
Fulmar*	Breeding	Not available	Not available	No
Gannet	Breeding	Not available	16,938 individuals	Yes
Cormorant*	Breeding	Not available	Not available	No
Shag*	Breeding	Not available	Not available	No

*Named components of the assemblage only.

Assessment for the gannet population

2368. The Flamborough and Filey Coast SPA gannet population is currently estimated to number 26,784 individuals, based upon the most recently available count data from 2017 (Offshore EIA Report, volume 3, appendix 11.5). This is substantially higher than the citation level of 16,938 individuals (Table 5.177). As with the Forth Islands SPA gannet population (and most gannet colonies elsewhere in Britain and Ireland – Mitchell *et al.* 2004, Murray *et al.* 2015), the Flamborough and Filey Coast SPA population has shown a marked and consistent increase in numbers with the annual population growth rate averaging approximately 11% since the colony establishment in the late 1930s (Natural England 2020). The population was estimated as fewer than 1,500 individuals in the mid-1980s, with numbers increasing to approximately 7,000 individuals by 2005 and 22,000 individuals by 2012, since when there is some indication of a possible (and slight) reduction in the rate of growth to give the 2017 estimate of almost 27,000 individuals (SMP 2022).

The potential for impacts on the gannet population

2369. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Flamborough and Filey Coast SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this qualifying feature is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the '*breeding population: abundance*' attribute which has the target of maintaining the abundance of the breeding population of this feature above the citation level, whilst avoiding deterioration from its current level. Clearly, other attributes (e.g. *connectivity with supporting habitats*) are also relevant but, as for the conservation objectives above, their significance is linked to whether they prevent achievement of the attribute concerned with maintaining the abundance of the breeding population.

2370. From published information on gannet foraging ranges (Woodward *et al.* 2019) it is feasible that during the breeding season birds from this SPA population could occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area (because the Proposed Development is within the mean maximum foraging range plus 1 SD of gannet from the Flamborough and Filey Coast SPA). However, tracking data for gannet from the SPA provide no evidence that their breeding season foraging ranges encroach on waters close to the Proposed Development, whilst analyses of gannet tracking data from multiple colonies in Britain and Ireland suggest that the breeding season foraging ranges of birds from different colonies tend to be mutually exclusive, with the Proposed Development encompassed by the foraging ranges of birds from the Forth islands SPA population (Langston *et al.* 2013, Wakefield *et al.* 2013). The apportioning calculations estimate that 1.3% of the gannets occurring on the Proposed Development array area during the breeding season derive from the Flamborough and Filey Coast SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance.

2371. Gannets from the Flamborough and Filey Coast SPA move south in autumn to winter in more southern waters, returning north in the spring (Furness 2015), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Flamborough and Filey Coast SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

2372. Direct disturbance to gannets during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2373. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

2374. When using the marine environment (and not at the breeding colony), gannets are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign gannet as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2375. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to gannets from the Flamborough and Filey Coast SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable encompasses 168 km^2. Together these areas represent less than 0.5% of the total breeding season foraging area that is potentially available to the SPA gannet population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 309.2±194.2 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array area and export cable corridor represent less than 1% of the breeding season foraging area if considering the mean maximum foraging range only. Furthermore, as detailed above, evidence from tracking data suggests that the waters encompassed by the Proposed Development are rarely used by gannets from the Flamborough and Filey Coast SPA during the breeding season (Langston *et al.* 2013, Wakefield *et al.* 2013).

2376. During the autumn and spring passage periods, the potential for effects of construction-related disturbance is limited to SPA gannets are essentially transiting through the waters within which the Proposed Development is located.

2377. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2378. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2379. Given the low sensitivity of gannet to disturbance effects, the low likelihood of birds from this SPA population occurring within the waters encompassed by the Proposed Development during the breeding season, the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population.

Displacement

2380. As detailed above, gannet is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas potentially used by the Flamborough and Filey Coast SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2381. Therefore, based upon the above, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population.

Changes to prey availability

2382. Gannets predominantly prey upon fish including herring, mackerel, sprat and sandeel, as well as fishery discards (del Hoyo *et al*., 1996). Indirect effects on gannets may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Flamborough and Filey Coast SPA gannet population in the short-term.

2383. During construction there are a number of ways in which effects on gannet prey species could occur, which are as outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey* availability for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 9 of the Offshore EIA Report. However, the Proposed Development array area and export cable represent less than 0.5% of the total breeding season foraging area that is potentially available to the SPA gannet population, as defined by the species' mean-maximum breeding season foraging range plus 1 SD (i.e. 309.2±194.2 km; Woodward *et al*., 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Additionally, the evidence from tracking data, which suggests that gannets from the Flamborough and Filey Coast SPA will rarely use the waters encompassed by the Proposed Development during the breeding season, is relevant (Langston *et al.* 2013, Wakefield *et al.* 2013). The potential for any effects during the autumn and spring passage periods is considered to be low because birds disperse widely through UK waters to their wintering grounds (Kubetski *et al*., 2009; Furness 2015).

2384. During decommissioning, the effects from changes in prey availability are considered to be the same (or less) as for construction. It is currently unclear as to how the presence, and subsequent removal of, subsea structures may affect gannet prey species (Birchenough and Degrae 2020; Scott, 2022). It is possible that prey abundance could decline from the levels present during the operation and maintenance period. This could occur if the sub-surface structures associated with the Proposed Development in the marine environment lead to an increase in key prey abundance within the Proposed Development array area and export cable corridor via the provision of artificial reef habitats. However, some infrastructure (such as scour and cable protection) is assumed to be left *in situ* with the impact of colonisation of infrastructure continuing in perpetuity following decommissioning. Thus, any reduction in prey abundance through removal of foundations is likely to be very small relative to the area over which breeding and non-breeding gannets forage.

2385. Given their wide-ranging foraging behaviour and degree of plasticity in diet (del Hoyo *et al*., 1996), together with any effects being intermittent, spatially-restricted and temporary in nature, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on gannets during construction and decommissioning were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Project alone: operation and maintenance

Disturbance

2386. Vessel use within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project (Table 4.1).

2387. Based on information presented in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high (see section on Project Alone: Operation and Maintenance – Disturbance for the St Abb's Head to Fast Castle SPA kittiwake population). In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance.

2388. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower than during the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often small) parts of these wider areas.

2389. Given the low sensitivity of gannet to disturbance effects at sea (Garthe and Hüppop 2004; Furness *et al.*, 2013), the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities (Woodward *et al.*, 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/barrier effects

2390. As outlined above, displacement effects on the Flamborough and Filey Coast SPA gannet population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2391. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on gannet are estimated for the breeding period and each of the autumn and spring passage periods. The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for gannet are:

- Breeding period: 70% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 70% displacement with lower and upper mortality rates of 1% and 3%.

2392. As with other species for which displacement effects are assessed (see above), the approach to estimating gannet displacement effects advocated by the Scoping Opinion was considered overly precautionary. For gannet, this was specifically concerned with the upper range of the proposed mortality rates, and the evidence available to support this (volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for gannet displacement, the extent of the species' ranging behaviour, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach (for both displacement and consequent mortality) are as for the lower range of the Scoping Approach (i.e. 70% displacement and 1% mortality in for all seasonal periods).

2393. Estimates of gannet mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Flamborough and Filey Coast SPA gannet population during the breeding and non-breeding periods according to the NatureScot (2018) approach and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.178). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of gannets recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.178: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Flamborough and Filey Coast SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			ADULTS	IMMATURES	
Breeding	4,735	0.99	0.013	0.013	0.10
Autumn migration	1,500	N/A	0.02	0.02	N/A
Spring migration	269	N/A	0.04	0.03	N/A

2394. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as a single bird (adults and immatures combined) based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as two adult and one immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.179). Approximately 40% of the predicted displacement effects are attributable to the breeding season for both the Developer and Scoping Approaches (Table 5.179).

Table 5.179: Estimated Potential Annual Mortality of Flamborough and Filey Coast SPA Gannets as a result of Displacement from the Proposed Development Array Area and 2 km buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.4	0.0
	Autumn migration	70%	1%	0.2	0.2
	Spring migration	70%	1%	0.1	0.1
	Annual total	-	-	0.7	0.3
Scoping B	Breeding	70%	3%	1.2	0.0
	Autumn migration	70%	3%	0.7	0.6
	Spring migration	70%	3%	0.2	0.2
	Annual total	-	-	2.1	0.8
Developer	Breeding	70%	1%	0.4	0.0
	Autumn migration	70%	1%	0.2	0.2
	Spring migration	70%	1%	0.1	0.1
	Annual total	-	-	0.7	0.3

2395. The additional annual mortality of adult gannets from the Flamborough and Filey Coast SPA population predicted due to displacement as a result of the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 26,784 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of approximately 0.1% for the Developer Approach and of 0.1 – 0.2% for the lower and upper estimates from the Scoping Approach.

2396. These are very small levels of effect which would be highly unlikely to lead to any detectable population-level impacts. Consequently, it is considered that there is no potential for displacement and barrier effects from the Proposed Development alone during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population.

<u>Collision risk</u>

2397. Predictions of the number of gannets at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for gannet (SNCBs 2014) and as advised by the Scoping Opinion.

2398. As outlined for St Abb's Head to Fast Castle SPA kittiwake population above, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for gannet were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

2399. In addition to the above, collision estimates for gannets were also calculated using option 2 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018). These additional collision estimates are not used as the basis of the assessments on the SPA gannet populations but, instead, are used solely to illustrate the consequences of applying these alternative avoidance rates which have been derived from studies at an actual offshore wind farm. Details of these additional CRMs are provided in annex C of the Offshore EIA Report, volume 3, appendix 11.3.

2400. As for the predicted displacement effects, gannet collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the gannet SPA population during the breeding and non-breeding periods according to the NatureScot (2018) approach and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.178). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.178).

2401. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of gannets from the Flamborough and Filey Coast SPA is predicted to be approximately three birds (adults and immatures combined) as determined by the Scoping Approach, and approximately two birds (adults and immatures combined) as determined by the Developer Approach (Table 5.180). In contrast to displacement, the majority of this mortality (i.e. 57 – 69%) is predicted to occur during the breeding season.

Table 5.180: Predicted collision Effects from the Proposed Development on the Flamborough and Filey Coast SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text)

Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Scoping	*Breeding*	2.0	0.0
	Autumn migration	0.4	0.3
	Spring migration	0.1	0.1
	Annual total	2.5	0.4
Developer	*Breeding*	1.6	0.0
	Autumn migration	0.3	0.2
	Spring migration	0.1	0.1
	Annual total	2.0	0.3

2402. The additional annual mortality of adult gannets from the Flamborough and Filey Coast SPA population predicted due to collisions with wind turbines in the Proposed Development array represents less than 0.01% of the number of adults currently estimated to breed at this colony (i.e. 26,784 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of approximately 0.2% for both the Developer and Scoping Approaches.

2403. The collision estimates produced using option 2 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied are 54% lower than those presented in Table 5.180 (for both the Scoping and Developer Approaches).

2404. The levels of effect detailed in Table 5.180 are very small and would be highly unlikely to lead to any detectable population-level impacts. Consequently, it is considered that there is no potential for collision mortality associated with the Proposed Development alone during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population.

Changes to Prey Availability

2405. Potential impacts on key prey species for gannets breeding at the Flamborough and Filey Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures could affect gannet survival and productivity in the Flamborough and Filey Coast SPA population.

2406. Artificial structures introduced to the marine environment provide hard substrate for settlement of various organisms, which can increase local food availability for higher trophic levels. Whilst there is mounting evidence of potential benefits of artificial structures in marine environment (Birchenough and Degrae 2020), the statistical significance of such benefits and details about trophic interactions remain largely unknown (Scott, 2022).

2407. Given their wide-ranging foraging behaviour and degree of plasticity in diet (del Hoyo *et al*., 1996), together with any effects being largely intermittent across a relatively small spatial extent, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population. This conclusion is consistent with the outcome of the EIA which concluded that effects from changes in prey availability on gannets during operation and maintenance were not significant in EIA terms (volume 2, chapter 11 of the Offshore EIA Report).

Combined effects of displacement/barrier effects and collision risk

2408. As determined above, none of the effect pathways identified as relevant to the Stage Two assessment are considered to have the potential to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population when considered on their own. However, both displacement (inclusive of barrier effects) and collision risk during the operation and maintenance phase are identified as having the potential to result in (small levels of) additional mortality. Therefore, it is relevant to determine the potential effects of the combined mortality from these two effect pathways on the Flamborough and Filey Coast SPA gannet population.

2409. Based upon the Developer Approach the potential combined mortality from displacement and collision risk equates to a total of 2.7 adult and 0.6 immature birds, whilst for the Scoping Approach the potential combined mortality ranges from 3.2 – 4.6 adult and 0.7 – 1.2 immature birds (Tables 5.179 and 5.180). Considering the adult age class, these levels of additional mortality represent 0.01% of the number of adults currently estimated to breed at this colony (i.e. 26,784 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and between 0.011 – 0.017% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted combined adult mortality equates to increases of 0.2% for the Developer Approach and of 0.3 – 0.4% for lower and upper estimates from the Scoping Approach.

2410. These are very small levels of effect which would be highly unlikely to lead to any detectable population-level impacts. Consequently, it is considered that there is no potential for the predicted combined mortality resulting from displacement (inclusive of barrier effects) and collisions from the Proposed Development alone during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA gannet population.

Project alone: conclusion

2411. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Flamborough and Filey Coast SPA gannet population are predicted to be small and would be highly unlikely to lead to any detectable population-level impacts. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

2412. As detailed above, any effects from the Proposed Development alone on the Flamborough and Filey Coast SPA gannet population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from the effects due to other plans and projects.

2413. Therefore, the potential for effects of the Proposed Development to act on the Flamborough and Filey Coast SPA gannet population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

2414. To estimate the breeding season displacement mortality for the Flamborough and Filey Coast SPA gannet population due to the other UK North Sea wind farms, the apportioned breeding season gannet numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were first extracted from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see annex E of volume 3, appendix 11.6 of the Offshore EIA Report for more details). No information could be determined on the age distribution of the birds comprising these totals and it was assumed that 97% were breeding adults from the SPA, on the basis that this is the average percentage of adults recorded in the breeding season during baseline surveys of the three existing Forth and Tay wind farms (ICOL 2018). This is likely to be a highly precautionary assumption because most of the plans and projects contributing to these cumulative totals are located at considerably greater distances from the Flamborough and Filey Coast SPA than are the existing Forth and Tay wind farms from the Forth Islands SPA (and hence it is likely that they would include a higher proportion of non-breeding birds). Displacement mortality estimates for the breeding season were then calculated by applying the displacement and mortality rates appropriate to the Scoping and Developer Approaches to the apportioned cumulative total number of adults and immatures (Table 5.179).

2415. For the non-breeding periods, gannet numbers for each of the relevant seasonal periods were also extracted from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report annex E of volume 3, appendix 11.6 for more details). The cumulative numbers for each of the autumn and spring passage periods were apportioned to the Flamborough and Filey Coast SPA gannet population according to the BDMPS approach as detailed in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015, Royal HaskoningDHV *et al.* 2015). The subsequent displacement mortality was calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.179).

2416. The predicted displacement mortality derived for the other UK North Sea wind farms was combined with that from the Proposed Development to give the in-combination estimates according to both the Scoping and Developer Approaches (Table 5.181).

Table 5.181: Estimated Annual Mortality of Flamborough and Filey Coast SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	60.0	1.8	5.8	2.8	2.2	1.8	68.0	6.4
	Scoping B	180.1	5.5	17.3	8.4	6.5	5.3	203.9	19.2
	Developer	60.0	1.8	5.8	2.8	2.2	1.8	68.0	6.4

2417. The incorporation of the potential mortality associated with the other plans and projects results in substantive increases in the mortality predicted due to displacement effects relative to that from the Proposed Development alone. Thus, the potential mortality of adult birds from the Proposed Development in-combination with the other UK North Sea wind farms is almost 100 times greater than for the Proposed Development alone, for both the Developer and Scoping Approaches (compare Table 5.181 with Table 5.179). Increases in the potential mortality amongst the immature age class (which remains low compared to that of adults) relative to that from the Proposed Development alone are less marked but nonetheless substantive, being approximately twentyfold. The vast majority of the mortality (i.e. 83%) is attributable to the breeding season (Table 5.181).

2418. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the SPA population predicted due to displacement represents 0.25% of the current adult breeding population at this colony (i.e. 26,784 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.25 – 0.76% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult displacement mortality equate to an increase of 5.5% for the Developer Approach and of 5.5 – 16.5% for the lower and upper estimates from the Scoping Approach.

2419. The potential levels of impact on the Flamborough and Filey Coast SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In- combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

2420. For the breeding season, gannet collision estimates apportioned to the Flamborough and Filey Coast SPA for other offshore wind farms that are in planning, consented, under construction or in operation were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (Offshore EIA Report, annex E of volume 3, appendix 11.6). It was assumed that these breeding season collision estimates were entirely attributable to adult birds from the SPA population.

2421. For the non-breeding periods, collision estimates for other offshore wind farms that are in planning, consented, under construction or in operation were also derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects again updated using more recent design information where required (Offshore EIA Report annex E of volume 3, appendix 11.6). These collision estimates were apportioned to the SPA population according to the BDMPS approach as detailed in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015, Royal HaskoningDHV *et al.* 2015).

2422. Collision estimates based on consented and 'as-built'[11] designs were also considered (Offshore EIA Report, annex E of volume 3, appendix 11.6). For the current SPA population adoption of the 'as-built' designs reduced the in-combination totals by approximately 50 adults compared to those derived from the consented designs.

2423. In contrast to the displacement estimates derived for the other plans and projects, existing collision estimates for the other plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

2424. The predicted collision mortality derived for the other UK North Sea wind farms was combined with that from the Proposed Development to give the in-combination estimates according to both the Scoping and Developer Approaches (but noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.182).

Table 5.182: Predicted Collision Effects on the Flamborough and Filey Coast SPA Gannet Population due to the Proposed Development In-Combination with other UK North Sea Wind Farms. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	247.4	0.0
		Autumn migration	24.3	19.6
		Spring migration	12.3	10.0
		Annual total	284.0	29.6
	Developer	Breeding	247.0	0.0
		Autumn migration	24.2	19.6
		Spring migration	12.3	10.0
		Annual total	283.5	29.6

2425. As with the displacement effects, the incorporation of the potential collisions associated with the other plans and projects results in substantive increases in the predicted collision mortality relative to that from the Proposed Development alone, with a consequence of this being that the predicted mortalities differ little between the Developer and Scoping Approaches. Thus, the potential mortality of adult birds from the Proposed Development in-combination with the other UK North Sea wind farms is more than 100 times greater than for the Proposed Development alone, whilst the scale of increase in the potential mortality of immatures is only slightly lower than this (compare Table 5.182 with Table 5.180). The predicted mortality amongst the immature age class remains low compared to that of the adults. The vast majority of the mortality (i.e. 80%) is attributable to the breeding season (Table 5.182).

2426. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the SPA population predicted due to collisions represents 1.06% of the current adult breeding population at this colony (i.e. 26,784 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer and Scoping Approaches. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult collision mortality equate to an increase of 23.0% for the Developer and Scoping Approaches.

2427. Using the collision estimates for the 'as-built' (as opposed to the consented) designs reduces the total annual in-combination collision estimates to 234 adult and 29 immature birds for both the Scoping and Developer Approaches (the respective estimates for the different approaches differing by only 0.5 adults). This potential level of adult mortality represents 0.87% of the current adult population and a 19.0% increase to the baseline annual adult mortality.

2428. The potential levels of impact on the Flamborough and Filey Coast SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In- combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

2429. PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.181 and 5.182 above).

2430. The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.7 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2017 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA kittiwake above (with further details provided in the volume 3, appendix 11.6 of the Offshore EIA Report).

2431. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.183: Projected 35 Year Population Sizes and Associated PVA Metrics for the Flamborough and Filey Coast SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	243127 *(141247 – 386266)*	*1.000*	1.000	*50.0*
Scoping A	351.99	36.51	170114 (98806 – 271039)	0.699	0.990	9.9
Scoping B	487.86	49.52	148144 (86099 – 236140)	0.609	0.986	3.5
Developer	351.48	36.38	170211 (98863 – 271189)	0.699	0.990	9.9

2432. The PVA predicted that the Flamborough and Filey Coast SPA gannet population would increase strongly over the 35 year projection period irrespective of the effects from the Proposed Development in-combination with the other UK North Sea wind farms. Thus, the population is predicted to be nine times larger than the current estimate of 26,784 adult birds under baseline conditions which assume no wind farm effects, and almost six times its current size under the scenario of greatest annual mortality (i.e. Scoping Approach B) (Table 5.183). The predicted increases in population size are inevitably greatest for the baseline scenario because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population.

2433. The levels of increase in population size predicted by the PVA are highly unlikely to occur in reality and are, in part, a consequence of the absence of any compensatory density dependence within the population model (see above). The prediction of a strongly increasing trend is consistent with the documented long-term trend for this SPA population (Figure 5.17) and, more widely, for breeding gannet populations across the UK (Mitchell *et al.* 2004, Murray *et al.* 2015). However, it is likely that the availability of resources (e.g. suitable nesting sites or prey) will limit further growth of the SPA population at some point within the next few years or decades, with the previously observed high rates of increase unlikely to be maintained.

2434. The PVA metrics associated with the Scoping Approach indicate reductions of 30 – 39% in population size after 35 years relative to that in the absence of any wind farm effects (Table 5.183). The associated reductions in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 1.0 – 1.4%, whilst the centile values of 3.5 – 9.9 indicate very little overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being smaller than the unimpacted population after 35 years. As detailed above, the predicted in-combination mortality from displacement and collision effects as determined by the Developer Approach is almost equivalent to that as determined by the lower range of the Scoping Approach (Tables 5.181 and 5.182). Consequently, the values for PVA metrics as determined by the Developer Approach are equivalent to those for the lower range of the Scoping Approach (i.e. Scoping Approach A) (Table 5.183).

2435. Undertaking the PVAs on the basis of the collision estimates for the 'as-built' (as opposed to the consented) designs for the Proposed Development in-combination with the other UK North Sea wind farms increases the CPS values for the Scoping Approach to 0.639 – 0.733 (equivalent to reductions of 27 – 36% in population size after 35 years relative to that in the absence of any wind farm effects). The associated CPGR values are 0.988 – 0.991, whilst the centile values of 5.0 – 13.0 continue to indicate a high likelihood of the impacted population being smaller in size than the unimpacted population after 35 years (see Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.6).

2436. As detailed above, the Flamborough and Filey Coast SPA gannet population has shown a marked, and consistent, long-term increase in size, reflecting the wider trend in gannet populations across the UK (Mitchell et al. 2004, Murray *et al.* 2015, Natural England 2020). Based on the data from the SMP, the annual growth rate for this SPA population between 1986 and 2017 averaged just over 10% (Royal HaskoningDHV 2022). If this growth rate was to be maintained over the 35 year operation and maintenance period for the Proposed Development, the Flamborough and Filey Coast SPA population would still be more than 18 times larger than currently even when accounting for the 1.4% reduction in annual growth rate, as predicted by the upper range of the Scoping Approach for the Proposed Development in-combination with the other UK North Sea wind farms (Table 5.183). The mean annual growth rate for the SPA population under baseline conditions (i.e without any wind farm effects) would have to decrease to below 1.4% for this predicted impact to result in the population declining below its current level over the 35 year operation and maintenance period.

2437. As noted above, it is possible that the availability of resources will limit further growth of this SPA population at some point within the 35 year operation and maintenance period for the Proposed Development. If this occurs, it is likely that there would remain a considerable capacity for population regulation via the operation of compensatory density dependence, particularly given the evidence for environmental conditions remaining highly suitable for the SPA (and other gannet) population(s) over the long term. Thus, it is likely that the SPA population would remain stable despite increased levels of mortality (at least of a scale which could potentially occur as a result of the effects from the Proposed Development in-combination with the other UK North Sea wind farms.

2438. As for the assessment of the Forth Islands SPA gannet population, the assessment for the Flamborough and Filey Coast SPA gannet population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendices 11.3 and 11.4). This includes the reliance on PVAs which are based on density independent population models, as already considered in relation to the expectation that compensatory density dependence would offset increased mortality resulting from the predicted effects. In addition, and of particular relevance to the gannet assessment, the avoidance rate used with the CRM relates to behaviour within the wind farm array only and excludes consideration of macro-avoidance, which is likely to be high for gannet (Cook *et al.* 2014, Cook 2021, Peschko *et al.* 2021). This issue is now recognised in recent advice from Natural England, which recommends the application of a macro-avoidance correction for gannet (ranging from 65 – 85%) to reduce the estimated density of birds in flight within the array area (Natural England 2022b)[14]. This would (obviously) substantially reduce the collision estimates and, hence, the scale of the predicted population-level impacts. In relation to the estimation of displacement effects, as for other species, these are based upon the seasonal mean peak abundance estimates (which are substantially higher than the seasonal mean values).

In-combination: conclusion

2439. For both the Developer and Scoping Approach, the CPS values suggest a marked reduction in the SPA population size after 35 years relative to that in the absence of any wind farm effects, whilst the centile values also indicate that a high likelihood of the impacted population being smaller than the un-impacted population after 35 years. However, when these predicted levels of impacts are considered within the context of the precaution incorporated within the assessment and the status and long-term, strongly increasing, trend of the SPA population, as well as the consequences in terms of population growth rates, it is concluded that they would not lead to an adverse effect. This is as determined by both the Developer and Scoping Approaches.

2440. This conclusion aligns with the indication from Natural England in their recent Relevant Representations for the Sheringham Shoal Extension and Dudgeon Extension projects that they are likely to reach a conclusion of no adverse effect in relation to the in-combination impact (inclusive of these two projects) on the Flamborough and Filey Coast SPA gannet population (Natural England 2022c). This indication from Natural England is based on an assessment of in-combination impacts which does not account for the effects from the Proposed Development but (as detailed in Tables 5.179 and 5.180) these are predicted to be very small.

Assessment for the kittiwake population

2441. The Flamborough and Filey Coast SPA kittiwake population is currently estimated to number 91,008 individuals, based upon the most recently available count data from 2017, representing the largest kittiwake colony in the UK (Offshore EIA Report, volume 3, appendix 11.5, Natural England 2022d). This is slightly higher than the citation level of 89,040 individuals (Table 5.177). There is uncertainty over the long-term trend in the size of this SPA population, with the citation population for the former Flamborough and Bempton Cliffs SPA (which was subsequently superceded by the Flamborough and Filey Coast SPA) being 166,740 individuals, as derived from counts undertaken in 1987. Subsequent counts in 2000 and

2008 gave estimates of approximately 80,000 individuals (SMP 2022), suggesting that the population underwent a major decline between the late 1980s and late 1990s (Natural England 2022d). However, there is uncertainty over the veracity of the 1987 count, with a lack of supporting detail being available on survey methods and suggestions that the count unit may have been mistakenly transcribed as pairs (rather than individuals), whilst associated monitoring of breeding productivity predicts an increasing, not declining, population trend during this period (Coulson 2011, 2017). As such, it is unclear whether this SPA population has been subject to a marked long-term decline or gradual increase, although the SPA conservation objectives are based upon the former.

The potential for impacts on the kittiwake population

2442. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Flamborough and Filey Coast SPA, so that potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this qualifying feature is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the '*breeding population: abundance*' attribute which has the target of restoring the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level. Clearly, other attributes (e.g. *connectivity with supporting habitats*) are also relevant but, as for the conservation objectives above, their significance is linked to whether they prevent achievement of the attribute concerned with restoring or maintaining the abundance of the breeding population (see appendix 3A).

2443. From published information on kittiwake foraging ranges (Woodward *et al.* 2019) it is feasible that during the breeding season birds from this SPA population could occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area (because the Proposed Development is within the mean maximum foraging range plus 1 SD of gannet from the Flamborough and Filey Coast SPA). However, tracking data (and associated modelling of such data) for kittiwake from the SPA provide no evidence that their breeding season foraging ranges encroach on waters close to the Proposed Development (Cleasby *et al.* 2018, Wischnewski *et al.* 2018). The apportioning calculations estimate that considerably less than 1% of the kittiwakes occurring on the Proposed Development array area during the breeding season derive from the Flamborough and Filey Coast SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance.

2444. For the reasons described for the St Abb's Head to Fast Castle SPA kittiwake population, during the non-breeding season there is likely to be the potential for kittiwake from the Flamborough and Filey Coast SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given the above, there is potential for the Proposed Development to have effects on the Flamborough and Filey Coast SPA kittiwake population during breeding and non-breeding periods, albeit that this potential is extremely low in relation to the breeding season.

Project alone: construction and decommissioning

Disturbance

2445. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2446. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

2447. When using the marine environment (and not at the breeding colony), kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign kittiwake as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2448. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to kittiwakes from the Flamborough and Filey Coast SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent less than 1% of the total breeding season foraging area that is potentially available to the SPA kittiwake population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e.156.1±144.5 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 3% of the breeding season foraging area if considering the mean maximum foraging range only.

2449. Tracking of kittiwakes from the Flamborough and Filey Coast SPA, as well as modelling of kittiwake foraging distributions from tracking data, suggest that the Proposed Development array area and Proposed Development export cable corridor are beyond waters that are likely to be used by birds from the Flamborough and Filey Coast SPA during the breeding season (Cleasby *et al.* 2018, Wischnewski *et al.* 2018).

2450. During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.* 2012, Furness 2015). Thus, the potential for effects of construction-related disturbance is generally lower than during the breeding season (but noting that in the case of the Flamborough and Filey Coast SPA, the distance of the SPA from the Proposed Development means that the likelihood of usage of the Proposed Development by the SPA birds during the breeding season is also low and, hence, any such seasonal effect will be less marked).

2451. In addition, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2452. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2453. Given the low sensitivity of kittiwake to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated kittiwake breeding season foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement

2454. As detailed above, kittiwake is considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Flamborough and Filey Coast SPA kittiwake population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development offshore export cables corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwakes from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2455. Therefore, based upon the above, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA kittiwake population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction-related displacement was required (volume 2, chapter 11 of the Offshore EIA Report).

Changes to prey availability

2456. Key prey species for kittiwakes include sandeel and sprat (del Hoyo *et al*., 1996). Indirect effects on kittiwakes may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Flamborough and Filey Coast SPA kittiwake population in the short-term.

2457. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Flamborough and Filey Coast SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population. Additionally, the relatively large distance of the Proposed Development from the Flamborough and Filey Coast SPA is relevant because it reduces the likelihood that kittiwakes from this SPA will use the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5).

2458. Given this, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2459. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Flamborough and Filey Coast SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, kittiwakes are considered to have a relatively low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2460. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2461. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2462. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2463. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population.

Displacement/barrier effects

2464. As outlined above, the SNCB matrix approach provides the basis for estimating displacement effects on seabird species in this assessment, with this approach assumed to also incorporate the impact of barrier effects within the estimates that are derived (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2465. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on kittiwake are estimated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for kittiwake are:

- Breeding period: 30% displacement with lower and upper mortality rates of 1% and 3%.
- Non-breeding periods: 30% displacement with lower and upper mortality rates of 1% and 3%.

2466. However, the approach to estimating kittiwake displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to the upper mortality rate used and the incorporation of mortality effects in the non-breeding periods, as detailed in volume 3, appendix 11.4, annex G of the Offshore EIA Report. In particular, it represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change. Thus, based on a consideration of the available evidence for kittiwake displacement, the extent of the species' ranging behaviour (particularly in the non-breeding periods), previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 30% displacement with a mortality rate of 2%.
- Non-breeding periods: No measurable effects of displacement on mortality.

2467. Estimates of kittiwake mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Flamborough and Filey Coast SPA kittiwake population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.184). The resulting mortality estimates for the breeding period were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the breeding period in the baseline surveys (Offshore EIA Report, volume 3, appendix 11.1), whilst for the non-breeding periods age classes were apportioned according to the stable age distributions of the population model used in Furness (2015). Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 10% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.184: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Flamborough and Filey Coast SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Breeding	*21,141*	*0.97*	0.001	0.001	*0.10*
Autumn migration	*11,190*	*N/A*	0.054	0.032	*N/A*
Spring migration	*13,766*	*N/A*	0.072	0.032	*N/A*

2468. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA kittiwake population as a result of displacement is estimated as five adult and two immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 15 adult and seven immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.185). The displacement effects predicted by the Scoping Approach are (almost) entirely attributable to the non-breeding season (Table 5.185), reflecting the fact that this SPA is distant from the Proposed Development with a low likelihood of use by the SPA kittiwake population during the breeding season.

2469. The annual mortality from displacement as determined using the Developer Approach is predicted to be considerably less than a single adult bird, which (in contrast to the estimates from the Scoping Approach) is entirely attributable to breeding season effects (on the basis that displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population – volume3, appendix 11.4, annex G of the Offshore EIA Report).

Table 5.185: Estimated Potential Annual Mortality of Flamborough and Filey Coast SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	1.8	1.1
	Spring migration	30%	1%	3.0	1.3
	Annual total	-	-	4.8	2.4
Scoping B	Breeding	30%	3%	0.1	0.0
	Autumn migration	30%	3%	5.5	3.2
	Spring migration	30%	3%	8.9	4.0
	Annual total	-	-	14.5	7.2
Developer	Breeding	30%	2%	0.1	0.0
	Autumn migration	N/A	N/A	N/A	N/A

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.1	0.0

2470. The additional annual mortality of adult kittiwakes from the Flamborough and Filey Coast SPA population predicted due to displacement from the Proposed Development array represents considerably less than 0.01% of the current adult breeding population at this colony (i.e. 91,008 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between less than 0.01% and 0.02% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of considerably less than 0.1% for the Developer Approach and of between less than 0.1% and 0.2% for the lower and upper estimates from the Scoping Approach.

2471. The potential levels of impact on the Flamborough and Filey Coast SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

2472. Predictions of the number of kittiwakes at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3). Following the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), the assessment is based on option 2 of the CRM, which uses the generic flight height data from Johnston *et al.* (2014a,b) and assumes a uniform distribution of flight heights across the rotor swept zone (as opposed to using the modelled flight height distribution) (Band 2012). An avoidance rate of 98.9% was applied to these CRM outputs, as recommended for kittiwake (SNCBs 2014) and as advised by the Scoping Opinion.

2473. As detailed for the St Abb's Head to Fast Castle SPA kittiwake population, guidance on the use of the CRM suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within the array area (Band 2012)[8] and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments. Despite this, the Scoping Opinion advised that the CRMs for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Further details on this are provided above in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwakes (and in volume 3, appendix 11.3 of the Offshore EIA Report) but, as a result of this overly precautionary approach (which does not follow previous precedent), the CRMs for Flamborough and Filey Coast SPA kittiwakes were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

2474. As for the St Abb's Head to Fast Castle SPA kittiwake population, collision estimates were also calculated:

- Using option 2 of the deterministic version of the CRM but with site-specific flight height data from boat-based surveys of the Proposed Development array area[10] (as opposed to the generic flight height data of Johnston *et al.* 2014a,b).
- Using options 2 and 3 of the stochastic version of the CRM (McGregor *et al.* 2018) with avoidance rates as derived from the bird collision-avoidance study undertaken at the Thanet offshore wind farm (Bowgen and Cook 2018), noting that option 3 of the CRM uses the modelled flight height distributions from Johnston *et al.* (2014a,b).

2475. These additional collision estimates are not used as the basis of the assessments on the SPA kittiwake populations but, instead, are used in a comparative way to illustrate the extent to which some estimates may vary according to certain of the key assumptions on which they are based. Details of these additional CRMs are provided in annex B and annex C of Offshore EIA Report, volume 3, appendix 11.3.

2476. As for the predicted displacement effects, kittiwake collision estimates are calculated for the breeding and non-breeding periods, with the latter separated into autumn and spring passage periods (Offshore EIA Report, volume 3, appendix 11.5). Estimates were apportioned to the Flamborough and Filey Coast SPA population during the breeding and non-breeding periods according to the MS Apportioning Tool (Butler *et al.* 2020) and the BDMPS approach (Furness 2015), respectively (Offshore EIA Report, volume 3, appendix 11.5, Table 5.184). The age class proportions and assumptions on sabbatical rates are also as detailed above in relation to displacement effects (Table 5.184).

2477. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, and in conjunction with the estimates and assumptions detailed above, the annual collision mortality of kittiwakes from the Flamborough and Filey Coast SPA is predicted to be 24 adults and 12 immatures as determined by the Scoping Approach, and approximately 17 adults and eight immatures as determined by the Developer Approach (Table 5.186). Virtually all of this mortality is predicted to occur during the non-breeding periods (for the same reasons as outlined above for the displacement effects on this SPA population, as determined by the Scoping Approach).

Table 5.186: Predicted Collision Effects from the Proposed Development on the Flamborough and Filey Coast SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenarioand are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (see text).

Approach	Seasonal Period	Estimated Number Of Collisions Breeding Adults	Immatures
Scoping	Breeding	0.5	0.0
	Autumn migration	9.7	5.7
	Spring migration	13.7	6.1
	Annual total	23.9	11.8
Developer	Breeding	0.4	0.0
	Autumn migration	5.6	3.3
	Spring migration	11.1	5.0
	Annual total	17.1	8.3

2478. The additional annual mortality of adult kittiwakes from the Flamborough and Filey Coast SPA population predicted due to collisions with wind turbines in the Proposed Development array represents approximately 0.02% of the number of adults currently estimated to breed at this colony (i.e. 91,008 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 0.03% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 0.1% and 0.2% for the Developer and Scoping Approaches, respectively.

2479. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Flamborough and Filey Coast SPA kittiwake population that are at least 50% lower than those presented in Table 5.186 above (and on which the assessment is based).

2480. More detailed consideration of the potential population-level impacts associated with the predicted collision mortalities in Table 5.186 is undertaken below in the *Project Alone: Population-Level Impacts* section, which presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

2481. Potential impacts on key prey species for kittiwakes breeding at the Flamborough and Filey Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect kittiwake survival and productivity in the Flamborough and Filey Coast SPA kittiwake population.

2482. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Flamborough and Filey Coast SPA kittiwake population as to the St Abb's Head to Fast Castle SPA kittiwake population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population.

2483. Given this, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population.

Project alone: population-level impacts

2484. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Flamborough and Filey Coast SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2485. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Tables 5.185 and 5.186 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.13 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2019 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2486. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.187: Projected 35 Year Population Sizes and Associated PVA Metrics for the Flamborough and Filey Coast SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	55022 (20972 – 134598)	*1.000*	1.000	*50.0*
	Scoping A	28.51	14.12	54422 (20739 – 133151)	0.989	1.000	49.3
	Scoping B	38.17	18.88	54220 (20661 – 132664)	0.985	1.000	48.9
	Developer	17.05	8.24	54665 (20833 – 133735)	0.994	1.000	49.6

2487. The PVA predicted that the Flamborough and Filey Coast SPA kittiwake population would decline over the 35 year projection period, irrespective of the effects from the Proposed Development. Thus, the population is predicted to decline by 40% from the current estimate of 91,008 adult birds under all scenarios, including baseline conditions which assume no wind farm effects (Table 5.187). Although the predicted declines in population size are inevitably smallest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small. The prediction of a declining trend for the Flamborough and Filey Coast SPA population contrasts with the population trend as documented since the early 2000s, although there is uncertainty over the trend prior to this time (see above).

2488. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the upper range of the Scoping Approach (i.e. Scoping Approach B), the CPS value indicates a reduction of 1.5% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.187). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable (at least when the CPGR value is expressed to three decimal places) and the centile value of 48.9 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics for the lower range of the Scoping Approach and the Developer Approach suggest even smaller levels of impact (Table 5.187).

2489. The PVA outputs described above, and detailed in Table 5.187, need to be considered within the context of the evidence which demonstrates that the main pressures on kittiwake populations in the North Sea (including the Flamborough and Filey Coast SPA) derive from fisheries management and climate change (Frederiksen *et al.* 2004, Carroll *et al.* 2017), with the predicted effects from the Proposed Development likely to be of minor importance relative to these broader-scale effects. The high levels of precaution incorporated within the assessment, particularly as determined by the Scoping Approach, are also relevant in this regard (with this detailed in the *Project Alone: Population-Level Impacts* section for the St Abb's Head to Fast Castle SPA kittiwake population).

Project alone: conclusion

2490. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Flamborough and Filey Coast SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. In addition, the PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects In-combination

Effects of relevance to the in-combination assessment

2491. As detailed above, any effects from the Proposed Development alone on the Flamborough and Filey Coast SPA kittiwake population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2492. Therefore, the potential for effects of the Proposed Development to act on the Flamborough and Filey Coast SPA kittiwake population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) and collision risk effect pathways during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the offshore wind farms in the UK North Sea.

Displacement/barrier effects – operation and maintenance

2493. As described in Offshore EIA Report, annex E of volume 3, appendix 11.6, estimates of breeding season displacement mortality which had been attributed to the Flamborough and Filey Coast SPA kittiwake population were extracted from the existing assessments for offshore wind farms that are in planning, consented, under construction or in operation. As for the potential displacement mortality estimated for the Proposed Development, the mortality attributed to the SPA population from other offshore wind farms was estimated using the SNCB matrix approach, with details on the displacement and mortality rates that had been applied being available in each case. Thus, it was possible to adjust the estimated mortalities from each of the other projects to align with the displacement and mortality rates on which the Scoping and Developer Approaches are based.

2494. Few estimates of displacement mortality are available from other projects for kittiwake (for any SPA population) during the non-breeding periods because such effects have not been considered important in most previous assessments for offshore wind farms in Scotland or England. Therefore, relevant seasonal mean peak abundance estimates of kittiwake were extracted from the baseline data from the assessments for other projects in the UK North Sea waters (Offshore EIA Report, annex E in volume 3, appendix 11.6), with the in-combination estimates derived according to the Scoping and Developer approaches as detailed above in the section on the in- combination *Displacement/Barrier Effects – Operation and Maintenance* for the St Abb's Head to Fast Castle SPA kittiwake population.

2495. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates according to both the Scoping Approach and Developer Approach (Table 5.188).

Table 5.188: Estimated Annual Mortality of Flamborough and Filey Coast SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with other UK North Sea Wind Farms.

In-Combination Region	Approach	Seasonal Period: Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.1	0.0	9.7	5.7	14.9	6.6	24.7	12.3
	Scoping B	0.2	0.0	29.2	17.1	44.7	19.7	74.1	36.9
	Developer	0.1	0.0	N/A	N/A	N/A	N/A	0.1	0.0

2496. For the Scoping Approach, the incorporation of the potential mortality from the predicted displacement effects associated with other plans and projects results in a fivefold increase in the levels predicted for the Proposed Development alone (compare Tables 5.185 and 5.188). Virtually all of the predicted mortality as determined by the Scoping Approach is attributed to the non-breeding periods. However, for the Developer Approach, the potential mortality from the predicted in-combination displacement effects does not differ from that for the Proposed Development alone (on the basis that no breeding season displacement effects were estimated for the other plans and projects, whilst displacement effects on kittiwake during the non-breeding periods are not considered to result in detectable impacts on the population by the Developer Approach – volume3, appendix 11.4, annex G of the Offshore EIA Report).

2497. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Flamborough and Filey Coast SPA population predicted due to displacement represents considerably less than 0.01% of the current adult breeding population at this colony (i.e. 91,008 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach (with this being unchanged from the Proposed Development alone), and of approximately 0.03 – 0.08% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the PVA tech rept), the estimates of adult displacement mortality equate to an increase of considerably less than 0.1% for the Developer Approach (also unchanged from the Proposed Development alone) and of 0.2 – 0.6% for the lower and upper estimates from the Scoping Approach.

2498. The potential levels of impact on the Flamborough and Filey Coast SPA kittiwake population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

2499. For the breeding season, kittiwake collision estimates apportioned to the Flamborough and Filey Coast SPA for other offshore wind farms that are in planning, consented, under construction or in operation were derived from the information collated in the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021), with the collision numbers for some projects updated using more recent design information where required (Offshore EIA Report, annex E of volume 3, appendix 11.6). As for the breeding season collision estimates derived from the other UK North Sea wind farms for the Flamborough and Filey Coast SPA gannet, it was assumed that these collision estimates were entirely attributable to adult birds.

2500. The in-combination collision estimates for the non-breeding passage periods were also extracted from the information collated in the East Anglia TWO and East Anglia ONE North submissions (again with updates for more recent design information where required). These estimates were apportioned to the SPA population according to the BDMPS approach as detailed in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015, Royal HaskoningDHV *et al.* 2015).

2501. Collision estimates based on consented and 'as-built'[11] designs were also considered (Offshore EIA Report, annex E of volume 3, appendix 11.6). For the current SPA population adoption of the 'as-built' designs reduced the in-combination totals by approximately 35 adults and nine immatures compared to those derived from the consented designs.

2502. In contrast to the displacement estimates derived for the other plans and projects, existing collision estimates for the other plans and projects were not adjusted to align with the Scoping Approach of using the maximum (rather than the mean) monthly estimate of the density of birds in flight (with all of the other projects likely to have followed the 'standard' approach of using the mean density). Such an adjustment would require the re-calculation of the CRMs for each project, which would not be feasible in many cases because of the difficulty in accessing the appropriate baseline data.

2503. As for displacement, the potential mortality estimates derived for the other plans and projects were combined with those for the Proposed Development to give estimates for the Proposed Development in-combination with the other UK North Sea wind farms according to both the Scoping Approach and Developer Approach (noting that for the Scoping Approach it is only the estimates for the Proposed Development that are calculated according to this approach) (Table 5.189).

Table 5.189: Predicted Collision Effects on the Flamborough and Filey Coast SPA Kittiwake Population Due to the Proposed Development In-Combination with Other Projects in the UK North Sea Waters. Estimates are Presented for both the Scoping Approach and Developer Approach

In-Combination Region	Approach	Seasonal Period	Estimated Number Of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	306.56	0.00
		Autumn migration	76.19	34.95
		Spring migration	69.64	38.91
		Annual total	452.39	73.85
	Developer	Breeding	306.46	0.00
		Autumn migration	72.09	32.55
		Spring migration	67.04	37.81
		Annual total	445.59	70.35

2504. The incorporation of the potential collisions associated with the other plans and projects results in substantive increases in the predicted collision mortality relative to that from the Proposed Development alone, with a consequence of this being that the predicted mortalities differ little between the Developer and Scoping Approaches. Thus, the potential mortality of adult birds from the Proposed Development in-combination with the other UK North Sea wind farms is 18 to 25 times greater than for the Proposed Development alone, whilst for the immature age class there is a five to sevenfold increase (with the increase being greater for the Developer Approach in both cases) (compare Tables 5.186 and 5.188). The predicted mortality amongst the immature age class remains low compared to that of the adults. The majority of the mortality amongst the adults (i.e. almost 70%) is attributable to the breeding season but amongst the immature age class it is all attributable to the non-breeding periods (Table 5.188).

2505. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Flamborough and Filey Coast SPA population predicted due to collisions represents 0.49% of the current adult breeding population at this colony (i.e. 91,008 individuals – Table 3.3 in the Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.50% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult collision mortality equate to an increase of 3.4% for both the Developer and Scoping Approaches.

2506. Using the collision estimates for the 'as-built' (as opposed to the consented) designs reduces the total annual in-combination collision estimates to 418 adult and 65 immature birds for the Scoping Approach and to 411 adult and 61 immature birds for the Developer Approach. This potential level of adult mortality represents 0.45% of the current adult population and a 3.1% increase to the baseline annual adult mortality.

2507. The potential levels of impact on the Flamborough and Filey Coast SPA kittiwake population resulting from the predicted collision mortality associated with the Proposed Development in-combination with the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In- combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

2508. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the

Proposed Development in-combination the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Tables 5.188 and 5.189 above).

2509. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above.

Table 5.190: Projected 35 Year Population Sizes and Associated PVA Metrics for the Flamborough and Filey Coast SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Period	Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
		Adults	Immatures				
35 years	*Baseline*	*0*	*0*	55022 *(20972 – 134598)*	*1.000*	1.000	*50.0*
	Scoping A	476.81	86.02	47094 *(17920 – 115772)*	0.857	0.996	37.6
	Scoping B	526.17	110.58	46207 *(17576 – 113615)*	0.841	0.995	36.2
	Developer	445.57	70.34	47665 *(18141 – 117160)*	0.868	0.996	38.5

2510. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.190 with Table 5.187). Thus, the CPS value for the Developer Approach indicates that the SPA population size would be reduced by 13% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 14 – 16% (Table 5.190). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.4% for the Developer Approach and 0.4 – 0.5% for the Scoping Approach. The values for the centile metric are estimated as 38.5 after 35 years for the Developer Approach and as 36.2 – 37.6 for the Scoping Approach. These suggest at least moderate levels of overlap in the distribution of the predicted impacted and un-impacted population sizes and, hence, a reasonably high likelihood of the impacted population being similar in size to the un-impacted population after 35 years.

2511. Undertaking the PVAs on the basis of the collision estimates for the 'as-built' (as opposed to the consented) designs for the Proposed Development in-combination with the other UK North Sea wind farms results in CPS values that are 0.010 higher than those for the equivalent impact scenario in Table 5.190, CPGR values that are 0.001 higher than those for the equivalent impact scenario in Table 5.190, and centile values that are 0.9 – 1.0 higher than those for the equivalent impact scenario in Table 5.190 (see Tables 3.1 and 3.3 in the Offshore EIA Report, volume 3, appendix 11.6). Therefore, the predicted impacts for both the Developer and Scoping Approaches are marginally reduced when the collision estimates are based upon the 'as-built' (as opposed to the consented) designs.

2512. The context within which the PVA metrics from these in-combination scenarios should be considered is outlined above in the *Project Alone: Population-Level Impacts* section for this SPA population.

In-combination: conclusion

2513. For the Flamborough and Filey Coast SPA kittiwake population, the SACOs identify the requirement to restore the size of the breeding population to a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level (see section above on *The Potential for Impacts on the Kittiwake Population* for this SPA population). This is despite the uncertainty over the veracity of the evidence pertaining to size of this population in the late 1980s and, hence, the long-term status of the population. If the 1987 population estimate (and hence citation population size of 83,370 breeding pairs (or 166,740 individuals) for the now superseded Flamborough and Bempton Cliffs SPA on which this SACO target is based) is accepted, the target to restore this population represents a major challenge because it requires the impacts from both fisheries management and climate change to be addressed (these being the factors of greatest importance in determining the status of kittiwake populations in the North Sea - Frederiksen *et al.* 2004, Carroll *et al.* 2017).

2514. Compared to these wider scale management and environmental factors, it is likely that the predicted impacts from the Proposed Development in-combination with the other UK North Sea wind farms will be relatively minor (as determined by either the Developer or Scoping Approaches). Within the context of PVAs that are based on a density independent population model which does not account for the likely operation of compensatory density dependent mechanisms (as detailed in the section on *Project Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), the resultant metrics indicate (at most) moderate levels of reduction in the size of the Flamborough and Filey Coast SPA kittiwake population after 35 years, relative to that which would occur in the absence of the wind farm effects. Furthermore, the PVA metrics also indicate a reasonably high likelihood of the impacted population being similar in size to the un-impacted population after 35 years.

2515. However, these levels of predicted impact may still be sufficient to reduce the chances of achieving the target of restoring the SPA population size and, as such, it is considered that the predicted impacts from the Proposed Development in-combination with the other UK North Sea wind farms have the potential to result in an adverse effect on the SPA population. This conclusion applies to the predicted impacts as determined by both the Developer and Scoping Approaches, whilst the reduction in the levels of these impacts obtained by basing the collision estimates on the 'as-built' (as opposed to the consented) designs is not considered to be sufficient to affect the conclusion.

Assessment for the razorbill population

2516. The Flamborough and Filey Coast SPA razorbill population is currently estimated to number 37,476 individuals, based upon the most recently available count data from 2015 - 2018 (Offshore EIA Report, volume 3, appendix 11.6). This is higher than the citation level of 21,140 individuals (Table 5.177), whilst the available count data for the population indicate a consistent increase in numbers since at least 1987 when the population was estimated to number 10,302 individuals.

The potential for impacts on the razorbill population

2517. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Flamborough and Filey Coast SPA, so that potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this qualifying feature is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the *breeding populations abundance* attribute which has the target of maintaining the size of the breeding population above the citation level whilst avoiding deterioration from its current level. Clearly, other attributes (e.g. *connectivity with supporting habitats*) are also relevant but, as for the conservation objectives above, their significance is linked to whether they prevent achievement of the attribute concerned with maintaining the abundance of the breeding population (see appendix 3A).

2518. The Proposed Development is considerably beyond the breeding season foraging range of razorbill from the Flamborough and Filey Coast SPA so that connectivity is limited to the non-breeding periods (HRA Stage One Screening Report, Woodward *et al.* 2019). The full non-breeding period for razorbill is defined as mid-August to March, following the NatureScot (2020) guidance.

2519. Based on the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), which draws upon the findings from Buckingham *et al.* (2022), razorbills are assumed to disperse more widely than guillemots during the non-breeding period, with their distribution concentrated in central areas of the North Sea during the mid-winter period. Consequently, it is assumed (for the purposes of the assessment) that during the non-breeding period birds from the Flamborough and Filey Coast SPA population have the potential to occur within offshore wind farms throughout the UK North Sea waters during the autumn and spring passage periods and in mid-winter (defined as mid-August to October, January to March and November to December, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, Offshore EIA Report, volume 3, appendix 11.5). Given this, the Proposed Development may have potential effects on the Flamborough and Filey Coast SPA razorbill population during the non-breeding periods.

<u>Project alone: construction and decommissioning</u>

<u>Disturbance</u>

2520. Direct disturbance to razorbills during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2521. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer - Offshore EIA Report, volume 2, chapter 13).

2522. When using the marine environment (and not at the breeding colony), razorbills are considered to have a moderate sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign razorbill as '3' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2523. The Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. During the non-breeding periods, razorbills from the Flamborough and Filey Coast SPA population are likely to occur across large parts of the North Sea, as well as more southern European waters (Furness 2015, Buckingham *et al.* 2022). Therefore, the total area to be affected by construction-related disturbance over the full eight years of the construction phase represents a very small proportion of the total area of marine habitat available to the SPA population.

2524. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2525. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2526. Given the moderate sensitivity of razorbill to disturbance effects, the fact that potential connectivity with the Proposed Development is limited to the non-breeding season (when the SPA population may occur across a large expanse of the North Sea and more southern waters), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

<u>Displacement</u>

2527. As detailed above, razorbill is considered to have a moderate sensitivity to disturbance and the potential for effects of disturbance on the SPA population is limited to the non-breeding periods, whilst construction will (at most) extend over an eight year period (with a likely similar or shorter period for decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of razorbills from this SPA will be limited to relatively small areas during the non-breeding periods, with the potential effects also being of a temporary nature.

2528. Based upon the above, it is considered that there is little potential for the Flamborough and Filey Coast SPA razorbill population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

Changes to prey availability

2529. Sandeels are key prey for razorbills, with a range of other species taken including sprat and juvenile herring (del Hoyo *et al*., 1996). Indirect effects on razorbills may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Flamborough and Filey Coast SPA razorbill population in the short-term.

2530. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Flamborough and Filey Coast SPA razorbill population are as for the St Abb's Head to Fast Castle SPA razorbill population (and are detailed above in the equivalent section for that SPA population). Additionally, the potential for effects on the Flamborough and Filey Coast SPA razorbill population is limited to the non-breeding periods when foraging ranges are not constrained by the location of the breeding colonies and the population may be widely distributed across large parts of the North Sea, as well as more southern European waters (Furness 2015, Buckingham *et al.* 2022).

2531. Given this, it is considered that there is little potential for the Flamborough and Filey Coast SPA razorbill population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

Project alone: operation and maintenance

Disturbance

2532. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of razorbills from Flamborough and Filey Coast SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, razorbills are considered to have a moderate sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2533. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2534. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in the Offshore EIA Report, volume 2, chapter 13, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2535. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2536. Given the small, discrete, areas that will be subject intermittently to potential disturbance from vessel use and maintenance activities relative to the large expanses of sea over which this SPA is likely to be distributed during the non-breeding periods (Furness 2015), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

Displacement/barrier effects

2537. As outlined above, displacement effects on the Flamborough and Filey Coast SPA razorbill population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project Alone: Operation and Maintenance – Displacement / Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2538. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on razorbill are estimated for the breeding and non-breeding periods, although in the case of the Flamborough and Filey SPA population it is only the non-breeding period which is relevant (due to the absence of connectivity with the Proposed Development in the breeding period – HRA Stage One Screening Report). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for razorbill are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.
- Non-breeding periods: 60% displacement with lower and upper mortality rates of 1% and 3%.

2539. As with other species for which displacement effects are assessed (see above), the approach to estimating razorbill displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2540. Based upon a consideration of the available evidence for razorbill displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.
- Non-breeding period: 50% displacement with a mortality rate of 1%.

2541. Estimates of razorbill mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Flamborough and Filey Coast SPA razorbill population during the non-breeding periods according to the BDMPS approach (Offshore EIA Report, volume 3, appendix 11.5, Table 5.191, Furness 2015).

Table 5.191: The Mean Peak Abundance Estimates of Razorbill in the Proposed Development Array Area and 2 km Buffer for the Non-Breeding Periods, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Flamborough and Filey Coast SPA Population in Each Period. Breeding Period Data are not shown because there is no Breeding Season Connectivity with the Proposed Development

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			Adults	Immatures	
Autumn migration	8,849	N/A	0.034	0.025	N/A
Winter	1,399	N/A	0.027	0.007	N/A
Spring Migration	7,480	N/A	0.034	0.025	N/A

2542. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA razorbill population as a result of displacement is estimated as 3.5 adult and 2.5 immature birds based on the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as approximately 11 adult and eight immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.192).

2543. The annual mortality from displacement as determined using the Developer Approach is predicted to approximate to a three adult two immature birds, equating to 80% and 26% of the mortality predicted for the lower and upper range of the Scoping Approach, respectively (Table 5.192).

Table 5.192: Estimated Potential Annual Mortality of Flamborough and Filey Coast SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach. There is no Breeding Season Connectivity with the Proposed Development

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	N/A	N/A	N/A	N/A
	Autumn migration	60%	1%	1.8	1.3
	Winter	60%	1%	0.2	0.1
	Spring migration	60%	1%	1.5	1.1
	Annual total	-	-	3.5	2.5
Scoping B	Breeding	N/A	N/A	N/A	N/A
	Autumn migration	60%	3%	5.4	4.0
	Winter	60%	3%	0.7	0.2
	Spring migration	60%	3%	4.6	3.4
	Annual total	-	-	10.7	7.6
Developer	Breeding	N/A	N/A	N/A	N/A
	Autumn migration	50%	1%	1.5	1.1
	Winter	50%	1%	0.0	0.0
	Spring migration	50%	1%	1.3	0.9
	Annual total	-	-	2.8	2.0

2544. The additional annual mortality of adult razorbill from the Flamborough and Filey Coast SPA population predicted due to displacement from the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 37,476 individuals – Table 2.6 in the Offshore EIA Report, volume 3, appendix 11.6) as determined by the Developer Approach, and 0.01 – 0.03% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.090 – see Table 2.19 in the Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of less than 0.1% for the Developer Approach and of 0.1 – 0.3% for the lower and upper estimates from the Scoping Approach.

2545. The potential levels of impact on the Flamborough and Filey Coast SPA razorbill population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered in more detail below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

<u>Changes to prey availability</u>

2546. Potential impacts on key prey species for razorbills breeding at Flamborough and Filey Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect razorbill survival and productivity in the Flamborough and Filey Coast SPA population.

2547. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Flamborough and Filey Coast SPA razorbill population as to the St Abb's Head to Fast Castle SPA razorbill population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA population. In addition, such effects are only relevant to the non-breeding periods for the Flamborough and Filey Coast SPA razorbill population (when birds will be widely distributed across the North Sea and more southern European waters – Furness 2015).

2548. Given this, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA razorbill population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

Project alone: population-level impacts

2549. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Flamborough and Filey Coast SPA razorbill population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2550. Given this, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.192 above). The population model for the SPA population was a stochastic, density independent, matrix model, based upon the demographic parameters specified in Table 2.19 of the Offshore EIA Report, volume 3, appendix 11.6. The starting population size was the 2017 count for the SPA, with the projected population trends considered over a 35 year timescale (Offshore EIA Report, volume 3, appendix 11.5). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for the St Abb's to Fast Castle SPA kittiwake population above (with further details provided in the Offshore EIA Report, volume 3, appendix 11.6).

2551. Outputs from the PVA are summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report) advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The CPS – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;
- The CPGR - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

Table 5.193: Projected 35 Year Population Sizes and Associated PVA Metrics for the Flamborough and Filey Coast SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development Alone

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	192211 (*102337 – 335748*)	*1.000*	1.000	*50.0*
Scoping A	3.78	2.79	191495 (*101951 – 334505*)	0.996	1.000	49.4
Scoping B	11.04	8.04	190137 (*101221 – 332153*)	0.989	1.000	48.4
Developer	3.00	2.17	191647 (*102033 – 334768*)	0.997	1.000	49.5

2552. The PVA predicted that the Flamborough and Filey Coast SPA razorbill population would increase over the 35 year projection period irrespective of the effects from the Proposed Development. Thus, the population is predicted to be five times larger than the current estimate of 37,476 adult birds under all scenarios, including the baseline which assumes no wind farm effects (Table 5.193). Although the predicted increases in population size are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the impact scenarios are small. Whilst the predicted levels of increase are unlikely to occur in reality (and are, in part, a consequence of the absence of any compensatory density dependence within the models – as discussed in the section on *Project Alone: Population-level impacts* for the St Abb's Head to Fast Castle SPA kittiwake population), the prediction for an increasing trend is consistent with the documented long-term trend for this SPA population (see above).

2553. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for the higher mortality rates for the Scoping Approach (B), the CPS value indicates that the displacement effects from the Proposed Development alone would result in a reduction of 1% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.193). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is not detectable (at least when the CPGR is expressed to three decimal places), whilst the centile value of 48.4 indicates a considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years. As would be expected, the metrics as determined from either the lower mortality rates of the Scoping Approach or the Developer Approach suggest even smaller levels of impact (Table 5.193).

2554. For the same reasons as described in the section on *Project-Alone: Population-Level Impacts* for the St Abb's Head to Fast Castle SPA razorbill population, the assessment of the Flamborough and Filey Coast SPA razorbill population incorporates high levels of precaution, which extend beyond the differences between the Developer and Scoping Approaches that are outlined above (and detailed in the Offshore EIA Report, volume 3, appendix 11.4). Notably, the concerns over the extent to which the seasonal mean peak abundances (which provide the basis for the displacement mortality estimates) are likely to be representative of the overall usage of the Proposed Development array and two kilometre buffer by razorbill are also relevant to the Flamborough and Filey Coast SPA population, albeit that this only applies in relation to the non-breeding periods for this SPA population.

Project alone: conclusion

2555. It is considered that the predicted levels of impact from the Proposed Development alone on the Flamborough and Filey Coast SPA razorbill population are of a small scale, as determined by both the Developer and Scoping Approaches. For both the Developer and Scoping Approaches it is also the case that the centile metric indicates a high likelihood of the impacted population being of similar size to the un-impacted population after 35 years. These levels of impact are within the context of an assessment which incorporates high levels of precaution (particularly as determined by the Scoping Approach). Given this, it is concluded that the effects from the Proposed Development alone (as determined by either the Developer or Scoping Approaches) would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2556. As detailed above, any effects from the Proposed Development alone on the Flamborough and Filey Coast SPA razorbill population during construction and decommissioning and resulting from disturbance and changes to prey availability during operation and maintenance will be small and highly localised. As such, there is considered to be no potential for these effect pathways to add to impacts at the population-level that might result from other effects pathways associated with the Proposed Development or from the effects due to other plans and projects.

2557. Therefore, the potential for effects of the Proposed Development to act on the Flamborough and Filey Coast SPA razorbill population in-combination with other plans and projects is limited to the displacement (inclusive of barrier effects) effect pathway during operation and maintenance. The following sections consider these potential effects for the Proposed Development in-combination with the other UK North Sea wind farms.

Displacement/barrier effects – operation and maintenance

2558. To estimate the breeding season displacement mortality for the Flamborough and Filey Coast SPA razorbill population due to the other UK North Sea wind farms, the apportioned breeding season razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were first extracted from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report, annex E of volume 3, appendix 11.6 for more details). No information could be determined on the age distribution of the birds comprising these totals and it was assumed that all were breeding adults from the SPA. Displacement mortality estimates for the breeding season were then calculated by applying the displacement and mortality rates appropriate to the Scoping and Developer Approaches to the apportioned cumulative total number of adults and immatures (see section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the SPA population).

2559. For the non-breeding periods, razorbill numbers associated with other offshore wind farms that are in planning, consented, under construction or in operation were extracted for each of the relevant seasonal periods from the cumulative totals collated for the East Anglia TWO and East Anglia ONE North submissions (MacArthur Green and Royal HaskoningDHV 2021, see Offshore EIA Report, annex E of volume 3, appendix 11.6 for more details). The cumulative numbers for each of the non-breeding periods were apportioned to the Flamborough and Filey Coast SPA razorbill population according to the BDMPS approach (Furness 2015), with the subsequent displacement mortality calculated according to the displacement and mortality rates appropriate to each of the Scoping and Developer Approaches (Table 5.192)

2560. The predicted displacement mortality derived for the other UK North Sea wind farms was combined with that from the Proposed Development to give the in-combination estimates according to both the Scoping and Developer Approaches (Table 5.194).

Table 5.194: Estimated Annual Mortality of Flamborough and Filey Coast SPA Razorbills as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with the other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period: Breeding		Autumn Migration		Winter		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	78.8	0.2	11.0	7.5	4.5	1.1	8.5	5.8	102.8	14.7
	Scoping B	131.3	0.4	33.0	22.6	13.6	3.4	25.5	17.5	203.4	43.9
	Developer	21.9	0.1	9.2	6.3	3.6	0.9	7.1	4.8	41.7	12.1

2561. Incorporating the potential mortality predicted from the displacement effects associated with the other UK North Sea wind farms leads to an 11 to near twentyfold increase in the predicted displacement mortality compared to the Proposed Development alone, with the level of increase least for the Developer Approach and greatest for the lower range of the Scoping Approach (compare Tables 5.194 and 5.192). The breeding period accounts for the majority (i.e. approximately 55 – 70%) of the predicted annual mortality for the Proposed Development in-combination with the other UK North Sea wind farms (with this contribution being highest for the lower range of the Scoping Approach and lowest for the upper range of the Scoping Approach – Table 5.194).

For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult razorbills from the Flamborough and Filey Coast SPA population predicted due to displacement represents between 0.11% of the current adult breeding population at this colony (i.e. 37,476 individuals – Table 2.6 in volume 3, appendix 11.6 of the Offshore EIA Report) as determined by the Developer Approach, and between 0.27 – 0.54% as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.090 – see Table 2.19 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult displacement mortality equate to an increase of 1.2% for the Developer Approach and of 3.0 – 6.0% for the lower and upper estimates from the Scoping Approach.

2562. The potential levels of impact on the Flamborough and Filey Coast SPA razorbill population resulting from the predicted mortality from displacement and barrier effects associated with the Proposed Development in-combination with the other wind farms in the UK North Sea during the operation and maintenance phase are considered in more detail below in the *Effects In-Combination: Population-Level Impacts* section. This presents the outputs from PVAs of the potential effects of predicted displacement mortality on the SPA population.

In-combination: population-level impacts

2563. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the displacement effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.194 above).

2564. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for the Proposed Development alone (see *Project Alone: Population-Level Impacts* section above).

Table 5.195: Projected 35 Year Population Sizes and Associated PVA Metrics for the Flamborough and Filey Coast SPA Razorbill Population Under Different Impact Scenarios for the Proposed Development In-Combination with the other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number Of Breeding Adults In Population (2.5 – 97.5 Centiles)	Counterfactual Of Population Size (CPS)	Counterfactual Of Population Growth Rate (CPGR)	Centile Of Baseline Population Matching Median Of Impacted Population
	Adults	Immatures				
Baseline	*0*	*0*	192211 (102337 – 335748)	*1.000*	1.000	*50.0*
Scoping A	102.78	14.79	178834 (95189 – 312660)	0.930	0.998	41.1
Scoping B	203.34	43.94	165511 (87925 – 289492)	0.861	0.996	32.0
Developer	41.90	12.10	186098 (99093 – 325181)	0.968	0.999	45.7

2565. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with the other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.195 with Table 5.193).

2566. The CPS value for the Developer Approach indicates that the in-combination displacement effects would result in a reduction of 3% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects, whilst for the Scoping Approach the CPS values indicate reductions of 7 – 14% after 35 years, relative to that in the absence of any wind farm effects (Table 5.195). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is 0.1% for the Developer Approach and 0.2 – 0.4% for the Scoping Approach. The centile value of 45.7 for the Developer Approach indicates considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the un-impacted population after 35 years, whilst the values of 32.0 – 41.1 for the Scoping Approach indicate at least a moderate overlap in the distributions and, hence, a reasonable likelihood of the impacted population being of a similar size to the un-impacted population after 35 years (Table 5.195).

In-combination: conclusion

2567. On the basis of the Developer Approach, it is considered that the potential effects from the Proposed Development in-combination with the other UK North Sea wind farms are small, with the population-level impacts predicted to arise from these in-combination effects representing a small increase compared to those predicted due to the Proposed Development alone. It is considered that this level of impact would not result in an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

2568. As would be expected, the Scoping Approach predicts greater levels of effects and consequent population-level impacts than as predicted by the Developer Approach, with the resultant PVA metrics suggestive of small to (at most) moderate levels of impact. This is within the context of an assessment which incorporates a high degree of precaution and a SPA population which has shown a marked (and consistently) long-term increase in size. Given this, it is considered that the levels of impact predicted by the Scoping Approach would not result in an adverse effect on the Flamborough and Filey Coast SPA razorbill population.

Assessment for the puffin population

2569. The Flamborough and Filey Coast SPA puffin population is currently estimated to number 958 individuals, based upon the 2008 count at this colony (Offshore EIA Report, volume 3, appendix 11.5). This represents a substantial decline from earlier counts of 7,000 and 2,615 individuals as recorded in 1987 and 2000, respectively. Subsequent counts from 2017 and 2018 indicate considerably higher numbers of birds attending the colony (approximately 3,000 – 4,000) but these were recorded during the pre-laying period in early April and can only be regarded as providing a broad indication of colony size (Walsh *et al.* 1995).

The potential for impacts on the puffin population

2570. The Proposed Development and two kilometre buffer around the Proposed Development array area[7] do not overlap with the Flamborough and Filey Coast SPA, so that potential impacts on its puffin population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development. Consequently, the main focus of the assessment for this SPA population is concerned with the Conservation Objective of *maintaining or restoring the populations of each qualifying feature*, because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this Conservation Objective (as for *maintaining or restoring the structure and function of the habitats of the qualifying features*, because habitat structure and function would only be considered significant if it caused an adverse effect on the maintenance or restoration of the population of the qualifying features). In terms of the SACOs, this focus is most closely reflected in the attributes concerned with the abundance and diversity of the species assemblage which have the targets of maintaining; (i) the abundance of the breeding seabird assemblage qualifying feature at a level above 216,730 individuals, whilst avoiding deterioration from its current levels; and (ii) the species diversity of the breeding seabird assemblage qualifying feature.

2571. From published information on puffin foraging ranges (Woodward *et al.* 2019), puffins from the Flamborough and Filey Coast SPA could possibly occur within the area of the Proposed Development and of the two km buffer around the Proposed Development array area during the breeding period. However, the distance from the Proposed Development to the SPA as measured over sea (as opposed to the straight-line distance) is approximately 260 km and, as such, is close to likely limits of the breeding season foraging range of puffin (i.e. 265.4 km based upon the mean maximum foraging range plus 1 SD – Woodward *et al*. 2019). This is reflected in the findings of the apportioning exercise, which estimates that 0.1% of the puffins occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance.

2572. After the breeding season puffin migrate rapidly from their UK breeding areas, leaving the seas immediately adjacent to their colonies by late August and dispersing widely across north-west European seas and the Atlantic (Wernham *et al.* 2002, Harris and Wanless 2011, Stone *et al.* 1995, Jessopp *et al.* 2013). Consequently (and as advised in the NatureScot scoping advice - volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

Project alone: construction and decommissioning

Disturbance

2573. Direct disturbance to puffins during the construction phase may arise within the Proposed Development array area (and its immediate vicinity) as a result of increased vessel movements and helicopter activity, as well as from other activities directly associated with the installation of the wind turbine foundations and other infrastructure, whilst there will also be increased vessel activity along the Proposed Development export cable corridor due to the cable laying activities. The levels of such activities that could arise are outlined in Table 4.1, with these activities occurring during construction campaigns within a construction period of at most eight years duration.

2574. A total of up to 11,482 vessel round trips may occur over the construction phase, whilst it is estimated that a maximum of 134 vessels could occur within the area of the Proposed Development at any one time (Table 4.1). However, this is within the context of high baseline levels of vessel traffic within this area (e.g. surveys recorded an average of 14 vessels per day within a 10 nm buffer around the Proposed Development over a 14-day period in August 2022, whilst also showing an average of three to four vessels intersecting the Proposed Development array area per day over summer – Offshore EIA Report, volume 2, chapter 13).

2575. When using the marine environment (and not at the breeding colony), puffins are considered to have a relatively low sensitivity to such sources of direct disturbance. Thus, reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic assign puffin as '2' on a five-scale ranking system, where 1 indicates hardly any or limited escape/avoidance behaviour and very short flight distance when approached and 5 indicates strong escape/avoidance behaviour and a large response distance (Garthe and Hüppop 2004, Furness *et al.* 2013).

2576. The total area to be affected by such disturbance over the full eight years of the construction phase also represents a small proportion of the total area of marine habitat available to puffins from the Flamborough and Filey Coast SPA. Thus, the Proposed Development array area encompasses 1,010 km^2, whilst the Proposed Development export cable corridor encompasses 168 km^2. Together these areas represent approximately 1% of the total breeding season foraging area that is potentially available to the SPA puffin population, as defined by the generic measure of the species' mean maximum breeding season foraging range plus 1 SD (i.e. 137.1±128.3 km - Woodward *et al.* 2019) and assuming that this range is represented by a semicircle to the seaward side of the colony. Similarly, the Proposed Development array and export cable corridor represent approximately 4% of the breeding season foraging area if considering the mean maximum foraging range only.

2577. In addition to the above, it is important to consider that the construction activities will not occur simultaneously across the entirety of the Proposed Development array area or the Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, the activities will be concentrated within discrete (often small) parts of these wider areas, and within such areas they will not extend over the full duration of the construction phase, so further reducing the potential to which birds may be subject to disturbance effects. For example, cable laying for the Proposed Development export cable will occur over a total of two years, whilst within the Proposed Development array area it is likely that construction activities would be confined largely to discrete areas at any one time.

2578. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2579. Given the relatively low sensitivity of puffin to disturbance effects, the large distance of the Proposed Development from the SPA (relative to the estimated puffin foraging range), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

Displacement

2580. As detailed above, puffin is considered to have a relatively low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will (at most) only extend across a small part of the wider foraging areas used by the Flamborough and Filey Coast SPA puffin population and be limited to (at most) an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area or Proposed Development export cable corridor but, rather, will be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffins from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2581. Based upon the above, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA puffin population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

Changes to prey availability

2582. Sandeels are key prey for puffins, with a range of other species taken including clupeids and gadids (del Hoyo *et al*., 1996). Indirect effects on puffins may arise as a result of changes in the availability, distribution, or abundance of these species during the construction and decommissioning phases of the Proposed Development. Reduction or disruption to prey availability may cause displacement from foraging grounds or reduced energy intake, affecting survival rates or productivity in the Flamborough and Filey Coast SPA puffin population in the short-term.

2583. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The evidence base and context for assessing the potential for such effects to have impacts on the Flamborough and Filey Coast SPA puffin population are as for the Forth Islands SPA puffin population (with the exception that tracking data are not available to inform the foraging ranges used by the Flamborough and Filey Coast birds). These details are presented above in equivalent section for the Forth

Islands SPA puffin population. Additionally, the relatively large distance of the Proposed Development from the Flamborough and Filey Coast SPA is relevant because it reduces the likelihood that puffins from this SPA will use the Proposed Development (volume 3, appendix 11.5).

2584. Given this, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

Project alone: operation and maintenance

Disturbance

2585. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of puffins from Flamborough and Filey Coast SPA. As described in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the SPA population, puffins are considered to have a low sensitivity to such sources of direct disturbance at sea (Garthe and Hüppop 2004, Furness *et al*., 2013).

2586. The maximum design scenario is for up to 3,393 vessel round trips per year over the operational lifetime of the project. Vessel types which will be required during the operation and maintenance phase include those used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys (Table 4.1).

2587. Based on information presented in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St Abb's Head to Fast Castle SPA kittiwake population and in volume 2, chapter 13 of the Offshore EIA Report, baseline levels of vessel traffic in the Offshore Ornithology study area are relatively high. In the context of the baseline levels of vessel traffic across the Offshore Ornithology study area, the increase during the operation and maintenance phase is considered to be relatively small. Vessel movements will be within the Proposed Development array area and export cable corridor and will follow existing shipping routes to/from ports. In addition, Project Codes of Conduct included as a part of the NSVMP (Offshore EIA Report, volume 4, appendix 25) will be issued to all project vessel operators to avoid sudden changes in course or speed which will minimise the potential for disturbance. Within the Proposed Development array area, movements and associated maintenance activities will be restricted to individual wind turbines over a period of days to weeks.

2588. The size and noise outputs from vessels during the operation and maintenance phase will be similar to those used in the construction phase. However, the number of vessel return trips per year and their frequency will be much lower for the operation and maintenance phase compared to the construction phase. In addition, activities during the operation and maintenance phase will not occur simultaneously across the entirety of the Proposed Development array area and export cable corridor but intermittently within discrete (often very small) parts of these wider areas.

2589. Given the discrete areas relative to the species' foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities (Woodward *et al*., 2019), and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

Displacement/barrier effects

2590. As outlined above, displacement effects on the Flamborough and Filey Coast SPA puffin population are estimated using the SNCB matrix approach, as applied to the Proposed Development array and two kilometre buffer (SNCBs 2022, Offshore EIA Report, volume 3, appendix 11.4). Thus, throughout this section, mortality from displacement is assumed to refer to that which results from both displacement and barrier effects. The approach used to derive predicted levels of mortality is as described in the section on *Project alone: operation and maintenance – displacement/barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population above (and in the Offshore EIA Report, volume 3, appendix 11.4).

2591. On the basis of the advice provided in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report), displacement effects on puffin are estimated for the breeding period only (see above). The displacement and associated mortality rates advised in the Scoping Opinion (subsequently termed the Scoping Approach) for puffin are:

- Breeding period: 60% displacement with lower and upper mortality rates of 3% and 5%.

2592. As with other species for which displacement effects are assessed (see above), the approach to estimating puffin displacement effects advocated by the Scoping Opinion was considered overly precautionary in relation to both the displacement and mortality rates that were proposed, with these rates being higher than is considered to be justified on the basis of the available evidence (even when allowing for the incorporation of precaution in the assessment - volume 3, appendix 11.4, annex G of the Offshore EIA Report). Furthermore, the mortality rates advocated by the Scoping Opinion represented a marked change from the assumptions applied in assessments for other recent Scottish offshore wind farms (Marine Scotland 2017a,b,c) with no clear evidence apparently being available to justify such a change.

2593. Based upon a consideration of the available evidence for puffin displacement, the potential consequent mortality, previous precedent and a need to incorporate precaution within the assessment, an alternative Developer Approach to estimating displacement effects was determined (volume 3, appendix 11.4, annex G of the Offshore EIA Report). The rates adopted by the Developer Approach are:

- Breeding period: 50% displacement with a mortality rate of 1%.

2594. Estimates of puffin mortality were produced using the SNCB matrix on the basis of both the Scoping Approach and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Flamborough and Filey Coast SPA puffin population during the breeding season according to the NatureScot (2018) approach (Offshore EIA Report, volume 3, appendix 11.5, Table 5.196). The resulting mortality estimates for the breeding season were apportioned to age classes on the basis of the asymptotic age distribution of the population model used for the Farne Islands SPA puffin PVAs in this assessment (volume 3, appendix 11.6 of the Offshore EIA Report), noting that no population model was produced for the Flamborough and Filey Coast SPA puffin population. Based on advice provided by NatureScot and Marine Scotland Science following Roadmap Meeting 4 (G. Holland, email 26/01/2022), it was also assumed that 7% of the breeding adults in the SPA population miss breeding in any given year (i.e. sabbatical birds) so that the number of estimated adult deaths during the breeding season was adjusted accordingly.

Table 5.196: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer During the Breeding Season, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Flamborough and Filey Coast SPA Population

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion Of Sabbatical Adults
			ADULTS	IMMATURES	
Breeding	4,513	0.443	0.001	0.001	0.07

2595. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA puffin population as a result of displacement is estimated as fewer than 0.1 adult and 0.1 immature birds for both the Developer and Scoping Approaches (Table 5.197).

Table 5.197: Estimated Potential Annual Mortality of Flamborough and Filey Coast SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.03	0.05
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.03	0.05
Scoping B	Breeding	60%	5%	0.06	0.08
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.06	0.08
Developer	Breeding	50%	1%	0.01	0.01
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.01	0.01

2596. The additional annual mortality of adult puffin from the Flamborough and Filey Coast SPA population predicted due to displacement from the Proposed Development array represents less than 0.01% of the current adult breeding population at this colony (i.e. 958 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by either the Developer or Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 as derived for the Forth Islands SPA puffin population – see Table 2.17 in volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of less than 0.1% for either the Developer or Scoping Approach.

2597. The predicted additional annual mortality of puffins from the Flamborough and Filey Coast SPA population as a result of displacement from the Proposed Development array and two kilometre buffer represents small fractions of an individual bird (by either the Developer or Scoping Approaches). This translates into very small levels of effect which would be highly unlikely to lead to any detectable population-level impacts. Consequently, it is considered that there is no potential for displacement and barrier effects from the Proposed Development alone during operation and maintenance to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

<u>Changes to prey availability</u>

2598. Potential impacts on key prey species for puffins breeding at Flamborough and Filey Coast SPA during the operation and maintenance phase have been assessed in volume 2, chapter 9 of the Offshore EIA Report using the appropriate maximum design scenarios for these receptors. Reduction or disruption to prey availability through temporary and long-term subtidal habitat loss/disturbance, increased SSC and deposition, reductions in water clarity, EMF from subsea electrical cabling, and colonisation of subsea structures, could affect puffin survival and productivity in the Flamborough and Filey Coast SPA population.

2599. The same evidence basis and context in relation to this effect pathway for the operation and maintenance phase applies to the Flamborough and Filey Coast SPA puffin population as to the Forth Islands SPA puffin population. This is detailed in the section on *Project Alone: Operation and Maintenance – Changes to Prey Availability* for the Forth Islands SPA population.

2600. Given this, it is considered that there is relatively little potential for the Flamborough and Filey Coast SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

<u>Project alone: conclusion</u>

2601. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Flamborough and Filey Coast SPA puffin population are predicted to be very small and highly unlikely to any detectable to any detectable population-level impacts. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population (with this conclusion being irrespective of whether these effects are determined by the Scoping or Developer Approach.

<u>Effects In-combination</u>

2602. The effects from the Proposed Development alone on the Flamborough and Filey Coast SPA puffin population during the construction, operation and maintenance and decommissioning phases will be, at most, small and highly localised. It is considered highly unlikely that these effects have the potential to lead to any detectable population-level impacts.

2603. Therefore, it is concluded that there is no potential for effects of the Proposed Development in-combination with other plans and projects to lead to an adverse effect on the Flamborough and Filey Coast SPA puffin population.

Assessment for the breeding seabird assemblage

2604. The breeding seabird assemblage for the Flamborough and Filey Coast SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation stating that the SPA supports 216,730 individual seabirds). Puffin is amongst the species identified as a named component of the assemblage, whilst gannet, kittiwake, guillemot and razorbill are all qualifying features in their own right.

2605. Potential impacts of the Proposed Development alone and in-combination with the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature, such that the SACOs to (i) maintain the abundance of the breeding seabird assemblage qualifying feature at a level above 216,730 individuals, whilst avoiding deterioration from its current levels; and (ii) maintain the species diversity of the breeding seabird assemblage qualifying feature are not achieved.

2606. The assessments for both the Developer Approach and the Scoping Approach identify the potential for an adverse effect on the SPA kittiwake population in relation to the Proposed Development in-combination with the other UK North Sea wind farms. The potential impact on the SPA kittiwake population is not considered likely to lead to a risk of this population being lost from the breeding seabird assemblage at the Flamborough and Filey Coast SPA, on the basis of the large size of this population, the limited scale of the predicted impact (relative to the population size) and the (slightly) increasing trend in population size over the last 15 – 20 years (at least). Also, given the range of species present within the SPA seabird assemblage and their relative abundances, the potential adverse effect on the SPA kittiwake population is not considered to be sufficient to result in an adverse effect on the seabird assemblage via reductions in the overall abundance of this assemblage

2607. No potential for an adverse effect is identified in relation to any of the other SPA qualifying features or named components of the assemblage qualifying feature.

2608. Therefore, it is concluded that there is no potential for an adverse effect on the breeding seabird assemblage feature, irrespective of whether the effects are determined by the Scoping or Developer Approach.

Site conclusion

2609. For both the Developer Approach and Scoping Approach, it is concluded that the possibility of an adverse effect cannot be discounted for the Flamborough and Filey Coast SPA breeding kittiwake qualifying feature. The potential for an adverse effect arises from the Proposed Development in-combination with the other UK North Sea wind farms.

2610. Consequently, it is concluded that an Adverse Effects on Integrity of the Flamborough and Filey Coast SPA cannot be excluded due to effects of the Proposed Development in-combination with other plans and projects (as determined by both the Developer and Scoping Approaches).

5.7.9. COQUET ISLAND SPA

European site information and conservation objectives

2611. Coquet Island is located 1 km off the coast of Northumberland in north-east England and approximately 96 km from the Proposed Development. It is a small, flat-topped island with a plateau extent of approximately 7 ha. Coquet Island SPA was first classified in 1985 for its breeding seabirds, with the surrounding marine environment protected by the Northumberland Marine SPA, which was classified in 2017 to protect the foraging areas of these birds.

2612. The site qualifies by regularly supporting four annex I qualifying features, and in excess of 20,000 breeding seabirds. The assemblage comprises six additional named component species (Table 5.198). The potential for LSE has been identified in relation to four of these six qualifying features (Table 5.198), with the effect pathways associated with LSE for each of these detailed in Table 3.1and set out in the assessment below.

2613. The conservation objectives of this SPA (as determined through Natural England's Access to Evidence) are to:

- Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
  - *The extent and distribution of the habitats of the qualifying features;*
  - *The structure and function of the habitats of the qualifying features;*
  - *The supporting processes on which the habitats of the qualifying features rely;*
  - *The populations of each of the qualifying features; and*
  - *The distribution of qualifying features within the site.*

2614. The Proposed Development does not overlap with Coquet Island SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2615. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2616. Further information on this European site is presented in appendix 3A.

Table 5.198 Details on the Qualifying Features of the Coquet Island SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Not available	47,662 individuals	Yes
Kittiwake*	Breeding	Not available	Not available	Yes
Black-headed gull*	Breeding	Not available	7,772 individuals	No
Herring gull*	Breeding	Not available	Not available	No
Lesser black-backed gull*	Breeding	Not available	Not available	Yes
Sandwich tern	Breeding	Not available	2,600 individuals	No
Roseate tern	Breeding	Not available	160 individuals	No
Common tern	Breeding	Not available	2,378 individuals	No
Arctic tern	Breeding	Not available	2,460 individuals	No
Puffin*	Breeding	Not available	31,686 individuals	Yes
Fulmar*	Breeding	Not available	Not available	No

*Named components of the assemblage only.

Assessment for the kittiwake population

2617. The Coquet Island SPA kittiwake population is currently estimated to number 466 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2021. Kittiwake are listed on the Coquet SPA citation as a named component of the breeding seabird assemblage.

2618. Potential impacts on the Coquet Island SPA kittiwake population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the kittiwake population

2619. The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance. From published information on kittiwake foraging ranges generally (Woodward *et al*., 2019) it is apparent that during the breeding period kittiwakes from Coquet Island SPA could occur in the vicinity of the Proposed Development. However, the findings of the apportioning exercise found that no kittiwakes occurring in the Proposed Development array area during the breeding season derived from this SPA (Offshore EIA Report volume 3, appendix 11.5).

2620. In the non-breeding season kittiwakes are largely pelagic (Frederiksen *et al*., 2011), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the Coquet Island SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively - Furness 2015; NatureScot 2020; Offshore EIA Report volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Coquet Island SPA kittiwake population during the non-breeding passage periods only (Offshore EIA Report volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

2621. Direct disturbance to kittiwakes during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population; Table 4.1).

2622. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2623. Kittiwakes breeding at the Coquet Island SPA are not predicted to utilise the Proposed Development during the breeding season (Offshore EIA Report volume 3, appendix 11.5). During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2624. Furthermore, given the low sensitivity of kittiwake to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Coquet Island SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Offshore EIA Report, volume 2, chapter 11).

Displacement

2625. As detailed above, kittiwake is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the Coquet Island SPA kittiwake population during the non-breeding season. Furthermore, as detailed in see the section on *Project Alone: Construction and Decommissioning – Displacement* for St. Abb's Head to Fast Castle kittiwake population, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwake from this SPA during the non-breeding periods will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2626. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Coquet Island SPA kittiwake population.

Changes to prey availability

2627. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Coquet Island SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2628. Given this, it is considered that there is relatively little potential for the Coquet Island SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Coquet Island SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2629. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Coquet Island SPA during the non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Coquet Island SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2630. Given the discrete areas relative to the species' non-breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Coquet Island SPA kittiwake population.

Displacement/Barrier effects

2631. The approach used to derive predicted levels of mortality for Coquet Island SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report, volume 3, appendix 11.4)

2632. Estimates of kittiwake mortality for Coquet Island SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Coquet Island SPA kittiwake population as described in Offshore EIA Report, volume 3, appendix 11.5 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and according to the apportioning estimates in Table 5.199).

Table 5.199: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Coquet Island SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	Spa Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.000	0.000	0.10
Autumn migration	11,190	N/A	0.001	0.000	N/A
Spring migration	13,766	N/A	0.001	0.000	N/A

Table 5.200: Estimated Potential Annual Mortality of Coquet Island SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	0.0	0.0
	Spring migration	30%	1%	0.0	0.0
	Annual total	-	-	0.1	0.0
Scoping B	Breeding	30%	3%	0.0	0.0
	Autumn migration	30%	3%	0.1	0.0
	Spring migration	30%	3%	0.1	0.0
	Annual total	-	-	0.2	0.0
Developer	Breeding	30%	2%	0.0	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

2633. The potential annual mortality as a result of displacement is estimated as 0.1 adult and 0.0 immature birds based on Scoping Approach A and as 0.2 adult and 0.0 immature birds based Scoping Approach B (Table 5.200). All mortality was attributable to the non-breeding periods.

2634. No mortality from displacement was predicted using the Developer Approach for any age class or season Table 5.200).

2635. The additional annual mortality of adult kittiwakes from the Coquet Island SPA population predicted due to displacement from the Proposed Development array area represents 0.01% of the current adult breeding population at this colony (i.e. 932 individuals – Table 3.3 in volume 3, appendix 11.5 of Offshore EIA Report) as determined by Scoping Approach A, and 0.02% as determined by Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 of Offshore EIA Report, volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.07 – 0.15% for the lower and upper estimates from the Scoping Approach. As outlined above and in Table 5.200, no mortality was predicted using the Developer Approach.

2636. The potential levels of impact on the Coquet Island SPA kittiwake population resulting from predicted displacement/barrier effects associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

<u>Collision risk</u>

2637. The approach used to derive predicted levels of mortality for Coquet Island SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Collision Risk* for the St Abb's Head to Fast Castle SPA kittiwake population (and in the Offshore EIA Report2, volume 3, appendix 11.3)

2638. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of kittiwakes from the Coquet Island SPA is predicted to be approximately 0.4 adults and 0.0 immatures as determined by the Scoping Approach, and approximately 0.3 adults and 0.0 immatures as determined by the Developer Approach (Table 5.201). All mortality was attributable to the non-breeding periods.

Table 5.201: Predicted Collision Effects from the Proposed Development on the Coquet Island SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate

Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
Scoping	Breeding	0.0	0.0
	Autumn migration	0.2	0.0
	Spring migration	0.2	0.0
	Annual total	0.4	0.0
Developer	Breeding	0.0	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.2	0.0
	Annual total	0.3	0.0

2639. The additional annual mortality of adult kittiwakes from the Coquet Island SPA population predicted due to collision represents approximately 0.03% of the number of adults currently estimated to breed at this colony (i.e. 932 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.04% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.145 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.22% and 0.30% for the Developer and Scoping Approaches, respectively.

2640. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Coquet Island SPA kittiwake population that are at least 50% lower than those presented in Table 5.201 above (and on which the assessment is based).

2641. The potential levels of impact on the Coquet Island SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population

Changes to prey availability

2642. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Coquet Island SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2643. Given this, it is considered that there is relatively little potential for the Coquet Island SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Coquet Island SPA kittiwake population.

Project alone: population-level impacts

2644. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Coquet Island SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase.

2645. PVA was therefore undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.200 and Table 5.201 above). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2021 count for the SPA (Offshore EIA Report, volume 3, appendix 11.5).

Table 5.202: Projected 35 Year Population Sizes and Associated PVA Metrics for the Coquet Island SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development Alone

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	1995 (960 – 3977)	1.000	1.000	50.0
	Scoping A	0.49	0.00	1969 (947 – 3928)	0.987	1.000	48.4
	Scoping B	0.64	0.00	1962 (943 – 3911)	0.983	1.000	47.9
	Developer	0.30	0.00	1979 (952 – 3947)	0.992	1.000	49.0

2646. The PVA predicted a continuing population increase for the Coquet Island SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, the population is predicted to be twice as large as the current estimate of 932 adult birds under all scenarios, including baseline which assumes no wind farm effects (Table 5.202). Although the predicted increases are inevitably greatest for the baseline scenario (because the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population), the differences with the various impact scenarios are small.

2647. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 1.7% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.202). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be zero, whilst the centile value of 47.9 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest even smaller levels of impact (Table 5.202).

Project alone: conclusion

2648. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Coquet Island SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. The PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2649. For the same reasons as described in *Effects In-Combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, the potential for effects of the Proposed Development to act on the Coquet Island

SPA kittiwake population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

2650. In-combination totals have been collated for all relevant SPA populations for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning (Offshore EIA Report, volume 3, appendix 11.6, annex E). Separate in-combination totals for the Forth and Tay projects were not collated for the reasons outlined in *Effects In-Combination* for the Farne Islands SPA kittiwake population, volume 3, appendix 11.6, annex E and volume 3, appendix 11.8 of the Offshore EIA Report.

Displacement/Barrier effects – operation and maintenance

2651. The approach and methods for estimating in-combination displacement mortality are described in *Effects In-combination: Displacement/Barrier Effects – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2652. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.203).

Table 5.203: Estimated Annual Mortality of Coquet Island SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.0	0.0	0.1	0.1	0.2	0.1	0.3	0.1
	Scoping B	0.0	0.0	0.4	0.2	0.6	0.2	1.0	0.4
	Developer	0.0	0.0	N/A	N/A	N/A	N/A	0.0	0.0

2653. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Coquet Island SPA population predicted due to displacement represents between approximately 0.03-0.1% of the current adult breeding population at this colony (i.e. 932 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.22 – 0.74% for the lower and upper estimates from the Scoping Approach.

2654. The potential levels of impact on the Coquet Island SPA kittiwake population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

2655. The approach and methods for estimating in-combination collision mortality are described in *Effects In-combination: Collision – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2656. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.204).

Table 5.204: Predicted Collision Effects on the Coquet Island SPA Kittiwake Population due to the Proposed Development In-Combination with Other Projects in the UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.0	0.0
		Autumn migration	0.8	0.3
		Spring migration	1.0	0.3
		Annual total	1.8	0.6
	Developer	Breeding	0.0	0.0
		Autumn migration	0.7	0.3
		Spring migration	0.9	0.3
		Annual total	1.6	0.6

2657. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Coquet Island SPA population predicted due to collisions represents 0.17% of the current adult breeding population at this colony (i.e. 932 individuals – Table 3.3 in Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and 0.19% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 1.18% for the Developer Approach and of 1.33% for the Scoping Approach

2658. The potential levels of impact on the Coquet Island SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

2659. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.203 and Table 5.204 above).

2660. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-combination: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6 of the Offshore EIA Report.

Table 5.205: Projected 35 Year Population Sizes and Associated PVA Metrics for the Coquet Island SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other UK North Sea Wind Farms

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	1995 (960 – 3977)	1.000	1.000	50.0
	Scoping A	2.09	0.80	1863 (895 – 3718)	0.934	0.998	42.4
	Scoping B	2.74	1.10	1822 (875 – 3634)	0.913	0.997	40.1
	Developer	1.70	0.70	1885 (906-3761)	0.945	0.998	43.4

2661. The predicted in-combination population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. For Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 8.7% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.205). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.003, whilst the centile value of 40.1 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest even smaller levels of impact (Table 5.205).

<u>In-combination: conclusion</u>

2662. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Coquet Island SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Coquet Island SPA kittiwake population.

Assessment for the lesser black-backed gull population

2663. The Coquet Island SPA lesser black-backed gull population is currently estimated to number 20 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2019. Lesser black-backed gull are listed on the Coquet SPA citation as a named component of the breeding seabird assemblage.

2664. Potential impacts on the Coquet Island SPA lesser black-backed population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

<u>The potential for impacts on the lesser black-backed gull population</u>

2665. The breeding period for lesser black-backed gull is defined as mid-March to August, following NatureScot (2020). From published information on lesser black-backed gull foraging ranges generally (Woodward *et al.* 2019), it is possible that during the breeding period lesser black-backed gulls from the Coquet Island SPA occur within the Proposed Development array area and 2 km buffer. This is supported by the findings of the apportioning exercise, which estimates that 0.2% of the lesser black-backed gulls occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

2666. In the non-breeding season lesser black-backed gulls from Coquet Island SPA migrate south through the southern North Sea, undertaking the return journey in spring. Therefore, there is the potential for birds from Coquet Island SPA to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to October and the first half of March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015; NatureScot 2020; Offshore EIA Report, volume 3, appendix 11.5), and to a lesser extent in winter as well (defined as November to February – Furness 2015). Given the above, the Proposed Development may have potential effects on the Forth Islands SPA lesser black-backed gull population during breeding and non-breeding periods.

<u>Project alone: construction and decommissioning</u>

<u>Changes to prey availability</u>

2667. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA lesser black-backed gull population. The same evidence basis and context applies to the Coquet Island SPA lesser black-backed gull population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2668. Given this, it is considered that there is relatively little potential for the Coquet Island SPA lesser black-backed gull population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Coquet Island SPA lesser black-backed gull population.

<u>Project alone: operation and maintenance</u>

<u>Collision risk</u>

2669. The approach used to derive predicted levels of mortality for Coquet Island SPA lesser black-backed gulls is as described in the section on *Project Alone: Operation and Maintenance – Collision Risk* for the Forth Islands SPA lesser black-backed gull population (and in Offshore EIA Report, volume 3, appendix 11.3).

2670. Based upon option 2 of the deterministic CRM with a 99.5% avoidance rate applied, the annual collision mortality of lesser black-backed gulls from the Coquet Islands SPA is predicted to be 0.01 adults and zero immatures as determined by both the Scoping Approach and Developer Approach (Table 5.206).

Table 5.206: Predicted Collision Effects from the Proposed Development on the Coquet Island SPA Lesser Black-Backed Gull Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 99.5% Avoidance Rate (See Text).

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.01	0.00
	Autumn migration	0.00	0.00
	Winter	0.00	0.00
	Spring migration	0.00	0.00
	Annual total	0.01	0.00
Developer	Breeding	0.01	0.00
	Autumn migration	0.00	0.00
	Winter	0.00	0.00
	Spring migration	0.00	0.00
	Annual total	0.01	0.00

2671. Additional annual collision mortality of adult lesser black-backed gulls from the Coquet Island SPA represents approximately 0.03% of the breeding population for both the Scoping and Developer Approaches (i.e. 40 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report). Predicted adult collision mortality equates to an increase of 0.29% of the baseline annual adult mortality of the population (based on a mortality rate of 0.087 – see Table 2.14 in the volume 3, appendix 11.6 of the Offshore EIA Report)

2672. The potential levels of impact on the Coquet Island SPA lesser black-backed gull population resulting from predicted collision mortality associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of collision mortality on the SPA population

Changes to prey availability

2673. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA lesser black-backed gull population. The same evidence base and context applies to the Coquet Island SPA lesser black-backed gull population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2674. Given this, it is considered that there is little potential for the Coquet Island SPA lesser black-backed gull population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Coquet Island SPA lesser black-backed gull population.

Project alone: population-level impacts

2675. As determined above, the effect from the Proposed Development alone which could lead to an adverse effect on the Coquet Island SPA lesser black-backed gull population is collision mortality during the operation and maintenance phase. PVA was therefore undertaken. The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Population-Level Impacts* for Forth Islands SPA lesser black-backed gull population above and in volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2019 count for the SPA (Offshore EIA Report, volume 3, appendix 11.5).

Table 5.207: Projected 35 Year Population Sizes and Associated PVA Metrics for the Coquet Island SPA Lesser Black-Backed Gull Population Under Different Impact Scenarios for the Proposed Development Alone.

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	13 (4 - 43)	1.000	1.000	50.0
	Scoping	0.01	0.00	13 (4 - 43)	0.995	1.000	49.5
	Developer	0.01	0.00	13 (4 - 43)	0.996	1.000	49.6

2676. The predicted population-level impacts are negligible, irrespective of whether these are determined using the Developer or Scoping Approach. The Scoping Approach CPS value indicates that the collision mortality associated with the Proposed Development alone would not result in a reduction of approximately 0.5% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.207). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be zero, whilst the centile value of 49.5 indicates significant overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact (Table 5.207).

Project alone: conclusion

2677. For both the Developer and Scoping Approach, the potential effects from the Proposed Development alone on the Coquet Island SPA lesser black-backed gull population are predicted to be negligible, with the resultant population-level impacts also predicted to be negligible. The PVA metrics indicate a very high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2678. For the same reasons as described in *Effects In-Combination* for the Forth Islands SPA lesser black-backed gull population, the potential for effects of the Proposed Development to act on the Coquet Island SPA lesser black-backed gull population in-combination with other plans and projects is limited to collision risk during operation and maintenance. For the Coquet Island SPA lesser black-backed gull population, potential effects of collision are limited to the breeding season.

Collision risk - operation and maintenance

2679. Existing assessments for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning were checked to determine the collision estimates to be attributed to the Coquet Island SPA lesser black-backed gull population (Offshore EIA Report, volume 3, appendix 11.6, annex E).

2680. Following the approach to estimating in-combination mortalities as outlined in volume 3, appendix 11.6, annex E of the Offshore EIA Report, there are no projects considered to have effects on the Coquet Islands SPA lesser black-backed gull population during the breeding season. Therefore, it is assumed that existing in-combination effects are inconsequential to this feature and that, in line with conclusions for the project alone, in-combination population-level impacts resulting from predicted collision mortality are negligible.

In-combination: conclusion

2681. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Coquet Island SPA lesser black-backed gull population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the puffin population

2682. The Coquet Island SPA puffin population is currently estimated to number 25,029 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2019. Puffin are listed on the Coquet SPA citation as a named component of the breeding seabird assemblage, with a citation population size of 31,636 individuals, thus the numbers currently breeding on Coquet Island show an increase in the population since designation.

2683. Potential impacts on the Coquet Island SPA puffin population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the puffin population

2684. The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance. From published information on puffin foraging ranges generally (Woodward *et al.* 2019) it is possible that during the breeding period puffin from Coquet Island SPA occur within the Proposed Development and 2 km buffer. This is supported by the findings of the apportioning exercise, which estimates that 11% of the puffin occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

2685. As advised in the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

Project alone: construction and decommissioning

Disturbance

2686. As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the Forth Island SPA puffin population, direct disturbance to puffins during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see section 4.5; Table 4.1).

2687. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2688. Given the relatively low sensitivity of puffin to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Coquet Island SPA puffin population.

Displacement

2689. As detailed above, puffin is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the Coquet Island SPA puffin population during the breeding season. Furthermore, as detailed above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffin from this SPA during the breeding period will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2690. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Coquet Island SPA puffin population.

Changes to prey availability

2691. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence basis and context applies to the Coquet Island SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2692. Given this, it is considered that there is relatively little potential for the Coquet Island SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Coquet Island SPA puffin population.

Project alone: operation and maintenance

Disturbance

2693. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of puffins from Coquet Island SPA during the breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA puffin population. The same evidence base and context applies to the Coquet Island SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2694. Given the discrete areas relative to the species' breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Coquet Island SPA puffin population.

Displacement/Barrier effects

2695. The approach used to derive predicted levels of mortality for Coquet Island SPA puffins is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA puffin population (and in the Offshore EIA Report, volume 3, appendix 11.4)

2696. Estimates of puffin mortality for Coquet Island SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report volume 3, appendix 11.4), with these estimates then apportioned to the Coquet Island SPA puffin population as described in the Offshore EIA Report, volume 3, appendix 11.5 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier Effects* for the Forth Islands SPA puffin population (Table 5.208).

Table 5.208: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Coquet Island SPA Population in Each period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is Also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,513	0.443	0.106	0.106	0.07
Non-breeding	N/A	N/A	N/A	N/A	N/A

2697. The potential annual mortality as a result of displacement is estimated as 3.6 adults and 4.9 immatures based on Scoping Approach A and as 6.0 adults and 8.1 immatures based Scoping Approach B (Table 5.209). All mortality was attributable to the non-breeding periods. For the Developer Approach, annual displacement mortality was estimated as 1.0 adult and 1.4 immatures (Table 5.209).

Table 5.209: Estimated Potential Annual Mortality of Coquet Island SPA Puffins as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	3.6	4.9
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	3.6	4.9
Scoping B	Breeding	60%	5%	6.0	8.1
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	6.0	8.1
Developer	Breeding	50%	1%	1.0	1.4
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	1.0	1.4

2698. The additional annual mortality of adult puffins from the Coquet Island SPA population predicted due to displacement from the Proposed Development array area represents 0.007% of the current adult breeding population at this colony (i.e. 50,058 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by Scoping Approach A, 0.012% as determined by Scoping Approach B, and 0.002% as determined by the Developer Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.099 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.02% for the Developer Approach and of 0.07 – 0.12% for the lower and upper estimates from the Scoping Approach.

2699. Further consideration of the potential population-level impacts associated with the predicted displacement/barrier effect mortalities in Table 5.209 is undertaken below in the *Project Alone: Population-Level Impacts* section.

Changes to prey availability

2700. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence base and context applies to the Coquet Island SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2701. Given this, it is considered that there is relatively little potential for the Coquet Island SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Coquet Island SPA puffin population.

Project alone: population-level impacts

2702. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA puffin population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2703. As described in volume 3, appendix 11.6 of the Offshore EIA Report, PVAs were run for populations where the predicted wind farm associated mortality increased the baseline mortality rate by at least 0.02 percentage point (Offshore EIA Report, volume 3, appendix 11.8). Predicted displacement mortality for the Coquet Island SPA puffin population did not exceed this threshold under any approach and as such, PVA was not undertaken. Accordingly, it is considered that there is no potential for operation or maintenance related displacement/barrier effects to lead to an adverse effect on the Coquet Island SPA puffin population.

Project alone: Conclusion

2704. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Coquet Island SPA puffin population are predicted to be very small, with the resultant population-level impacts also predicted to be very small. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2705. For the same reasons as described in *Effects in-combination* for the Forth Islands SPA puffin population, the potential for effects of the Proposed Development to act on the Coquet Island SPA puffin population in-combination with other plans and projects is limited to displacement (inclusive of barrier effects) during operation and maintenance. For the Coquet Island SPA puffin population, potential effects of displacement are limited to the breeding season.

Displacement/Barrier effects – operation and maintenance

2706. Existing assessments for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning were checked to determine the displacement mortality estimates to be attributed to the Coquet Island SPA puffin population (Offshore EIA Report, volume 3, appendix 11.6, annex E).

2707. Following the approach to estimating in-combination mortalities as outlined in volume 3, appendix 11.6, annex E of the Offshore EIA Report, there are no projects considered to have effects on the Coquet Islands SPA puffin population during the breeding season. Therefore, it is assumed that existing in-combination effects are inconsequential to this feature and that, in line with conclusions for the project alone, in-combination population-level impacts resulting from predicted collision mortality are negligible.

In-combination: Conclusion

2708. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Coquet Island SPA puffin population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the breeding seabird assemblage

2709. The breeding seabird assemblage for the Coquet Island SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation noting a total of 47,662 individual breeding seabirds based on the five year mean peak of 2010-2014). Roseate tern, common tern, Sandwich tern, Arctic tern, puffin, black-headed gull, fulmar, herring gull, lesser black-backed gull and kittiwake are amongst the species identified in the citation as having nationally important populations which contribute to the Coquet Island SPA breeding seabird assemblage.

2710. Potential impacts of the Proposed Development alone and in-combination with either the other Forth and Tay or the other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the named components of the assemblage feature. For both the Scoping Approach and the Developer Approach, the assessments undertaken above identify no potential for adverse effects on kittiwakes, lesser black-backed gulls or puffins for the project along or in-combination with other plans or projects. Likely significant effects on all other named components of the assemblage have been screened out (Table 5.198).

2711. Therefore, it is concluded that there is no potential for an adverse effect on the Coquet Islands SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

2712. It is concluded that there is no potential for an Adverse Effect on Integrity on the Coquet Island SPA from the Proposed Development alone or in-combination with other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

5.7.10. NORTH CAITHNESS CLIFFS SPA

European site information and conservation objectives

2713. North Caithness Cliffs SPA includes sea-cliff areas between Freswick Bay and Strathy Point on the north coast of the Scottish mainland, in addition to the island of Stroma. The site is located approximately 280 km from the Proposed Development. The boundary of the SPA overlaps either partly or wholly with Duncansby Head Site of SSSI, Stroma SSSI, Dunnet Head SSSI, Holborn Head SSSI, and Red Point Coast SSSI. The seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1996, with the marine extension classified in 2009.

2714. The site qualifies under Article 4.2 by regularly supporting one migratory seabird species and in excess of 20,000 breeding seabird. The assemblage comprises five named component species (Table 5.210). The potential for LSE has been identified in relation to two of these five species: kittiwake and puffin (Table 5.210), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

2715. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

2716. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2717. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2718. Further information on this European site is presented in appendix 3A.

Table 5.210: Details on the Qualifying Features of the North Caithness Cliffs SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Favourable maintained	110,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	13,100 pairs	Yes
Guillemot	Breeding	Favourable maintained	38,300 individuals	No
Razorbill*	Breeding	Favourable recovered	4,000 individuals	No
Puffin*	Breeding	Favourable maintained	2,080 pairs	Yes
Fulmar*	Breeding	Favourable maintained	14,700 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

2719. The North Caithness Cliffs SPA kittiwake population is currently estimated to number 13,100 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2021. Kittiwake are listed on the North Caithness Cliffs SPA citation as a named component of the breeding seabird assemblage.

2720. Potential impacts on the North Caithness Cliffs SPA kittiwake population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the kittiwake population

2721. The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance. From published information on kittiwake foraging ranges generally (Woodward *et al*., 2019) it is apparent that during the breeding period kittiwakes from North Caithness Cliffs SPA could occur in the vicinity of the Proposed Development. However, the findings of the apportioning exercise found that no kittiwakes occurring in the Proposed Development array area during the breeding season derived from this SPA (Offshore EIA Report, volume 3, appendix 11.5).

2722. In the non-breeding season kittiwakes are largely pelagic (Frederiksen *et al*., 2011), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the North Caithness Cliffs SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively - Furness 2015; NatureScot 2020; volume 3, appendix 11.5 of the Offshore EIA Report). Given the above, the Proposed Development may have potential effects on the North Caithness Cliffs SPA kittiwake population during the non-breeding passage periods only (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

2723. Direct disturbance to kittiwakes during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population (Table 4.1).

2724. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2725. Kittiwakes breeding at the North Caithness Cliffs SPA are not predicted to utilise the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2726. Furthermore, given the low sensitivity of kittiwake to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Offshore EIA Report, volume 2, chapter 11).

Displacement

2727. As detailed above, kittiwake is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the North Caithness Cliffs SPA kittiwake population during the non-breeding season. Furthermore, as detailed in see the section on *Project Alone: Construction and Decommissioning – Displacement* for St. Abb's Head to Fast Castle SPA kittiwake population, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwake from this SPA during the non-breeding periods will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2728. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population.

Changes to prey availability

2729. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the North Caithness Cliffs SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2730. Given this, it is considered that there is relatively little potential for the North Caithness Cliffs SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2731. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from the North Caithness Cliffs SPA during the non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the North Caithness Cliffs SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2732. Given the discrete areas relative to the species' non-breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population.

Displacement/Barrier effects

2733. The approach used to derive predicted levels of mortality for North Caithness Cliffs SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report, volume 3, appendix 11.4)

2734. Estimates of kittiwake mortality for North Caithness Cliffs SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the North Caithness Cliffs SPA kittiwake population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and according to the apportioning estimates in Table 5.211).

Table 5.211: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the North Caithness Cliffs SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.000	0.000	0.10
Autumn migration	11,190	N/A	0.015	0.009	N/A
Spring migration	13,766	N/A	0.019	0.009	N/A

Table 5.212: Estimated Potential Annual Mortality of North Caithness Cliffs SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	0.5	0.3
	Spring migration	30%	1%	0.8	0.4
	Annual total	-	-	1.3	0.7
Scoping B	Breeding	30%	3%	0.0	0.0
	Autumn migration	30%	3%	1.5	0.8
	Spring migration	30%	3%	2.4	1.1
	Annual total	-	-	3.9	1.9
Developer	Breeding	30%	2%	0.0	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	30%	1%	0.0	0.0

2735. The potential annual mortality as a result of displacement is estimated as 1.3 adult and 0.7 immature birds based on Scoping Approach A and as 3.9 adult and 1.9 immature birds based Scoping Approach B (Table 5.212) All mortality was attributable to the non-breeding periods.

2736. The potential annual mortality as a result of displacement is estimated as 1.3 adult and 0.7 immature birds based on Scoping Approach A and as 3.9 adult and 1.9 immature birds based Scoping Approach B (Table 5.212) All mortality was attributable to the non-breeding periods.

2737. No mortality from displacement was predicted using the Developer Approach for any age class or season.

2738. The additional annual mortality of adult kittiwakes from the North Caithness Cliffs SPA population predicted due to displacement from the Proposed Development array area represents 0.02% of the current adult breeding population at this colony (i.e. 7,712 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by Scoping Approach A, and 0.05% as determined by Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.11 – 0.34% for the lower and upper estimates from the Scoping Approach. As outlined above and in (Table 5.212) no mortality was predicted using the Developer Approach.

2739. The potential levels of impact on the North Caithness Cliffs SPA kittiwake population resulting from predicted displacement/barrier effects associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Collision risk

2740. The approach used to derive predicted levels of mortality for North Caithness Cliffs SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report volume 3, appendix 11.3)

2741. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of kittiwakes from the North Caithness Cliffs SPA is predicted to be approximately 6.3 adults and 3.3 immatures as determined by the Scoping Approach, and approximately 4.5 adults and 2.3 immatures as determined by the Developer Approach (Table 5.213). All mortality was attributable to the non-breeding periods.

Table 5.213: Predicted Collision Effects from the Proposed Development on the North Caithness Cliffs SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate.

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.0	0.0
	Autumn migration	2.7	1.6
	Spring migration	3.6	1.7
	Annual total	6.3	3.3
Developer	Breeding	0.0	0.0
	Autumn migration	1.6	0.9
	Spring migration	2.9	1.4
	Annual total	4.5	2.3

2742. The additional annual mortality of adult kittiwakes from the North Caithness Cliffs SPA population predicted due to collision represents approximately 0.06% of the number of adults currently estimated to breed at this colony (i.e. 7,712 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.08% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.146 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.40% and 0.56% for the Developer and Scoping Approaches, respectively.

2743. As outlined in the *Project Alone: Operation and Maintenance - Collision risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the North Caithness Cliffs SPA kittiwake population that are at least 50% lower than those presented in Table 5.213 above (and on which the assessment is based).

2744. The potential levels of impact on the North Caithness Coast SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to prey availability

2745. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the North Caithness Cliffs SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2746. Given this, it is considered that there is relatively little potential for the North Caithness Cliffs SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population.

Project alone: population-level impacts

2747. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the North Caithness Cliffs SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase.

2748. PVA was therefore undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.212 and Table 5.213). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: population-level impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6 of the Offshore EIA Report. The starting population size was the 2021 count for the SPA (Offshore EIA Report, volume 3, appendix 11.5).

Table 5.214: Projected 35 Year Population Sizes and Associated PVA Metrics for the North Caithness Cliffs SPA Kittiwake Population under Different Impact Scenarios for the Proposed Development Alone.

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	5333 (1765 – 15194)	1.000	1.000	50.0
	Scoping A	7.62	3.81	5153 (1704 – 14687)	0.966	0.999	47.3
	Scoping B	10.21	5.09	5094 (1685 – 14519)	0.955	0.999	46.7
	Developer	4.54	2.22	5226 (1729 – 14891)	0.980	0.999	48.7

2749. The PVA predicted a continuing population decline for the North Caithness Cliffs SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, under baseline conditions (i.e. no wind farm effects), the population is predicted to decline by 36% after 35 years from the current estimate of 7,712 adult birds (Table 5.214). Given that the PVAs are based on density independent models, which assume all mortality from the wind farm effects is additive and that there are no compensatory mechanisms operating within the population, the predicted declines are inevitably greater for those scenarios incorporating the effects from the Proposed Development.

2750. The PVA metrics suggest that the effects from the Proposed Development will lead to relatively small population-level impacts, with the CPS values indicating that the SPA population size would be reduced by approximately 2% and between 3.4 and 4.5%, relative to the predicted population size under baseline conditions, after 35 years for the Developer Approach and Scoping Approach, respectively (Table 5.214). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.1% on the basis of both the Developer Approach and Scoping Approaches (Table 5.214). On the basis of the Developer Approach, centile values are estimated to be 48.7 after 35 years, whilst for the Scoping Approach the equivalent values are between 46.7 and 47.3 (Table 5.214). Thus, the centile metric indicates extensive overlap in the distribution of the predicted impacted and un-impacted population sizes, suggesting a low likelihood of the impacted population being smaller than the un-impacted population after 35 years, irrespective of whether the effects are estimated using the Developer or Scoping Approaches.

<u>Project alone: Conclusion</u>

2751. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the North Caithness Cliffs SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. The PVA metrics indicate a high chance of the population being of a similar size to that which would occur in the absence of the Proposed Development after 35 years. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

<u>Effects in-combination</u>

<u>Effects of relevance to the in-combination assessment</u>

2752. For the same reason as described in the *Effects in-combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, the potential for effects of the Proposed Development to act on the North Caithness Cliffs SPA kittiwake population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

2753. In-combination totals have been collated for all relevant SPA populations for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning (Offshore EIA Report, volume 3, appendix 11.6, annex E). Separate in-combination totals for the Forth and Tay projects were not collated for the reasons outlined in *Effects in-combination* for the Farne Islands SPA kittiwake population, volume 3, appendix 11.6, annex E and volume 3, appendix 11.8 of the Offshore EIA Report.

<u>Displacement/Barrier effects – operation and maintenance</u>

2754. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.215).

Table 5.215: Estimated Annual Mortality of North Caithness Cliffs SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, in-Combination with Other UK North Sea Wind Farms.

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES	ADULTS	IMMATURES
UK North Sea	Scoping A	1.0	0.1	2.6	1.6	4.0	1.8	7.6	3.4
	Scoping B	3.0	0.3	7.9	4.6	12.0	5.4	22.9	10.2
	Developer	2.0	0.2	N/A	N/A	N/A	N/A	2.0	0.2

2755. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the North Caithness Cliffs SPA population predicted due to displacement represents 0.02% of the current adult population as determined by the Developers Approach and between approximately 0.09-0.29% as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.18% for the Developers Approach and between 0.67 – 2.04% for the lower and upper estimates from the Scoping Approach.

2756. The potential levels of impact on the North Caithness Cliffs SPA kittiwake population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

2757. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2758. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.216).

Table 5.216 Predicted Collision Effects on the North Caithness Cliffs SPA Kittiwake Population Due to the Proposed Development in-Combination with Other Projects in the UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs.

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	3.7	0.3
		Autumn migration	15.5	9.1
		Spring migration	20.3	9.1
		Annual total	39.5	18.5
	Developer	Breeding	3.7	0.3
		Autumn migration	14.4	8.5
		Spring migration	19.7	8.8
		Annual total	37.8	17.6

2759. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the North Caithness Cliffs SPA population predicted due to collisions represents 0.49% of the current adult breeding population at this colony (i.e. 7,712 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.51% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 3.38% for the Developer Approach and of 3.51% for the Scoping Approach

2760. The potential levels of impact on the Coquet Island SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

2761. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.215 and Table 5.216 above).

2762. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-combination: population-level impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in the Offshore EIA Report, volume 3, appendix 11.6.

Table 5.217: Projected 35 Year Population Sizes and Associated PVA Metrics for the North Caithness Cliffs SPA Kittiwake Population Under Different Impact Scenarios for the Proposed Development in-Combination with the Other UK North Sea Wind Farms.

Period	Approach	Additional Annual Mortality Adults	Immatures	Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
35 years	Baseline	0	0	5333 (1765 – 15194)	1.000	1.000	50.0
	Scoping A	43.42	19.81	4402 (1452 – 12582)	0.826	0.995	35.5
	Scoping B	58.71	26.59	4113 (1356 – 11786)	0.772	0.993	30.8
	Developer	35.94	15.62	4559 (1504-13017)	0.855	0.996	38.2

2763. For the Developers Approach the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 14.5% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.217). The Scoping Approaches predict that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of between approximately 17.4% and 22.8% in the size of the SPA population after 35 years (Table 5.217).

2764. The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be between 0.4 and 0.7%, whilst the centile values of between 30.8 and 38.2 indicates a moderate level of overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence the potential for the impacted population being of a similar size to the unimpacted population after 35 years. (Table 5.217).

In-combination: Conclusion

2765. On the basis of the Developer Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the North Caithness Cliffs SPA kittiwake population are predicted to be relatively moderate. Although the impact on the population growth rate is small. The

PVA metrics indicate that it is possible that the population would be smaller to that which would occur in the absence of the in-combination impacts. For the Scoping Approach, the predicted reductions in population size and the likelihood of them occurring size are greater.

2766. It is considered likely that the assessment is overly precautionary and the level of impact would be lower than predicted. However, the population is in unfavourable condition and declining and it is therefore considered to be the potential for an adverse effect on the North Caithness Cliffs SPA kittiwake population as a result of the predicted in-combination effects. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approaches.

Assessment for the puffin population

2767. The North Caithness Cliffs SPA puffin population is currently estimated to number 1,517 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2015/16. Puffin are listed on the North Caithness Cliffs SPA citation as a named component of the breeding seabird assemblage, with a citation population size of 2,080 pairs, thus the numbers currently breeding on North Caithness Cliffs show an apparent decline in the population since designation. Although the population is considered to be in favourable and maintained condition.

2768. Potential impacts on the North Caithness Cliffs SPA puffin population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

<u>The potential for impacts on the puffin population</u>

2769. The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance. From published information on puffin foraging ranges generally (Woodward *et al.* 2019) it is possible that during the breeding period puffin from North Caithness Cliffs SPA occur within the Proposed Development and 2 km buffer. However, the number of puffins present are predicted to be very low with the results of the apportioning exercise estimating that 0.2% of the puffin occurring on the Proposed Development array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

2770. As advised in the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

<u>Project alone: construction and decommissioning</u>

<u>Disturbance</u>

2771. As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the Forth Island SPA puffin population, direct disturbance to puffins during the (at most) eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see maximum design scenario, Table 4.1).

2772. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2773. Given the relatively low sensitivity of puffin to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

<u>Displacement</u>

2774. As detailed above, puffin is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness et al., 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the North Caithness Cliffs SPA puffin population during the breeding season. Furthermore, as detailed in section above, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffin from this SPA during the breeding period will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2775. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

<u>Changes to prey availability</u>

2776. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence basis and context applies to the North Caithness Cliffs SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2777. Given this, it is considered that there is relatively little potential for the North Caithness Cliffs SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

<u>Project alone: operation and maintenance</u>

<u>Disturbance</u>

2778. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of puffins from North Caithness Cliffs SPA during the breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA puffin population. The same evidence base and context applies to the North Caithness Cliffs SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2779. Given the discrete areas relative to the species' breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

Displacement/Barrier effects

2780. The approach used to derive predicted levels of mortality for North Caithness Cliffs SPA puffins is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA puffin population (and in the Offshore EIA Report, volume 3, appendix 11.4)

2781. Estimates of puffin mortality for North Caithness Cliffs SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the North Caithness Cliffs SPA puffin population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA puffin population (and according to the apportioning estimates in Table 5.218).

Table 5.218: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the North Caithness Cliffs SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,513	0.571	0.002	0.002	0.07
Non-breeding	N/A	N/A	N/A	N/A	N/A

Table 5.219: Estimated Potential Annual Mortality of North Caithness Cliffs SPA Puffins as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.0	0.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0
Scoping B	Breeding	60%	5%	0.1	0.1
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.1	0.1
Developer	Breeding	50%	1%	0.0	0.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

2782. The potential annual mortality as a result of displacement is estimated as between 0 and 0.1 adults and 0 and 0.1 immatures based on Developer and Scoping Approaches (Table 5.219).

2783. The additional annual mortality of adult puffins from the North Caithness Cliffs SPA population predicted under Scoping Approach B due to displacement from the Proposed Development array area represents 0.003% of the current adult breeding population at this colony (i.e. 3,034 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report). Under all other approaches no adult mortality is predicted.

2784. Further consideration of the potential population-level impacts associated with the predicted displacement/barrier effect mortalities in Table 5.219 is undertaken below in the *Project Alone: population-level impacts* section.

Changes to prey availability

2785. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence base and context applies to the North Caithness Cliffs SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2786. Given this, it is considered that there is relatively little potential for the North Caithness Cliffs SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

Project alone: population-level impacts

2787. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Forth Islands SPA puffin population are limited to displacement (inclusive of barrier effects) during the operation and maintenance phase. For other effect pathways, there is considered to be no potential for an adverse effect on this population as a result of the Proposed Development alone, with any such effects likely to be small and of little, or no, consequence in terms of impacts at the population level.

2788. As described in the Offshore EIA Report, volume 3, appendix 11.6, PVAs were run for populations where the predicted wind farm associated mortality increased the baseline mortality rate by at least 0.02 percentage point (Offshore EIA Report, volume 3, appendix 11.8). Predicted displacement mortality for the North Caithness Cliffs SPA puffin population did not exceed this threshold under any approach and as such, PVA was not undertaken. Accordingly, it is considered that there is no potential for operation or maintenance related displacement/barrier effects to lead to an adverse effect on the North Caithness Cliffs SPA puffin population.

Project alone: Conclusion

2789. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the North Caithness Cliffs SPA puffin population are predicted to be very small, with the resultant population-level impacts also predicted to be very small. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2790. For the same reason as described in *Effects in-combination* for the Forth Islands SPA puffin population, the potential for effects of the Proposed Development to act on the North Caithness Cliffs SPA puffin population in-combination with other plans and projects is limited to displacement (inclusive of barrier effects) during operation and maintenance. For the North Caithness Cliffs SPA puffin population, potential effects of displacement are limited to the breeding season.

Displacement/Barrier effects – operation and maintenance

2791. Existing assessments for all UK North Sea offshore wind farms that are in operation, construction, consented or planning were checked to determine the displacement mortality estimates to be attributed to the North Caithness Cliffs SPA puffin population (Offshore EIA Report, volume 3, appendix 11.6, annex E).

2792. Following the approach to estimating in-combination mortalities as outlined in volume 3, appendix 11.6, annex E of the Offshore EIA Report, there are no projects considered to have effects on the North Caithness Cliffs SPA puffin population during the breeding season. Therefore, it is assumed that existing in-combination effects are inconsequential to this feature and that, in line with conclusions for the project alone, in-combination population-level impacts resulting from predicted collision mortality are negligible.

In-combination: Conclusion

2793. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the North Caithness Cliffs SPA puffin population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the breeding seabird assemblage

2794. The breeding seabird assemblage for the North Caithness Cliffs SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation noting a total of 110,000 individual breeding seabirds). Fulmar, kittiwake, guillemot, razorbill and puffin are amongst the species identified in the citation as having nationally important populations which contribute to the North Caithness Cliffs SPA breeding seabird assemblage.

2795. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the named components of the assemblage feature. For both the Scoping Approach and the Developer Approach, the assessments undertaken above identify no potential for adverse effects on kittiwake or puffin for the project alone or for puffin for the project in-combination with other plans or projects. Likely significant effects on all other named components of the assemblage have been screened out (Table 5.210).

2796. The assessment identifies the potential for an adverse effect to arise from the Proposed Development in-combination with other plans or projects on kittiwake.

2797. Therefore, it is concluded that there is potential for an adverse effect on the North Caithness Cliffs breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

2798. It is concluded that there is no potential for an Adverse Effect on Integrity on the North Caithness Cliffs SPA from the Proposed Development alone. There is potential for an Adverse Effect on Integrity from the Proposed Development in-combination with other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

5.7.11. HOY SPA

European site information and conservation objectives

2799. Hoy is a mountainous island at the south-western end of the Orkney archipelago, located approximately 312 km from the Proposed Development. Hoy SPA covers the northern and western two-thirds of Hoy island. The boundary of Hoy SPA overlaps with that of Hoy SSSI, and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 2000, with the marine extension classified in 2009.

2800. There is one annex 1 qualifying seabird species and the site qualifies under Article 4.2 by regularly supporting one migratory seabird species and in excess of 20,000 breeding seabirds, including six named component species (Table 5.220). The potential for LSE has been identified in relation to three species: kittiwake, great skua and puffin along with the Seabird Assemblage (Table 5.220), with the effect pathways associated with LSE for each of these detailed in Table 3.1and set out in the assessment below.

2801. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

2802. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2803. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2804. Further information on this European site is presented in appendix 3A.

Table 5.220: Details on the Qualifying Features of Hoy SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable declining	120,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	3,000 pairs	Yes
Great black-backed gull*	Breeding	Unfavourable declining	570 pairs	No
Great skua	Breeding	Unfavourable declining	1,900 pairs	Yes
Arctic skua*	Breeding	Unfavourable declining	59 pairs	No
Guillemot*	Breeding	Unfavourable no change	13,400 pairs	No
Puffin*	Breeding	Unfavourable declining	3,500 pairs	Yes
Red-throated diver	Breeding	Favourable maintained	58 territories	No
Fulmar*	Breeding	Unfavourable no change	35,000 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

2805. The Hoy SPA kittiwake population is currently estimated to number 608 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2016/17. Kittiwake are listed on the Hoy SPA citation as a named component of the breeding seabird assemblage.

2806. Potential impacts on the Hoy SPA kittiwake population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the kittiwake population

2807. The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance. From published information on kittiwake foraging ranges generally (Woodward *et al*., 2019) it is apparent that during the breeding period kittiwakes from Hoy SPA could occur in the vicinity of the Proposed Development. However, the findings of the apportioning exercise found that no kittiwakes occurring in the Proposed Development array area during the breeding season derived from this SPA (Offshore EIA Report, volume 3, appendix 11.5: Table 4.5).

2808. In the non-breeding season kittiwakes are largely pelagic (Frederiksen et al., 2011), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the Hoy SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively - Furness 2015; NatureScot 2020; Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Hoy SPA kittiwake population during the non-breeding passage periods only (Offshore EIA Report, volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

2809. Direct disturbance to kittiwakes during the construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population, Table 5.4).

2810. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2811. Kittiwakes breeding at the Hoy SPA are not predicted to utilise the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2812. Furthermore, given the low sensitivity of kittiwake to disturbance effects (Garthe and Hüppop 2004; Furness et al., 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Hoy SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Chapter 11, Offshore EIA Report).

Displacement

2813. As detailed above, kittiwake is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the Hoy SPA kittiwake population during the non-breeding season. Furthermore, as detailed in the section on *Project Alone: Construction and Decommissioning – Displacement* for St. Abb's Head to Fast Castle kittiwake population, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwake from this SPA during the non-breeding periods will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2814. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Hoy SPA kittiwake population.

Changes to prey availability

2815. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Hoy SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2816. Given this, it is considered that there is no potential for the Hoy SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Hoy SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2817. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Hoy SPA during the non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Hoy SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2818. Given the discrete areas relative to the species' non-breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Hoy SPA kittiwake population.

Displacement/Barrier effects

2819. The approach used to derive predicted levels of mortality for Hoy SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and in volume 3, appendix 11.4 of the Offshore EIA Report)

2820. Estimates of kittiwake mortality for Hoy SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Hoy SPA kittiwake population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and according to the apportioning estimates in Table 5.211).

Table 5.221: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Hoy SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.000	0.000	0.10
Autumn migration	11,190	N/A	0.001	0.000	N/A
Spring migration	13,766	N/A	0.001	0.000	N/A

Table 5.222: Estimated Potential Annual Mortality of Hoy SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	0.0	0.0
	Spring migration	30%	1%	0.0	0.0
	Annual total	-	-	0.1	0.0
Scoping B	Breeding	30%	3%	0.0	0.0
	Autumn migration	30%	3%	0.1	0.0
	Spring migration	30%	3%	0.1	0.0
	Annual total	-	-	0.2	0.0
Developer	Breeding	30%	2%	0.0	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

2821. The potential annual mortality as a result of displacement is estimated as 0.1 adult and no immature birds based on Scoping Approach A and as 0.2 adult and no immature birds based Scoping Approach B (Table 5.222). All mortality was attributable to the non-breeding periods.

2822. No mortality from displacement was predicted using the Developer Approach for any age class or season Table 5.222).

2823. The additional annual mortality of adult kittiwakes from the Hoy SPA population predicted due to displacement from the Proposed Development array area represents 0.016% of the current adult breeding population at this colony (i.e. 608 individuals – Table 4.5 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by Scoping Approach A, and 0.03% as determined by Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.188 from West Westray, the closest colony to Hoy– see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.09 – 0.17% for the lower and upper estimates from the Scoping Approach. As outlined above and in Table 5.222, no mortality was predicted using the Developer Approach.

Collision risk

2824. The approach used to derive predicted levels of mortality for Hoy SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the St Abb's Head to Fast Castle SPA kittiwake population (and in the Offshore EIA Report, volume 3, appendix 11.3)

2825. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of kittiwakes from the Hoy SPA is predicted to be approximately 0.4 adults and no immatures as determined by the Scoping Approach, and approximately 0.3 adults and no immatures as determined by the Developer Approach (Table 5.223). All mortality was attributable to the non-breeding periods.

Table 5.223: Predicted Collision Effects from the Proposed Development on the Hoy SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.0	0.0
	Autumn migration	0.2	0.0
	Spring migration	0.2	0.0
	Annual total	0.4	0.0
Developer	Breeding	0.0	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.2	0.0
	Annual total	0.3	0.0

2826. The additional annual mortality of adult kittiwakes from the Hoy SPA population predicted due to collision represents approximately 0.05% of the number of adults currently estimated to breed at this colony (i.e.

608 individuals – Table 4.5 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.06% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying the West Westray mortality rate of 0.188 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.26% and 0.35% for the Developer and Scoping Approaches, respectively.

2827. As outlined in the Project Alone: Operation and Maintenance - Collision risk section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Hoy SPA kittiwake population that are at least 50% lower than those presented in Table 5.223 above (and on which the assessment is based).

Changes to prey availability

2828. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Hoy SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2829. Given this, it is considered that there is no potential for the Hoy SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Hoy SPA kittiwake population.

Project alone: population-level impacts

2830. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Hoy SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase.

2831. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. The potential increase in annual adult mortality from displacement is between zero and 0.2 birds per year and those from collision impacts from between 0.3 and 0.4 adult birds per year.

Project alone: Conclusion

2832. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Hoy SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. Any impacts are likely to be within the natural variation of the population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2833. For the same reasons as described in *Effects in-combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, the potential for effects of the Proposed Development to act on the Hoy SPA kittiwake population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

2834. In-combination totals have been collated for all relevant SPA populations for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning (Offshore EIA Report, volume 3, appendix 11.6, annex E). Separate in-combination totals for the Forth and Tay projects were not collated for the reasons outlined in *Effects in-combination* for the Farne Islands SPA kittiwake population, volume 3, appendix 11.6, annex E and volume 3, appendix 11.8 of the Offshore EIA Report.

Displacement/Barrier effects – operation and maintenance

2835. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2836. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.224).

Table 5.224: Estimated Annual Mortality of Hoy SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, in-Combination With Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.0	0.0	0.1	0.0	0.2	0.1	0.3	0.1
	Scoping B	0.0	0.0	0.4	0.1	0.5	0.2	0.9	0.3
	Developer	0.0	0.0	N/A	N/A	N/A	N/A	0.0	0.0

2837. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Hoy SPA population predicted due to displacement represents between approximately 0.05-0.14% of the current adult breeding population at this colony (i.e. 608 individuals – Table 4.5 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.26 – 0.79% for the lower and upper estimates from the Scoping Approach. No mortality of kittiwake from displacement effects is predicted to occur following the Developer Approach.

Collision risk - operation and maintenance

2838. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2839. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.225).

Table 5.225: Predicted Collision Effects on the Hoy SPA Kittiwake Population Due to the Proposed Development in-Combination With Other Projects in the UK North Sea waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.0	0.0
		Autumn migration	0.7	0.3
		Spring migration	0.8	0.3
		Annual total	1.5	0.6
	Developer	Breeding	0.0	0.0
		Autumn migration	0.6	0.3
		Spring migration	0.8	0.3
		Annual total	1.4	0.6

2840. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Hoy SPA population predicted due to collisions represents 0.23% of the current adult breeding population at this colony (i.e. 608 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.25% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 1.22% for the Developer Approach and of 1.32% for the Scoping Approach.

In-combination: population-level impacts

2841. The combined in-combination impacts arising from both displacement and collision impacts are presented in Table 5.226.

Table 5.226: Predicted Collision Effects on the Hoy SPA Kittiwake Population Due to the Proposed Development in-Combination With Other Projects in the UK North Sea waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Sseasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping A	Displacement	0.3	0.1
		Collision	1.5	0.6
		Total	1.8	0.7
	Scoping B	Displacement	0.9	0.3
		Collision	1.5	0.6
		Total	2.4	0.9
	Developer	Displacement	0.0	0.0
		Collision	1.4	0.6
		Total	1.4	0.6

2842. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Hoy SPA population predicted due to the combined impacts from displacement and collisions represents 0.23% of the current adult breeding population at this colony (i.e. 608 individuals – Table 4.5 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, 0.29% of this population as determined by the Scoping Approach A and 0.39% for Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult mortality equate to an increase of 1.6% for the Developer Approach and of 0.75% for the Scoping Approach B and up to 2.0% based on Scoping Approach B.

2843. The predicted in-combination population-level impacts are small, in particular if the Developer Approach are considered. Although it is recognised that the kittiwake population is declining and identified as being in unfavourable condition, any in-combination impacts are likely to be within the natural variation of the population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

In-combination: Conclusion

2844. Based on the Developer and Scoping Approaches, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Hoy SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Hoy SPA kittiwake population.

Assessment for the great skua population

2845. Great skua only occur in the North Atlantic, nesting at relatively high latitudes and wintering south of their breeding sites. Most great skua nest in the eastern Atlantic, with an estimated global breeding population of 16,000 pairs, of which approximately 60% nest on islands in north and west Scotland. Great skua also nests in Faroes, Norway and Iceland and a small population breed in Ireland. Great skua forage on fish obtained via Kleptoparasitism from other seabird species and discards from fishing boats. They also predate on other seabird species. Great skua have a large foraging range when breeding, with the mean maximum foraging range reported as being 443.3 km (±487.9) (Woodward *et al.* 2019).

2846. The Hoy SPA great skua population is currently estimated to number 1,041 Apparently Occupied Territories (2,082 individuals) based on the most recent count in 2019.

The potential for impacts on the great skua population

2847. Potential impacts on the Hoy SPA great skua population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

2848. From published information on great skua foraging ranges it is apparent that during the breeding period great skua from the Hoy SPA could, in theory, occur within the area of the Proposed Development and the

2 km buffer around the Proposed Development Array area (Woodward et al. 2019). The breeding period for great skua is defined as mid-April to mid-September, following the NatureScot (2020) guidance

2849. Great skuas move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa and also North America returning north in the spring (Furness 2015), so that the non-breeding season is divided into autumn and spring passage periods (defined as August to October and March to April, respectively, with the winter period from November to February). Given the above, the Proposed Development may have potential effects on the Hoy SPA great skua population during breeding and non-breeding periods.

Project alone: operation and maintenance

Collision risk

2850. Predictions of the number of great skua at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report appendix 11.3 in Table 4.9). The assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014) avoidance rates of 98.0% were applied to the outputs from option 2 and option 3, respectively. Annual great skua collision estimates are calculated.

2851. As outlined elsewhere (e.g. the St Abb's Head to Fast Castle SPA kittiwake CRM) the CRMs for great skua were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

2852. Based upon the Developer Approach option 2 of the deterministic CRM with a 98.0% avoidance rate applied, the total annual collision mortality of great skua is 0.18 adults. Based on the Scoping Approach option 2 and a 98% avoidance rate the total annual mortality of great skua is estimated to be 0.35 (Table 5.227 and see appendix 11.3 Table 4.9) for all modelled scenarios). The estimated impacts based on the use of option 3 were lower at 0.02 and 0.05 birds per year for Developer and Scoping Approaches respectively.

Table 5.227: Predicted Collision Effects From the Proposed Development on Great Skua Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98% Avoidance Rate

Approach	Seasonal Period	Total Estimated Number of Collisions All Ages
Scoping	Annual total	0.35
Developer	Annual total	0.18

2853. Based upon the estimates from option 2 of the CRM, the additional annual mortality of great skua is 0.18 birds per year based on the Developer Approach. Under a worst-case scenario all 0.18 collisions per year have been assumed to be adults and apportioned to the Hoy SPA breeding population. On this highly precautionary and unrealistic worst-case scenario it is estimated that the predicted collisions represent approximately 0.008% of the number of adults currently estimated to breed at this colony (i.e. 1,041 individuals) as determined by the Developer Approach and approximately 0.016% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.08% and 0.15% for the Developer and Scoping Approaches, respectively.

2854. The estimated number of collisions per annum relates to impacts on the whole great skua population and not just adults from this SPA. Most impacts are predicted to occur during spring and autumn passage periods (appendix 11.1: section 5.14) when approximately 14.1% of the North Sea great skua population are birds from Hoy SPA (Furness 2015). Consequently, of the 0.18 collisions per year 14.1% could be predicted to be on birds from this SPA, equating to collision mortality of 0.02 birds per year based on the Developers Approach and 0.05 birds per year based on Scoping Approach. This estimated number of collisions represent approximately <0.001% of the number of adults currently estimated to breed at this colony (i.e. 1,041 individuals) as determined by the Developer Approach and approximately 0.002% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.009% and 0.021% for the Developer and Scoping Approaches, respectively.

Project alone: Conclusion

2855. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Hoy SPA great skua population are predicted to be negligible, with the resultant population-level impacts also predicted to be negligible. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Collision risk

As detailed above, any effects from the Proposed Development alone on the Hoy SPA great skua population resulting from collision during operation and maintenance will be very small impacting on no more than 0.002% of the adult population and increasing the adult mortality by no more than 0.021%. Consequently, it is considered that there is no potential for an effect from the Proposed Development to add to impacts at a population level that could cause an in-combination adverse effect.

In-combination: Conclusion

2856. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Hoy SPA great skua population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the puffin population

2857. The Hoy SPA puffin population is currently estimated to number 361 individuals.

2858. Potential impacts on the Hoy SPA puffin population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the puffin population

2859. The breeding period for puffin is defined as April to mid-August, following the NatureScot (2020) guidance. From published information on puffin foraging ranges generally (Woodward *et al.* 2019) it is possible that during the breeding period puffin from Hoy SPA occur within the Proposed Development and 2 km buffer. However, the SPA is 312 km from the Proposed Development and the results from the apportioning exercise indicate that no puffins occurring in the Proposed Development array area during the breeding season are from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5).

2860. As advised in the NatureScot scoping advice (volume 3, appendix 6.2 of the Offshore EIA Report), no assessment of impacts during the non-breeding period is undertaken for puffin.

Project alone: construction and decommissioning

Disturbance

2861. As outlined in the section on *Project Alone: Construction and Decommissioning – Disturbance* for the Forth Island SPA puffin population, direct disturbance to puffins during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see maximum design scenario; Table 4.1).

2862. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2863. Given the relatively low sensitivity of puffin to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), the relatively small areas that will be subject to activities with the potential to result in disturbance at any given time during the construction period and the fact that these potential effects will be temporary, it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Hoy SPA puffin population.

Displacement

2864. As detailed above, puffin is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the Hoy SPA puffin population during the breeding season. Furthermore, as detailed in section xxxx, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of puffin from this SPA during the breeding period will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2865. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Hoy SPA puffin population.

Changes to prey availability

2866. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence basis and context applies to the Hoy SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2867. Given this, it is considered that there is relatively little potential for the Hoy SPA puffin population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Hoy SPA puffin population.

Project alone: operation and maintenance

Disturbance

2868. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of puffins from Hoy SPA during the breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA puffin population. The same evidence base and context applies to the Hoy SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2869. Given the discrete areas relative to the species' breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Hoy SPA puffin population.

Displacement/Barrier effects

2870. The approach used to derive predicted levels of mortality for Hoy SPA puffins is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA puffin population (and in Offshore EIA Report, volume 3, appendix 11.4)

2871. Estimates of puffin mortality for Hoy SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Hoy SPA puffin population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA puffin population (and according to the apportioning estimates in Table 5.228).

2872. The results indicate that no puffins from the Hoy SPA will occur within the Development Area and 2 km buffer, so that there are no resulting displacement effects (see Table 4.3 in volume 3, appendix 11.5 of the Offshore EIA Report).

2873. The potential annual mortality as a result of displacement is estimated as zero adults and zero immatures based on both developer and Scoping Approaches (Table 5.229).

Table 5.228: The Mean Peak Abundance Estimates of Puffin in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Hoy SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,513	0.571	0.000	0.000	0.07
Non-breeding	N/A	N/A	N/A	N/A	N/A

Table 5.229: Estimated Potential Annual Mortality of Hoy SPA Puffins as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	60%	3%	0.0	0.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0
Scoping B	Breeding	60%	5%	0.0	0.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0
Developer	Breeding	50%	1%	0.0	0.0
	Non-breeding	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

Changes to prey availability

2874. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA puffin population. The same evidence base and context applies to the Hoy SPA puffin population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2875. Given this, it is considered that there is relatively little potential for the Hoy SPA puffin population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Hoy SPA puffin population.

Project alone: population-level impacts

2876. As determined above, there are no effects from the Proposed Development alone which could lead to an adverse effect on the Hoy SPA puffin population

Project alone: Conclusion

2877. For both the Developer and Scoping Approaches, no potential effects from the Proposed Development alone on the Hoy SPA puffin population are predicted to occur. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2878. As no potential effects of the Proposed Development alone have been identified to act on the Hoy SPA puffin population there will be no in-combination impact with other plans and projects.

Assessment for the breeding seabird assemblage

2879. The breeding seabird assemblage for the Hoy SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds.

2880. Potential impacts of the Proposed Development alone and in-combination with other plans and projects on the breeding seabird assemblage for the SPA could arise via effects on the named components of the assemblage feature. For both the Scoping Approach and the Developer Approach, the assessments undertaken above identify no potential for adverse effects on kittiwake, great skua and puffin for the project alone or in-combination with other plans or projects. Likely significant effects on all other named components of the assemblage have been screened out (HRA Stage One Screening Report (SSER, 2021b)).

2881. Therefore, it is concluded that there is no potential for an adverse effect on the hoy SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

2882. It is concluded that there is no potential for an Adverse Effect on Integrity on the Hoy SPA from the Proposed Development alone or in-combination with other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

5.7.12. COPINSAY SPA

European site information and conservation objectives

2883. The Copinsay SPA comprises a group of islands 4 km off the east coast of Orkney Mainland, approximately 307 km from the Proposed Development. The islands have a cliffed rocky coastline and maritime vegetation that support large colonies of breeding seabirds. The boundary of the SPA encompasses Copinsay SSSI, and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1994, with the marine extension classified in 2009.

2884. The site qualifies under Article 4.2 by regularly supporting in excess of 20,000 breeding seabirds (Table 5.230). The potential for LSE has been identified in relation to kittiwake (Table 5.230), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

2885. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

2886. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2887. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2888. Further information on this European site is presented in appendix 3A.

Table 5.230: Details on the Qualifying Features of Copinsay SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable no change	70,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	9,550 pairs	Yes
Great black-backed gull*	Breeding	Unfavourable declining	490 pairs	No
Guillemot*	Breeding	Unfavourable no change	29,450 individuals	No
Fulmar*	Breeding	Favourable maintained	1,615 pairs	No

*Named components of the assemblage only.

Assessment for the kittiwake population

2889. The Copinsay SPA kittiwake population is currently estimated to number 955 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2021. Kittiwake are listed on the Copinsay SPA citation as a named component of the breeding seabird assemblage.

2890. Potential impacts on the Copinsay SPA kittiwake population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the kittiwake population

2891. The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance. From published information on kittiwake foraging ranges generally (Woodward *et al*., 2019) it is apparent that during the breeding period kittiwakes from Copinsay SPA could occur in the vicinity of the Proposed Development. However, the findings of the apportioning exercise found that no kittiwakes occurring in the Proposed Development array area during the breeding season derived from this SPA (Offshore EIA Report, volume 3, appendix 11.5).

2892. In the non-breeding season kittiwakes are largely pelagic (Frederiksen et al., 2011), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the Copinsay SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively - Furness 2015; NatureScot 2020; volume 3, appendix 11.5 of the Offshore EIA Report). Given the above, the Proposed Development may have potential effects on the Copinsay SPA kittiwake population during the non-breeding passage periods only (Offshore EIA Report volume 3, appendix 11.5).

Project alone: construction and decommissioning

Disturbance

2893. Direct disturbance to kittiwakes during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on Project alone: construction and decommissioning for St. Abb's Head to Fast Castle kittiwake population; Table 4.1).

2894. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2895. Kittiwakes breeding at the Copinsay SPA are not predicted to utilise the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2896. Furthermore, given the low sensitivity of kittiwake to disturbance effects (Garthe and Hüppop 2004; Furness et al., 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project alone: construction and decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Copinsay SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Offshore EIA Report volume 2 Chapter 11).

Displacement

2897. As detailed above, kittiwake is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the Copinsay SPA kittiwake population during the non-breeding season. Furthermore, as detailed in the section on *Project alone: construction and decommissioning – Displacement* for St. Abb's Head to Fast Castle kittiwake population, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and Proposed Development export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwake from this SPA during the non-breeding periods will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2898. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Copinsay SPA kittiwake population.

Changes to prey availability

2899. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the Copinsay Island SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2900. Given this, it is considered that there is no potential for the Copinsay SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Copinsay SPA kittiwake population.

Project alone: operation and maintenance

Disturbance

2901. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from Copinsay SPA during the non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Copinsay SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

2902. Given the discrete areas relative to the species' non-breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Copinsay SPA kittiwake population.

Displacement/Barrier effects

2903. The approach used to derive predicted levels of mortality for Copinsay SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report volume 3, appendix 11.4)

2904. Estimates of kittiwake mortality for Copinsay SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Copinsay SPA kittiwake population as described in Offshore EIA Report, volume 3, appendix 11.5 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and according to the apportioning estimates in Table 5.231).

Table 5.231: The Mean Peak Abundance Estimates of Kittiwake in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be from the Copinsay SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.000	0.000	0.10
Autumn migration	11,190	N/A	0.001	0.000	N/A
Spring migration	13,766	N/A	0.001	0.000	N/A

Table 5.232: Estimated Potential Annual Mortality of Copinsay SPA Kittiwakes as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	0.0	0.0
	Spring migration	30%	1%	0.0	0.0
	Annual total	-	-	0.1	0.1
Scoping B	Breeding	30%	3%	0.0	0.0
	Autumn migration	30%	3%	0.1	0.1
	Spring migration	30%	3%	0.1	0.1
	Annual total	-	-	0.2	0.2
Developer	Breeding	30%	2%	0.0	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

2905. The potential annual mortality as a result of displacement is estimated as 0.1 adult and 0.1 immature birds based on Scoping Approach A and as 0.2 adult and 0.2 immature birds based Scoping Approach B (Table 5.232). All mortality was attributable to the non-breeding periods.

2906. No mortality from displacement was predicted using the Developer Approach for any age class or season Table 5.232).

2907. The additional annual mortality of adult kittiwakes from the Copinsay SPA population predicted due to displacement from the Proposed Development array area represents 0.005% of the current adult breeding population at this colony (i.e. 1,910 individuals – Offshore EIA Report, Table 3.3 in volume 3, appendix

11.5) as determined by Scoping Approach A, and 0.01% as determined by Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.188 from West Westray, the closest colony to Copinsay– see Offshore EIA Report, Table 2.13 of volume 3, appendix 11.6), the estimates of adult mortality equate to an increase of 0.03 – 0.06% for the lower and upper estimates from the Scoping Approach. As outlined above and in Table 5.232, no mortality was predicted using the Developer Approach.

Collision risk

2908. The approach used to derive predicted levels of mortality for Copinsay SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report volume 3, appendix 11.3)

29. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of kittiwakes from the Copinsay SPA is predicted to be approximately 0.4 adults and 0.4 immatures as determined by the Scoping Approach, and approximately 0.3 adults and 0.3 immatures as determined by the Developer Approach (Table 5.233). All mortality was attributable to the non-breeding periods.

Table 5.233: Predicted Collision Effects from the Proposed Development on the Copinsay SPA Kittiwake Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.0	0.0
	Autumn migration	0.2	0.2
	Spring migration	0.2	0.2
	Annual total	0.4	0.4
Developer	Breeding	0.0	0.0
	Autumn migration	0.1	0.1
	Spring migration	0.2	0.2
	Annual total	0.3	0.3

2909. The additional annual mortality of adult kittiwakes from the Copinsay SPA population predicted due to collision represents approximately 0.01% of the number of adults currently estimated to breed at this colony (i.e. 1910 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.02% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying the West Westray mortality rate of 0.188 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.08% and 0.11% for the Developer and Scoping Approaches, respectively.

2910. As outlined in the Project Alone: Operation and Maintenance - Collision risk section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the Copinsay SPA kittiwake population that are at least 50% lower than those presented in Table 5.233 above (and on which the assessment is based).

Changes to prey availability

2911. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the Copinsay SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

2912. Given this, it is considered that there is no potential for the Copinsay SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Copinsay SPA kittiwake population.

Project alone: population-level impacts

2913. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the Copinsay SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase.

2914. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. The potential increase in annual adult mortality from displacement is between zero and 0.2 birds per year and those from collision impacts from between 0.3 and 0.4 adult birds per year.

Project alone: Conclusion

2915. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Copinsay SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. Any impacts are likely to be within the natural variation of the population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects in-combination

Effects of relevance to the in-combination assessment

2916. For the same reasons as described in *Effects in-combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, the potential for effects of the Proposed Development to act on the Copinsay Island SPA kittiwake population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

2917. In-combination totals have been collated for all relevant SPA populations for all UK North Sea and Channel offshore wind farms in operation, construction, consented or planning (volume 3, appendix 11.6, annex E of the Offshore EIA Report). Separate in-combination totals for the Forth and Tay projects were not collated for the reasons outlined in *Effects in-combination* for the Farne Islands SPA kittiwake population, volume 3, appendix 11.6, annex E and volume 3, appendix 11.8 of the Offshore EIA Report.

Displacement/Barrier effects – operation and maintenance

2918. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for St Abb's Head to Fast

Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2919. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.234).

Table 5.234: Estimated Annual Mortality of Copinsay SPA Kittiwakes as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, in-Combination With Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.0	0.0	0.2	0.1	0.3	0.1	0.4	0.3
	Scoping B	0.0	0.0	0.5	0.3	0.8	0.4	1.3	0.8
	Developer	0.0	0.0	N/A	N/A	N/A	N/A	0.0	0.0

2920. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Copinsay SPA population predicted due to displacement represents between approximately 0.02-0.06% of the current adult breeding population at this colony (i.e. 1,910 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.11 – 0.36% for the lower and upper estimates from the Scoping Approach. No mortality of kittiwake from displacement effects is predicted to occur following the Developer Approach.

Collision risk - operation and maintenance

2921. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2922. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.235).

Table 5.235: Predicted Collision Effects on the Copinsay SPA Kittiwake Population Due to the Proposed Development in-Combination With Other Projects in the UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions: Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.0	0.0
		Autumn migration	1.0	0.7
		Spring migration	1.3	0.7
		Annual total	2.3	1.4
	Developer	Breeding	0.0	0.0
		Autumn migration	0.9	0.6
		Spring migration	1.3	0.6
		Annual total	2.2	1.2

2923. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Copinsay SPA population predicted due to collisions represents 0.11% of the current adult breeding population at this colony (i.e. 1,910 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and 0.12% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 0.61% for the Developer Approach and of 0.64% for the Scoping Approach.

In-combination: population-level impacts

2924. The combined in-combination impacts arising from both displacement and collision impacts are presented in Table 5.236.

Table 5.236: Predicted Collision Effects on the Copinsay SPA Kittiwake Population Due to the Proposed Development In-Combination With Other Projects in the UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions: Breeding Adults	Immatures
UK North Sea	Scoping A	Displacement	0.4	0.3
		Collision	2.3	1.4
		Total	2.7	1.7
	Scoping B	Displacement	1.3	0.8
		Collision	2.3	1.4
		Total	3.6	2.2
	Developer	Displacement	0.0	0.0
		Collision	2.2	1.2
		Total	2.2	1.2

2925. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the Copinsay SPA population predicted due to the combined impacts from displacement and collisions represents 0.11% of the current adult breeding population at this colony (i.e. 1,910 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, 0.14% of this population as determined by the Scoping Approach A and 0.19% for Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 0.61% for the Developer Approach and of 0.75% for the Scoping Approach B and up to 1.0% based on Scoping Approach B.

2926. The predicted in-combination population-level impacts are small, in particular if the Developer Approach or Scoping Approach A are considered. Although it is recognised that the kittiwake population is declining and identified as being in unfavourable condition, any in-combination impacts are likely to be within the natural variation of the population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

In-combination: Conclusion

2927. On the basis of the Developer and Scoping Approaches, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Copinsay SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Copinsay SPA kittiwake population.

Assessment for the breeding seabird assemblage

2928. The breeding seabird assemblage for the Copinsay SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supported 70,000 seabirds). Kittiwakes are amongst the species identified in the citation as having nationally important populations which contribute to the Copinsay SPA breeding seabird assemblage. No LSE was determined for the other species in relation to the Proposed Development (HRA Stage One Screening Report; SSER, 2021b).

2929. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA kittiwake population in relation to the Proposed Development alone and in-combination.

2930. Given the above, it is concluded that there is no potential for an adverse effect on the Copinsay SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

2931. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Copinsay SPA population of breeding kittiwake and breeding seabird assemblage qualifying feature.

5.7.13. SULE SKERRY AND SULE STACK SPA

European site information and conservation objectives

2932. Sule Skerry and Sule Stack are isolated islets 60 km west of Mainland, Orkney, approximately 391 km from the Proposed Development. Sule Skerry is larger, low-lying and vegetated whereas Sule Stack is a higher, bare rock stack. The boundary of the SPA overlaps with those of Sule Skerry SSSI and Sule Stack SSSI and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1994, with the marine extension classified in 2009.

2933. There are two annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting two migratory seabird species and in excess of 20,000 breeding seabirds (Table 5.237). The potential for LSE has been identified in relation to gannet (Table 5.237), with the effect pathways associated with LSE detailed in Table 3.1 and set out in the assessment below.

2934. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

2935. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2936. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2937. Further information on this European site is presented in appendix 3A.

Table 5.237: Details on the Qualifying Features of the Sule Skerry and Sule Stack SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Favourable maintained	100,000 individuals	Yes
Guillemot*	Breeding	Favourable maintained	6,298 pairs	No
Puffin	Breeding	Favourable declining	46,900 pairs	No
Storm petrel	Breeding	Favourable declining	5,000 pairs	No
Leach's storm petrel	Breeding	Unfavourable declining	5 pairs	No
Gannet	Breeding	Favourable maintained	5,900 pairs	Yes
Shag*	Breeding	Unfavourable declining	874 pairs	No

*Named components of the assemblage only.

Assessment for the gannet population

2938. The Sule Skerry and Sule Stack SPA gannet population is currently estimated to number 9,065 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2013. Gannet are also listed on the Sule Skerry and Sule Stack SPA citation as a named component of the breeding seabird assemblage.

2939. Potential impacts on the Sule Skerry and Sule Stack SPA gannet population screened in for assessment are outlined in section 3 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the gannet population

2940. The Proposed Development and associated buffers (e.g. as used in the estimation of displacement effects from the Proposed Development Array Area) do not overlap with the Sule Skerry and Sule Stack SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2941. From published information on gannet foraging ranges it is possible that during the breeding period gannets from this SPA could occur within the area of the proposed development and the 2 km buffer around the Proposed Development Array area (Woodward *et al.* 2019). However, Sule Skerry and Sule Stack SPA is located 391 km from the Proposed development and therefore the use of the Proposed Development array area by gannet from this SPA during the breeding period is predicted to be relatively low. This is reflected in the findings of the apportioning exercise, which estimates that 0.3% of the adult gannets occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance

2942. During the non-breeding period gannets move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, (Offshore EIA Report, volume 3, appendix 11.5)). Given the above, the Proposed Development may have potential effects on the Sule Skerry and Sule Stack SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

2943. Direct disturbance to gannet during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Firth of Forth gannet population; Table 4.1).

2944. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2945. Gannet breeding at the Sule Skerry and Sule Stack SPA are predicted to utilise the Proposed Development during the breeding season to a relatively low extent (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, gannet distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located. The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2946. Furthermore, given the low sensitivity of gannet to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Forth Islands SPA gannet population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Sule Skerry and Sule Stack SPA gannet population.

Displacement

2947. Gannet are considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Sule Skerry and Sule Stack SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development Array Area or Proposed Development export cable corridor but will, rather, be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

2948. Therefore, based upon the above, it is considered that there is relatively little potential for the Sule Skerry and Sule Stack SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Sule Skerry and Sule Stack SPA gannet population.

Changes to prey availability

2949. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence basis and context applies to the Sule Skerry and Sule Stack SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2950. Given this, it is considered that there is relatively little potential for the Sule Skerry and Sule Stack SPA gannet population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Sule Skerry and Sule Stack SPA gannet population.

Project alone: operation and maintenance

Disturbance

2951. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets from Sule Skerry and Sule Stack SPA during the breeding and non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Sule Skerry and Sule Stack SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the breeding and non-breeding periods.

2952. Given the low sensitivity of gannet to disturbance effects at sea, the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Sule Skerry and Sule Stack SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/Barrier effects

2953. The approach used to derive predicted levels of mortality for Sule Skerry and Sule Stack SPA gannets is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and in the Offshore EIA Report volume 3, appendix 11.4)

2954. Estimates of gannet mortality for Sule Skerry and Sule Stack SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Sule Skerry and Sule Stack SPA gannet population as described in the Offshore EIA Report, volume 3, appendix 11.5 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and according to the apportioning estimates in Table 5.238).

Table 5.238: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Sule Skerry and Sule Stack SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,735	0.99	0.003	0.003	0.10
Autumn migration	1,500	N/A	0.003	0.000	N/A
Spring migration	269	N/A	0.000	0.000	N/A

Table 5.239: Estimated Potential Annual Mortality of Sule Skerry and Sule Stack SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.0	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.1	0.0
Scoping B	Breeding	70%	3%	0.3	0.0
	Autumn migration	70%	3%	0.1	0.0
	Spring migration	70%	3%	0.0	0.0
	Annual total	-	-	0.4	0.0
Developer	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.0	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.1	0.0

2955. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 0.1 adult and no immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 0.4 adult and no immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.239).

2956. The additional annual mortality of adult gannets from the Sule Skerry and Sule Stack SPA population predicted due to displacement from the Proposed Development Array represents <0.001% of the current adult breeding population at this colony (i.e. 18,130 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately <0.001 – 0.002% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2. of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.01% for the Developer Approach and of 0.01 – 0.05% for the lower and upper estimates from the Scoping Approach.

2957. The potential levels of impact on the Sule Skerry and Sule Stack SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered to be relatively very small compared to the breeding population and the loss of up to 0.4 adult gannets per year will not cause a population level effect.

Collision risk

2958. The approach used to derive predicted levels of mortality for Sule Skerry and Sule Stack SPA gannet is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the Forth Islands SPA gannet population (and in the Offshore EIA Report volume 3, appendix 11.3)

2959. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of gannet from the Sule Skerry and Sule Stack SPA is predicted to be approximately 0.4 adults and 0.0 immatures as determined by the Scoping Approach, and approximately 0.6 adults and 0.0 immatures as determined by the Developer Approach (Table 5.240). All mortality was attributable to the non-breeding periods.

Table 5.240: **Predicted Collision Effects from the Proposed Development on the Sule Skerry and Sule Stack SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate**

Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
Scoping	Breeding	0.5	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.0	0.0
	Annual total	0.6	0.0
Developer	Breeding	0.4	0.0
	Autumn migration	0.0	0.0
	Spring migration	0.0	0.0
	Annual total	0.4	0.0

2960. The additional annual mortality of adult gannets from the Sule Skerry and Sule Stack SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.002% of the number of adults currently estimated to breed at this colony (i.e. 18,130 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.003% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.05% and 0.07% for the Developer and Scoping Approaches, respectively.

2961. The collision estimates produced using option 2 of the stochastic CRM with the Bowgen and Cook (2018) avoidance rates applied are 54% lower than those presented in Table 5.240 (for both the Scoping and Developer Approaches).

2962. The potential levels of impact on the Sule Skerry and Sule Stack SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance phase are relatively very small compared with the breeding population. The potential loss of up to 0.6 gannets per year is not predicted to cause a population level effect.

Changes to prey availability

2963. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Sule Skerry and Sule Stack SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

2964. Given this, it is considered that there is relatively little potential for the Sule Skerry and Sule Stack SPA gannet population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Sule Skerry and Sule Stack SPA gannet population.

Project alone: population-level impacts

2965. Based on the Developers Approach the potential loss of up to 0.5 gannets per year from the combined impacts arising from displacement and collisions equates to 0.002% of the breeding adult population. This increases to up to 0.7 gannets per year; 0.004% of the adult population based on the Scoping A approach and 1.0 gannets per year based on Scoping B approach; equivalent to a 0.005% of the breeding adult population. These levels of impact could increase the baseline mortality rate from between 0.06% and 0.12%.

2966. This level of impact is not predicted to cause a population level effect to the breeding gannet population at the Sule Skerry and Sule Stack SPA.

Project alone: Conclusion

2967. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Sule Skerry and Sule Stack SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be very small and at levels that would not impact on the population being of a similar size to that which would occur in the absence of the Proposed Development. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

2968. For the same reasons as described in *Effects in-combination for the Forth Islands* SPA gannet population, the potential for effects of the Proposed Development to act on the Sule Skerry and Sule Stack SPA gannet population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

Displacement/Barrier effects – operation and maintenance

2969. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2970. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.241)

Table 5.241: **Estimated Annual Mortality of Sule Skerry and Sule Stack SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with Other UK North Sea Wind Farms**

In-Combination Region	Approach	Seasonal Period: Breeding Adults	Breeding Immatures	Autumn Migration Adults	Autumn Migration Immatures	Spring Migration Adults	Spring Migration Immatures	Annual Total Adults	Annual Total Immatures
UK North Sea	Scoping A	0.1	0.0	0.5	0.3	0.0	0.0	0.6	0.3
	Scoping B	0.3	0.0	1.4	0.9	0.0	0.0	1.7	0.9
	Developer	0.1	0.0	0.5	0.3	0.0	0.0	0.6	0.3

2971. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannet from the Sule Skerry and Sule Stack SPA population predicted due to displacement represents between approximately 0.003% of the current adult breeding population at this colony (i.e. 18,130 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Developers Approach and between 0.003% and 0.009% based on Scoping Approaches A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.07% for developers approach and 0.07 – 0.20% for the lower and upper estimates from the Scoping Approach.

2972. The potential levels of impact on the Sule Skerry and Sule Stack SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array in-combination with other North Sea wind farms during the operation and maintenance phase are relatively very small compared to the breeding population and the loss of between 0.6 and 1.7 adult gannets per year will not cause a population level effect.

Collision risk - operation and maintenance

2973. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

2974. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.242).

Table 5.242: Predicted Collision Effects on the Sule Skerry and Sule Stack SPA Gannet Population Due to the Proposed Development In-Combination With Other Projects in the in UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs.

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.5	0.0
		Autumn migration	1.8	1.3
		Spring migration	0.0	0.0
		Annual total	2.2	1.3
	Developer	Breeding	0.4	0.0
		Autumn migration	1.8	1.3
		Spring migration	0.0	0.0
		Annual total	2.1	1.3

2975. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Sule Skerry and Sule Stack SPA population predicted due to collisions represents 0.01% of the current adult breeding population at this colony (i.e. 18,130 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and approximately 0.01% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population the estimates of adult collision mortality equate to an increase of 0.25% for the Developer Approach and 0.26% for the Scoping Approach.

2976. The potential levels of impact on the Sule Skerry and Sule Stack SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with other UK North Sea wind farms during the operation and maintenance phase are relatively very small compared to the breeding population and the loss of between 2.1 and 2.2 adult gannets per year will not cause a population level effect.

In-combination: population-level impacts

2977. Based on the Developers Approach the potential loss of up to 2.7 gannets per year from the combined in-combination impacts arising from displacement and collisions equates to 0.015% of the breeding adult population. This increases to up to 2.8 gannets per year; 0.015% of the adult population based on the Scoping Approach A and 3.9 gannets per year based on Scoping B approach; equivalent to a 0.021% of the breeding adult population. These levels of impact could increase the baseline mortality rate from between 0.32% and 0.47%.

2978. This level of in-combination impact is not predicted to cause a population level effect to the breeding gannet population at the Sule Skerry and Sule Stack SPA.

In-combination: Conclusion

2979. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Sule Skerry and Sule Stack SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Sule Skerry and Sule Stack SPA gannet population.

Assessment for the breeding seabird assemblage

2980. The breeding seabird assemblage for the Sule Skerry and Sule Stack SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Gannet is amongst the species identified in the citation as having nationally important populations which contribute to the Sule Skerry and Sule Stack SPA breeding seabird assemblage.

2981. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA gannet population in relation to the Proposed Development alone and in-combination.

2982. Given the above, it is concluded that there is no potential for an adverse effect on the Sule Skerry and Sule Stack SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

2983. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Sule Skerry and Sule Stack SPA population of breeding gannet.

5.7.14. FAIR ISLE SPA

European site information and conservation objectives

2984. The island of Fair Isle is the most southerly of the Shetland group, lying halfway between Mainland Shetland and Orkney, approximately 358 km from the Proposed Development. The boundary of Fair Isle SPA is coincident with Fair Isle SSSI and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1994, with the marine extension classified in 2009.

2985. There is one annex I qualifying seabird feature and the site qualifies under Article 4.2 by regularly supporting one migratory seabird species and in excess of 20,000 breeding seabirds, including eight named component species Table 5.243). The potential for LSE has been identified in relation to gannet (Table 5.243), with the effect pathways associated with LSE detailed in Table 3.1 and set out in the assessment below.

2986. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (SiteLink (nature.scot)) are:

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

2987. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2988. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

2989. Further information on this European site is presented in appendix 3A.

Table 5.243: Details on the Qualifying Features of Fair Isle SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable no change	180,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	18,160 pairs	No
Arctic tern	Breeding	Unfavourable declining	1,100 pairs	No
Great skua*	Breeding	Favourable maintained	110 pairs	No
Arctic skua*	Breeding	Unfavourable declining	110 pairs	No
Guillemot	Breeding	Unfavourable declining	32,300 individuals	No
Razorbill*	Breeding	Unfavourable declining	3,400 individuals	No
Puffin*	Breeding	Unfavourable declining	23,000 individuals	No
Fulmar*	Breeding	Favourable maintained	35,210 pairs	No
Gannet*	Breeding	Favourable maintained	1,166 pairs	Yes
Shag*	Breeding	Unfavourable declining	1,100 pairs	No

*Named components of the assemblage only.

Assessment for the gannet population

2990. The Fair Isle SPA gannet population is currently estimated to number 9942 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2021. Gannet are listed on the Fair Isle SPA citation as a named component of the breeding seabird assemblage.

2991. Potential impacts on the Fair Isle SPA gannet population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the gannet population

2992. The Proposed Development and associated buffers (e.g. as used in the estimation of displacement effects from the Proposed Development Array Area) do not overlap with the Fair Isle SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

2993. From published information on gannet foraging ranges it is possible that during the breeding period gannets from this SPA could occur within the area of the proposed development and the 2 km buffer around the Proposed Development Array area (Woodward *et al.* 2019). However, Fair Isle SPA is located 358 km from the Proposed development and therefore the use of the Proposed Development array area by gannet from this SPA during the breeding period is predicted to be relatively low. This is reflected in the findings of the apportioning exercise, which estimates that 0.2% of the gannets occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance

2994. During the non-breeding period gannets move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, (Offshore EIA Report, volume 3, appendix 11.5)). Given the above, the Proposed Development may have potential effects on the Fair Isle SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

2995. Direct disturbance to gannet during the assumed construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Firth of Forth gannet population; Table 4.1).

2996. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

2997. Gannet breeding at the Fair Isle SPA are predicted to utilise the Proposed Development during the breeding season to a relatively low extent (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, gannet distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located. The potential for effects of construction- and decommissioning-related disturbance is therefore low.

2998. Furthermore, given the low sensitivity of gannets to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to construction activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Forth Islands SPA gannet population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Fair Isle SPA gannet population.

Displacement

2999. Gannet are considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Fair Isle SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development Array Area or Proposed Development export cable corridor but will, rather, be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannets from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

3000. Therefore, based upon the above, it is considered that there is relatively little potential for the Fair Isle SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Fair Isle SPA gannet population.

Changes to prey availability

3001. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence basis and context applies to the Fair Isle SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3002. Given this, it is considered that there is relatively little potential for the Fair Isle SPA gannet population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Fair Isle SPA gannet population.

Project alone: operation and maintenance

Disturbance

3003. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets from Fair Isle SPA during the breeding and non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Fair Isle SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the breeding and non-breeding periods.

3004. Given the low sensitivity of gannets to disturbance effects at sea, the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Fair Isle SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/Barrier effects

3005. The approach used to derive predicted levels of mortality for Fair Isle SPA gannets is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and in Offshore EIA Report volume 3, appendix 11.4)

3006. Estimates of gannet mortality for Fair Isle SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Fair Isle SPA gannet population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and according to the apportioning estimates in Table 5.244).

Table 5.244: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Fair Isle SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is Also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,735	0.99	0.002	0.002	0.10
Autumn migration	1,500	N/A	0.006	0.000	N/A
Spring migration	269	N/A	0.005	0.004	N/A

Table 5.245: Estimated Potential Annual Mortality of Fair Isle SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.1	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.2	0.0

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality Breeding Adults	Immatures
Scoping B	Breeding	70%	3%	0.2	0.0
	Autumn migration	70%	3%	0.2	0.0
	Spring migration	70%	3%	0.0	0.0
	Annual total	-	-	0.4	0.0
Developer	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.1	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.2	0.0

3007. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 0.2 adult and no immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 0.4 adult and no immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.245).

3008. The additional annual mortality of adult gannets from the Fair Isle SPA population predicted due to displacement from the Proposed Development Array represents 0.002% of the current adult breeding population at this colony (i.e. 9,942 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.002 – 0.004% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.04% for the Developer Approach and of 0.04 – 0.09% for the lower and upper estimates from the Scoping Approach.

3009. The potential levels of impact on the Fair Isle SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered to be relatively very small compared to the breeding population and the loss of up to 0.4 adult gannets per year will not cause a population level effect.

Collision risk

3010. The approach used to derive predicted levels of mortality for Fair Isle SPA gannet is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the Forth Islands SPA gannet population (and in the Offshore EIA Report volume 3, appendix 11.3)

3011. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of gannet from the Fair Isle SPA is predicted to be approximately 0.4 adults and 0.0 immatures as determined by the Scoping Approach, and approximately 0.3 adults and 0.0 immatures as determined by the Developer Approach (Table 5.246). All mortality was attributable to the non-breeding periods.

Table 5.246: Predicted Collision Effects From the Proposed Development on the Fair Isle SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (See Text)

Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
Scoping	Breeding	0.3	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.0	0.0
	Annual total	0.4	0.0
Developer	Breeding	0.2	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.0	0.0
	Annual total	0.3	0.0

3012. The additional annual mortality of adult gannets from the Fair Isle SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.003% of the number of adults currently estimated to breed at this colony (i.e. 9,942 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.004% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.06% and 0.09% for the Developer and Scoping Approaches, respectively.

3013. The potential levels of impact on the Fair Isle SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance phase are relatively very small compared with the breeding population. The potential loss of up to 0.4 gannets per year is not predicted to cause a population level effect.

Changes to prey availability

3014. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Fair Isle SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3015. Given this, it is considered that there is relatively little potential for the Fair Isle SPA gannet population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Fair Isle SPA gannet population.

Project alone: population-level impacts

3016. Based on the Developer Approach the potential loss of up to 0.5 gannets per year from the combined impacts arising from displacement and collisions equates to 0.005% of the breeding adult population. This increases to up to 0,8 gannets per year; 0.008% of the adult population based on the Scoping approach. This could increase the baseline mortality rate from between 0.11% and 0.17%.

3017. This level of impact is not predicted to cause a population level effect to the breeding gannet population at the Fair Isle SPA.

Project alone: Conclusion

3018. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Fair Isle SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be very small and at levels that would not impact on the population being of a similar size to that which would occur in the absence of the Proposed Development. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

3019. For the same reasons as described in *Effects in-combination* for the Forth Islands SPA gannet population, the potential for effects of the Proposed Development to act on the Fair Isle SPA gannet population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

Displacement/Barrier effects – operation and maintenance

3020. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3021. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.247)

Table 5.247: Estimated Annual Mortality of Fair Isle SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.1	0.0	1.2	1.0	0.7	0.5	1.9	1.6
	Scoping B	0.2	0.0	3.6	3.0	2.0	1.6	5.7	4.7
	Developer	0.1	0.0	1.2	1.0	0.7	0.5	1.9	1.6

3022. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannet from the Fair Isle SPA population predicted due to displacement represents between approximately 0.02% of the current adult breeding population at this colony (i.e. 9,942 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Developers Approach and between 0.02% and 0.06% based on Scoping Approaches A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.41% for the Developer Approach and 0.41 – 1.24% for the lower and upper estimates from the Scoping Approach.

3023. The potential levels of impact on the Fair Isle SPA gannet population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

3024. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3025. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.248).

Table 5.248: Predicted Collision Effects on the Fair Isle SPA Gannet Population Due to the Proposed Development in-Combination With Other Projects in the UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.3	0.0
		Autumn migration	4.8	3.9
		Spring migration	3.6	2.9
		Annual total	8.7	6.9
	Developer	Breeding	0.2	0.0
		Autumn migration	4.8	3.9
		Spring migration	3.6	2.9
		Annual total	8.6	6.9

3026. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Fair Isle SPA population predicted due to collisions represents 0.08% of the current adult breeding population at this colony (i.e. 9,942 individuals –Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.09% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population the estimates of adult collision mortality equate to an increase of 1.9% for both the Developer and Scoping Approaches.

3027. The potential levels of impact on the Fair Isle SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with either the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

3028. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the

Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.247 and Table 5.248 above).

3029. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-combination: population-level impacts* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6 of the Offshore EIA Report.

Table 5.249: Projected 35 Year Population Sizes and Associated PVA Metrics for the Fair Isle SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
	Adults	Immatures				
Baseline	0	0	52106 (30201 – 81721)	1.000	1.000	50.0
Scoping A	10.66	8.42	49925 (28918 – 78309)	0.958	0.999	44.0
Scoping B	14.42	11.55	49144 (28460 – 77092)	0.943	0.998	42.0
Developer	10.57	8.42	49925 (28918 – 78309)	0.958	0.999	44.0

3030. The predicted in-combination population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. For Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development in-combination with estimated impacts with other North Sea wind farms would result in a reduction of approximately 5.7% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.249). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.002, whilst the centile value of 42.0 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest smaller levels of impact (Table 5.249).

In-combination: Conclusion

3031. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Fair Isle SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Fair Isle SPA gannet population.

Assessment for the breeding seabird assemblage

3032. The breeding seabird assemblage for the Fair Isle SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Gannet is amongst the species identified in the citation as having nationally important populations which contribute to the Fair Isle SPA breeding seabird assemblage.

3033. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA gannet population in relation to the Proposed Development alone and in-combination.

3034. Given the above, it is concluded that there is no potential for an adverse effect on the Fair Isle SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3035. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Fair Isle SPA population of breeding gannet and breeding seabird assemblage qualifying feature.

5.7.15. NORTH RONA AND SULA SGEIR SPA

European site information and conservation objectives

3036. The uninhabited islands of North Rona and Sula Sgeir SPA, together with several outlying rocky islets and adjacent waters, lie 65 km north of Lewis and approximately 475 km from the Proposed Development. The coastlines of both islands consist mainly of cliffs except for two low-lying peninsulas on North Rona. Sula Sgeir lies about 15 km west of North Rona. The boundary of the SPA overlaps with the boundary of North Rona & Sula Sgeir SSSI, and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 2001, with the marine extension classified in 2009.

3037. There are two annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting two migratory seabird species and in excess of 20,000 breeding seabirds (Table 5.250). The potential for LSE has been identified for gannet (Table 5.250), with the effect pathways associated with LSE detailed in Table 3.1 and set out in the assessment below.

3038. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

- To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and

– No significant disturbance of the species.

3039. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3040. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3041. Further information on this European site is presented in appendix 3A.

Table 5.250: Details on the Qualifying Features of the North Rona and Sula Sgeir SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Favourable maintained	130,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	5,000 pairs	No
Great black-backed gull*	Breeding	Unfavourable declining	730 pairs	No
Guillemot	Breeding	Unfavourable declining	43,200 individuals	No
Razorbill*	Breeding	Unfavourable declining	2,300 individuals	No
Puffin*	Breeding	Unfavourable no change	5,300 apparently occupied sites	No
Storm petrel	Breeding	Favourable maintained	Not available	No
Leach's storm petrel	Breeding	Unfavourable declining	Not available	No
Fulmar*	Breeding	Unfavourable declining	11,500 pairs	No
Gannet	Breeding	Favourable maintained	10,400 pairs	Yes

*Named components of the assemblage only.

Assessment for the gannet population

3042. The North Rona and Sula Sgeir SPA gannet population is currently estimated to number 11,230 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2013. Gannet are listed on the North Rona and Sula Sgeir SPA citation as a named component of the breeding seabird assemblage.

3043. Potential impacts on the North Rona and Sula Sgeir SPA gannet population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the gannet population

3044. The Proposed Development and associated buffers (e.g. as used in the estimation of displacement effects from the Proposed Development Array Area) do not overlap with the North Rona and Sula Sgeir SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3045. From published information on gannet foraging ranges it is possible that during the breeding period gannets from this SPA could occur within the area of the proposed development and the 2 km buffer around the Proposed Development Array area (Woodward *et al.* 2019). However, North Rona and Sula Sgeir SPA is located 475 km from the Proposed development and therefore the use of the Proposed Development array area by gannet from this SPA during the breeding period is predicted to be relatively low. This is reflected in the findings of the apportioning exercise, which estimates that 0.2% of the gannets occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance

3046. During the non-breeding period gannets move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, (Offshore EIA Report volume 3, appendix 11.5)). Given the above, the Proposed Development may have potential effects on the North Rona and Sula Sgeir SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

3047. Direct disturbance to gannet during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Firth of Forth gannet population; Table 4.1).

3048. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

3049. Gannet breeding at the North Rona and Sula Sgeir SPA are predicted to utilise the Proposed Development during the breeding season to a relatively low extent (Offshore EIA Report volume 3, appendix 11.5). During the non-breeding periods, gannet distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located. The potential for effects of construction- and decommissioning-related disturbance is therefore low.

3050. Furthermore, given the low sensitivity of gannet to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Forth Islands SPA gannet population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the North Rona and Sula Sgeir SPA gannet population.

Displacement

3051. Gannet are considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the North Rona and Sula Sgeir SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development Array Area or Proposed Development export cable corridor but will, rather, be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

3052. Therefore, based upon the above, it is considered that there is relatively little potential for the North Rona and Sula Sgeir SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the North Rona and Sula Sgeir SPA gannet population.

Changes to prey availability

3053. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence basis and context applies to the North Rona and Sula Sgeir SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3054. Given this, it is considered that there is relatively little potential for the North Rona and Sula Sgeir SPA gannet population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the North Rona and Sula Sgeir SPA gannet population.

Project alone: operation and maintenance

Disturbance

3055. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets from North Rona and Sula Sgeir SPA during the breeding and non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA gannet population. The same evidence base and context applies to the North Rona and Sula Sgeir SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the breeding and non-breeding periods.

3056. Given the low sensitivity of gannet to disturbance effects at sea, the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the North Rona and Sula Sgeir SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/Barrier effects

3057. The approach used to derive predicted levels of mortality for North Rona and Sula Sgeir SPA gannets is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and in Offshore EIA Report, volume 3, appendix 11.4)

3058. Estimates of gannet mortality for North Rona and Sula Sgeir SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report volume 3, appendix 11.4), with these estimates then apportioned to the North Rona and Sula Sgeir SPA gannet population as described in the Offshore EIA Report, volume 3, appendix 11.5 and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and according to the apportioning estimates in Table 5.251).

Table 5.251: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the North Rona and Sula Sgeir SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			ADULTS	IMMATURES	
Breeding	4,735	0.99	0.002	0.002	0.10
Autumn migration	1,500	N/A	0.006	0.000	N/A
Spring migration	269	N/A	0.000	0.000	N/A

Table 5.252: Estimated Potential Annual Mortality of North Rona and Sula Sgeir SPA Gannets as a Result of Displacement from the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.1	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.2	0.0
Scoping B	Breeding	70%	3%	0.2	0.0
	Autumn migration	70%	3%	0.2	0.0
	Spring migration	70%	3%	0.0	0.0
	Annual total	-	-	0.4	0.0
Developer	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.1	0.0
	Spring migration	70%	1%	0.0	0.0
	Annual total	-	-	0.2	0.0

3059. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 0.2 adult and no immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 0.4 adult and no immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.252).

3060. The additional annual mortality of adult gannets from the North Rona and Sula Sgeir SPA population predicted due to displacement from the Proposed Development Array represents <0.001% of the current adult breeding population at this colony (i.e. 22460 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately <0.001 – 0.002% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2. of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.02% for the Developer Approach and of 0.02 – 0.04% for the lower and upper estimates from the Scoping Approach.

3061. The potential levels of impact on the North Rona and Sula Sgeir SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered to be relatively very small compared to the breeding population and the loss of up to 0.4 adult gannets per year will not cause a population level effect.

Collision risk

3062. The approach used to derive predicted levels of mortality for North Rona and Sula Sgeir SPA gannet is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the Forth Islands SPA gannet population (and in the Offshore EIA Report, volume 3, appendix 11.3)

3063. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of gannet from the North Rona and Sula Sgeir SPA is predicted to be approximately 0.4 adults and 0.0 immatures as determined by the Scoping Approach, and approximately 0.3 adults and 0.0 immatures as determined by the Developer Approach (Table 5.253). All mortality was attributable to the non-breeding periods.

Table 5.253: Predicted Collision Effects From the Proposed Development on the North Rona and Sula Sgeir SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (See Text)

Approach	Seasonal period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.3	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.0	0.0
	Annual total	0.4	0.0
Developer	Breeding	0.2	0.0
	Autumn migration	0.1	0.0
	Spring migration	0.0	0.0
	Annual total	0.3	0.0

3064. The additional annual mortality of adult gannets from the North Rona and Sula Sgeir SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.001% of the number of adults currently estimated to breed at this colony (i.e. 22,460 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.002% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.03% and 0.04% for the Developer and Scoping Approaches, respectively.

3065. The potential levels of impact on the North Rona and Sula Sgeir SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance phase are relatively very small compared with the breeding population. The potential loss of up to 0.4 gannets per year is not predicted to cause a population level effect.

Changes to prey availability

3066. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence base and context applies to the North Rona and Sula Sgeir SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3067. Given this, it is considered that there is relatively little potential for the North Rona and Sula Sgeir SPA gannet population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the North Rona and Sula Sgeir SPA gannet population.

Project alone: population-level impacts

3068. Based on the Developers Approach the potential loss of up to 0.5 gannets per year from the combined impacts arising from displacement and collisions equates to 0.002% of the breeding adult population. This increases to up to 0.8 gannets per year; 0.003% of the adult population based on the Scoping approach. This could increase the baseline mortality rate from between 0.05% and 0.08%.

3069. This level of impact is not predicted to cause a population level effect to the breeding gannet population at the North Rona and Sula Sgeir SPA.

Project alone: Conclusion

3070. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the North Rona and Sula Sgeir SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be very small and at levels that would not impact on the population being of a similar size to that which would occur in the absence of the Proposed Development. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

3071. For the same reasons as described in *Effects in-combination* for the Forth Islands SPA gannet population, the potential for effects of the Proposed Development to act on the North Rona and Sula Sgeir SPA gannet population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

Displacement/Barrier effects – operation and maintenance

3072. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3073. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.254)

Table 5.254 Estimated Annual Mortality of North Rona and Sula Sgeir SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination with Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.1	0.0	0.8	0.6	0.0	0.0	0.9	0.6
	Scoping B	0.2	0.0	2.5	1.9	0.0	0.0	2.7	1.9
	Developer	0.1	0.0	0.8	0.6	0.0	0.0	0.9	0.6

3074. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannet from the North Rona and Sula Sgeir SPA population predicted due to displacement represents between approximately 0.004% of the current adult breeding population at this colony (i.e. 22,460 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Developers Approach and between 0.004% and 0.012% based on Scoping Approaches A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.09% for developers approach and 0.09 – 0.26% for the lower and upper estimates from the Scoping Approach.

The potential levels of impact on the North Rona and Sula Sgeir SPA gannet population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

3075. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3076. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.255).

Table 5.255 Predicted Collision Effects on the North Rona and Sula Sgeir SPA Gannet Population Due to the Proposed Development In-Combination With Other Projects in UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.3	0.0
		Autumn migration	3.1	2.5
		Spring migration	0.0	0.0
		Annual total	3.4	2.5
	Developer	Breeding	0.2	0.0
		Autumn migration	3.1	2.5
		Spring migration	0.0	0.0
		Annual total	3.3	2.5

3077. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the North Rona and Sula Sgeir SPA population predicted due to collisions represents 0.01% of the current adult breeding population at this colony (i.e. 9942 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.02% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population the estimates of adult collision mortality equate to an increase of 0.32% for the Developer Approach and 0.33% for the Scoping Approach.

3078. The potential levels of impact on the North Rona and Sula Sgeir SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with either the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In- combination: population-level impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

3079. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.254 and Table 5.255 above).

3080. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-combination: population-level impacts* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6 of the Offshore EIA Report.

Table 5.256 Projected 35 Year Population Sizes and Associated PVA Metrics for the North Rona and Sula Sgeir SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with Other UK North Sea Wind Farms.

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
	Adults	Immatures				
Baseline	0	0	138982 (76351 – 233225)	1.000	1.000	50.0
Scoping A	4.33	3.10	137929 (75765 – 231488)	0.992	1.000	48.8
Scoping B	6.08	4.41	137500 (75526 – 230782)	0.989	1.000	48.3
Developer	10.57	8.42	137942 (75772 – 231512)	0.993	1.000	48.8

3081. The predicted in-combination population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. For Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development in-combination with estimated impacts with other North Sea wind farms would result in a reduction of approximately 1.1% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.256). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be zero, whilst the centile value of 48.3 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest smaller levels of impact (Table 5.256).

In-combination: Conclusion

3082. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the North Rona and Sula Sgeir SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the North Rona and Sula Sgeir SPA gannet population.

Assessment for the breeding seabird assemblage

3083. The breeding seabird assemblage for the North Rona and Sula Sgeir SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Gannet is amongst the species identified in the citation as having nationally important populations which contribute to the North Rona and Sula Sgeir SPA breeding seabird assemblage.

3084. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA gannet population in relation to the Proposed Development alone and in-combination.

3085. Given the above, it is concluded that there is no potential for an adverse effect on the North Rona and Sula Sgeir SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3086. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the North Rona and Sula Sgeir SPA population of breeding gannet and breeding seabird assemblage qualifying feature.

5.7.16. FOULA SPA

European site information and conservation objectives

3087. Foula is the most westerly of the Shetland Islands which are situated to the north of the Scottish mainland and Orkney. It lies 20 km west of Shetland Mainland and approximately 402 km from the Proposed Development. The boundary of the SPA overlaps with the boundary of Foula SSSI and Foula Coast SSSI, and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1995, with the marine extension classified in 2009.

3088. There are three annex I qualifying features and the site qualifies under Article 4.2 by regularly supporting four migratory seabird species and in excess of 20,000 breeding seabirds, including four species only named as component species (Table 5.257). The potential for LSE has been identified in relation great skua (Table 5.257), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

3089. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

3090. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3091. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3092. Further information on this European site is presented in appendix 3A.

Table 5.257: Details on the Qualifying Features of Foula SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable declining	250,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	3,840 pairs	No
Arctic tern	Breeding	Unfavourable declining	1,500 pairs	No
Great skua	Breeding	Favourable recovered	2,270 pairs	Yes
Arctic skua*	Breeding	Unfavourable declining	133 pairs	No
Guillemot	Breeding	Unfavourable declining	37,500 individuals	No
Razorbill*	Breeding	Unfavourable declining	6,200 individuals	No
Puffin	Breeding	Unfavourable no change	48,000 pairs	No
Red-throated diver	Breeding	Favourable maintained	11 pairs	No
Leach's storm petrel	Breeding	Unfavourable declining	50 pairs	No
Fulmar*	Breeding	Unfavourable declining	46,800 pairs	No
Shag	Breeding	Unfavourable declining	2,400 pairs	No

*Named components of the assemblage only.

3093. Great skua only occur in the North Atlantic, nesting at relatively high latitudes and wintering south of their breeding sites. Most great skua nest in the eastern Atlantic, with an estimated global breeding population of 16,000 pairs, of which approximately 60% nest on islands in north and west Scotland. Great skua also nests in Faroes, Norway and Iceland and a small population breed in Ireland. Great skua forage on fish obtained via Kleptoparasitism from other seabird species and discards from fishing boats. They also predate on other seabird species. Great skua have a large foraging range when breeding, with the mean maximum foraging range reported as being 443.3 km (±487.9) (Woodward *et al.* 2019).

3094. The largest great skua colony in the world occurs on Foula. The population peaked in 1977 at 3,200 pairs but has since declined to 1,800 apparently occupied territories in 2015. The presence of HPAIV H5N1 (Avian Influenza) on Foula in 2022 (and possibly 2021) caused a high level of mortality in both adults and chicks with an estimated likely decline in breeding numbers of between 60 – 70% (Camphuysen and Gear 2022).

The potential for impacts on the great skua population

3095. Potential impacts on the Foula SPA great skua population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

3096. From published information on great skua foraging ranges it is apparent that during the breeding period great skua from the Foula SPA could, in theory, occur within the area of the Proposed Development and the 2 km buffer around the Proposed Development Array area (Woodward *et al*. 2019). However, data from tracking studies undertaken on Foula indicate that during the breeding period great skua utilise waters to the north and west of the SPA and do not occur regularly in the North Sea (Wade *et al.* 2014). The breeding period for great skua is defined as mid-April to mid-September, following the NatureScot (2020) guidance.

3097. Great skuas move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa and also North America returning north in the spring (Furness 2015), so that the non-breeding season is divided into autumn and spring passage periods (defined as August to October and March to April, respectively, with the winter period from November to February). Given the above, the Proposed Development may have potential effects on the Foula SPA great skua population during breeding and non-breeding periods.

Project alone: operation and maintenance

Collision risk

3098. Predictions of the number of great skua at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3 appendix 11.3 in Table 4.9). The assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), avoidance rates of 98.0% were applied to the outputs from option 2 and option 3, respectively. Annual great skua collision estimates are calculated.

3099. As outlined elsewhere (e.g. the St Abb's Head to Fast Castle SPA kittiwake CRM) the CRMs for great skua were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

3100. Based upon the Developer Approach option 2 of the deterministic CRM with a 98.0% avoidance rate applied, the total annual collision mortality of great skua is 0.18 adults. Based on the Scoping Approach option 2 and a 98% avoidance rate the total annual mortality of great skua is estimated to be 0.35 (Table 5.258 and see Offshore EIA Report, volume 3 appendix 11.3 Table 4.31) for all modelled scenarios). The estimated impacts based on the use of option 3 were lower with an estimated mortality of 0.02 and 0.05 birds per year for Developer and Scoping Approaches respectively.

Table 5.258: Predicted Collision Effects From the Proposed Development on Great Skua Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98% Avoidance Rate

Approach	Seasonal Period	Total Estimated Number of Collisions All Ages
Scoping	Annual total	0.35
Developer	Annual total	0.18

3101. Based upon the estimates from option 2 of the CRM, the additional annual mortality of great skua is 0.18 birds per year based on the Developer Approach. Under a worst-case scenario all 0.18 collisions per year have been assumed to be adults and apportioned to the Foula SPA breeding population. On this highly precautionary and unrealistic worst-case scenario it is estimated that the predicted collisions represent approximately 0.005% of the number of adults currently estimated to breed at this colony (i.e. 3,600 individuals) as determined by the Developer Approach and approximately 0.009% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.04% and 0.09% for the Developer and Scoping Approaches, respectively.

3102. The estimated number of collisions per annum relates to impacts on the whole great skua population and not just adults from this SPA. Most impacts are predicted to occur during spring and autumn passage periods (Offshore EIA Report appendix 11.1: section 5.14) when approximately 17.2% of the North Sea great skua population are birds from Foula SPA (Furness 2015). Consequently, of the 0.18 collisions per year 17.2% could be precited to be on birds from this SPA, equating to collision mortality of 0.03 birds per year based on the Developers Approach and 0.06 birds per year based on Scoping Approach. This estimated number of collisions represent approximately 0.0008% of the number of adults currently estimated to breed at this colony (i.e. 3,600 individuals) as determined by the Developer Approach and approximately 0.002% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of <0.01% and 0.01% for the Developer and Scoping Approaches, respectively.

Project alone: Conclusion

3103. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Foula SPA great skua population are predicted to be negligible, with the resultant population-level impacts also predicted to be negligible. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Collision risk

3104. As detailed above, any effects from the Proposed Development alone on the Foula SPA great skua population resulting from collision during operation and maintenance will be very small impacting on no more than 0.002% of the adult population and increasing the adult mortality by no more than 0.01%. Consequently, it is considered that there is no potential for an effect from the Proposed Development to add to impacts at a population level that could cause an in-combination adverse effect.

In-combination: Conclusion

3105. On the basis of the above considerations, it is concluded that the scale of the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Foula SPA great skua population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the breeding seabird assemblage

3106. The breeding seabird assemblage for the Foula SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supported 250,000 seabirds). Great skua are amongst the species identified in the citation as having nationally important populations which contribute to the Foula SPA breeding seabird assemblage. No LSE was determined for the other species in relation to the Proposed Development (HRA Stage One Screening Report; SSER, 2021b).

3107. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA great skua population in relation to the Proposed Development alone and in-combination.

3108. Given the above, it is concluded that there is no potential for an adverse effect on the Foula SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3109. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Foula SPA population of breeding great skua and breeding seabird assemblage qualifying feature.

5.7.17. NOSS SPA

European site information and conservation objectives

3110. Noss is an offshore island lying 5 km east of Lerwick, Shetland, approximately 429 km from the Proposed Development. The boundary of the SPA overlaps that of the Noss SSSI and NNR and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1996, with the marine extension classified in 2009.

3111. The site qualifies under Article 4.2 by regularly supporting three migratory seabird species and in excess of 20,000 breeding seabirds (Table 5.259). The potential for LSE has been identified in relation to gannet (Table 5.259), with the effect pathways associated with LSE detailed in Table 3.1 and set out in the assessment below.

3112. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

3113. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3114. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3115. Further information on this European site is presented in appendix 3A.

Table 5.259: Details on the Qualifying Features of Noss SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable declining	35,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	7,020 pairs	No
Great skua	Breeding	Favourable maintained	420 pairs	No
Guillemot	Breeding	Unfavourable no change	38,970 individuals	No
Puffin*	Breeding	Unfavourable declining	2,348 individuals	No
Fulmar*	Breeding	Favourable maintained	6,350 pairs	No
Gannet	Breeding	Favourable maintained	6,860 pairs	Yes

*Named components of the assemblage only.

Assessment for the gannet population

3116. The Noss SPA gannet population is currently estimated to number 13,765 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2019. Gannet are listed on the Noss SPA citation as a named component of the breeding seabird assemblage.

3117. Potential impacts on the Noss SPA gannet population screened in for assessment are outlined in Section 3.1 and in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the gannet population

3118. The Proposed Development and associated buffers (e.g. as used in the estimation of displacement effects from the Proposed Development Array Area) do not overlap with the Noss SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3119. From published information on gannet foraging ranges it is possible that during the breeding period gannets from this SPA could occur within the area of the proposed development and the 2 km buffer around the Proposed Development Array area (Woodward *et al.* 2019). However, Noss SPA is located 429 km from the Proposed development and therefore the use of the Proposed Development array area by gannet from this SPA during the breeding period is predicted to be relatively low. This is reflected in the findings of the apportioning exercise, which estimates that 0.4% of the gannets occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance

3120. During the non-breeding period gannets move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, (Offshore EIA Report, volume 3, appendix 11.5)). Given the above, the Proposed Development may have potential effects on the Noss SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

3121. Direct disturbance to gannet during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Firth of Forth gannet population; Table 4.1).

3122. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

3123. Gannet breeding at the Noss SPA are predicted to utilise the Proposed Development during the breeding season to a relatively low extent (Offshore EIA Report volume 3, appendix 11.5). During the non-breeding periods, gannet distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located. The potential for effects of construction- and decommissioning-related disturbance is therefore low.

3124. Furthermore, given the low sensitivity of gannet to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Forth Islands SPA gannet population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Noss SPA gannet population.

Displacement

3125. Gannet are considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Noss SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, otential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development Array Area or Proposed Development export cable corridor but will, rather, be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

3126. Therefore, based upon the above, it is considered that there is relatively little potential for the Noss SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Noss SPA gannet population.

Changes to prey availability

3127. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence basis and context applies to the Noss SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3128. Given this, it is considered that there is relatively little potential for the Noss SPA gannet population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Noss SPA gannet population.

Project alone: operation and maintenance

Disturbance

3129. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets from Noss SPA during the breeding and non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Noss SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the breeding and non-breeding periods.

3130. Given the low sensitivity of gannet to disturbance effects at sea, the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Noss SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/Barrier effects

3131. The approach used to derive predicted levels of mortality for Noss SPA gannets is as described in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and in volume 3, appendix 11.4 of the Offshore EIA Report)

3132. Estimates of gannet mortality for Noss SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Noss SPA gannet population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (and according to the apportioning estimates in Table 5.260).

Table 5.260: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together with the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Noss SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is Also Presented

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,735	0.99	0.004	0.004	0.10
Autumn migration	1,500	N/A	0.028	0.000	N/A
Spring migration	269	N/A	0.026	0.021	N/A

Table 5.261: Estimated Potential Annual Mortality of Noss SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.3	0.0
	Spring migration	70%	1%	0.1	0.0
	Annual total	-	-	0.5	0.0
Scoping B	Breeding	70%	3%	0.4	0.0
	Autumn migration	70%	3%	0.9	0.0
	Spring migration	70%	3%	0.2	0.1
	Annual total	-	-	1.5	0.1
Developer	Breeding	70%	1%	0.1	0.0
	Autumn migration	70%	1%	0.3	0.0
	Spring migration	70%	1%	0.1	0.0
	Annual total	-	-	0.5	0.0

3133. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 0.5 adult and no immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and as 1.5 adult and no immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.261).

3134. The additional annual mortality of adult gannets from the Noss SPA population predicted due to displacement from the Proposed Development Array represents 0.002% of the current adult breeding population at this colony (i.e. 27,530 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and between approximately 0.002 – 0.005% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.04% for the Developer Approach and of 0.04 – 0.12% for the lower and upper estimates from the Scoping Approach.

3135. The potential levels of impact on the Noss SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered to be relatively very small compared to the breeding population and the loss of up to 1.5 adult gannets per year will not cause a population level effect.

Collision risk

3136. The approach used to derive predicted levels of mortality for Noss SPA gannet is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the Forth Islands SPA gannet population (and in Offshore EIA Report volume 3, appendix 11.3)

3137. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of gannet from the Noss SPA is predicted to be approximately 1.2 adults and 0.0 immatures as determined by the Scoping Approach, and approximately 1.0 adults and 0.0 immatures as determined by the Developer Approach (Table 5.262). All mortality was attributable to the non-breeding periods.

Table 5.262: Predicted Collision Effects From the Proposed Development on the Noss SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (See Text)

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.6	0.0
	Autumn migration	0.5	0.0
	Spring migration	0.1	0.1
	Annual total	1.2	0.1
Developer	Breeding	0.5	0.0
	Autumn migration	0.4	0.0
	Spring migration	0.1	0.0
	Annual total	1.0	0.0

3138. The additional annual mortality of adult gannets from the Noss SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.004% of the number of adults currently estimated to breed at this colony (i.e. 27,350 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach and approximately 0.004% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.08% and 0.09% for the Developer and Scoping Approaches, respectively.

3139. The potential levels of impact on the Noss SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance phase are relatively very small compared with the breeding population. The potential loss of up to 1.2 gannets per year is not predicted to cause a population level effect.

Changes to prey availability

3140. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Noss SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3141. Given this, it is considered that there is relatively little potential for the Noss SPA gannet population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Noss SPA gannet population.

Project alone: population-level impacts

3142. Based on the Developers Approach the potential loss of up to 1.5 gannets per year from the combined impacts arising from displacement and collisions equates to 0.005% of the breeding adult population. This increases to up to 1.7 gannets per year; 0.006% of the adult population based on the Scoping A approach and 2.7 gannets per year based on Scoping B approach; equivalent to a 0.009% of the breeding adult population. These levels of impact could increase the baseline mortality rate from between 0.12% and 0.21%.

3143. This level of impact is not predicted to cause a population level effect to the breeding gannet population at the Noss SPA.

Project alone: Conclusion

3144. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Noss SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be very small and at levels that would not impact on the population being of a similar size to that which would occur in the absence of the Proposed Development. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

3145. For the same reasons as described in *Effects in-combination* for the Forth Islands SPA gannet population, the potential for effects of the Proposed Development to act on the Noss SPA gannet population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

Displacement/Barrier effects – operation and maintenance

3146. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3147. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.263).

Table 5.263: Estimated Annual Mortality of Noss SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination With Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.1	0.0	4.3	3.3	2.2	1.8	6.7	5.1
	Scoping B	0.4	0.0	13.0	9.9	6.7	5.5	20.0	15.4
	Developer	0.1	0.0	4.3	3.3	2.2	1.8	6.7	5.1

3148. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannet from the Noss SPA population predicted due to displacement represents between approximately 0.024% of the current adult breeding population at this colony (i.e. 27,460 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Developers Approach and between 0.024% and 0.073% based on Scoping Approaches A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.53% for developers approach and 0.53 – 1.58% for the lower and upper estimates from the Scoping Approach.

3149. The potential levels of impact on the Noss SPA gannet population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

3150. The approach and methods for estimating in-combination collision mortality are described in *Effects In-combination: Collision – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3151. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.264).

Table 5.264: Predicted Collision Effects on the Noss SPA Gannet Population Due to the Proposed Development In-Combination With Other Projects in UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.6	0.0
		Autumn migration	16.3	12.9
		Spring migration	11.8	9.6
		Annual total	28.7	22.5
	Developer	Breeding	0.5	0.0
		Autumn migration	16.1	12.9
		Spring migration	11.8	9.6
		Annual total	28.4	22.5

3152. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Noss SPA population predicted due to collisions represents 0.10% of the current adult breeding population at this colony (i.e. 27,530 individuals –Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by the Developer Approach, and approximately 0.10% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population the estimates of adult collision mortality equate to an increase of 2.24% for the Developer Approach and 2.27% for the Scoping Approach.

3153. The potential levels of impact on the Noss SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with either the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the *In-combination: population-level impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

3154. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.263 and Table 5.264 above).

3155. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-combination: population-level impacts* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6 of the Offshore EIA Report.

Table 5.265 Projected 35 Year Population Sizes and Associated PVA Metrics for the Noss SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination with Other UK North Sea Wind Farms

Approach	Additional Annual Mortality adults	Additional Annual Mortality immatures	Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
Baseline	0	0	166390 (96170 – 268809)	1.000	1.000	50.0
Scoping A	35.37	27.72	158122 (91300 – 255514)	0.950	0.999	42.8
Scoping B	48.68	37.93	155137 (89544 – 250711)	0.932	0.998	39.8
Developer	35.08	28.51	158808 (91277 – 255457)	0.950	0.999	42.8

3156. The predicted in-combination population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. For Developer Approach the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development in-combination with estimated impacts with other North Sea wind farms would result in a reduction of approximately 5% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.265). Based on the Scoping Approach B the estimated reduction in the size of the population increases to approximately 6.8% after 35 years, relative to that in the absence of any wind farm effects (Table 5.265). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be no greater than 0.2%, whilst the centile value of 39.8 indicates a relatively large overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest smaller levels of impact (Table 5.265).

In-combination: Conclusion

3157. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Noss SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Noss SPA gannet population.

Assessment for the breeding seabird assemblage

3158. The breeding seabird assemblage for the Noss SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Gannet is amongst the species identified in the citation as having nationally important populations which contribute to the Noss SPA breeding seabird assemblage.

3159. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA gannet population in relation to the Proposed Development alone and in-combination.

3160. Given the above, it is concluded that there is no potential for an adverse effect on the Noss SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3161. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Noss SPA population of breeding gannet.

5.7.18. FETLAR SPA

European site information and conservation objectives

3162. Fetlar is an island in the Shetland group, lying to the east and south respectively of the larger islands of Yell and Unst. The SPA is located approximately 452 km from the Proposed Development. Fetlar SPA overlaps North Fetlar SSSI, Lamb Hoga SSSI and Trona Mires SSSI and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 1994, with the marine extension classified in 2009.

3163. There are two annex I qualifying seabird feature and the site qualifies under Article 4.2 by regularly supporting one migratory seabird species and in excess of 20,000 breeding seabirds (Table 5.266). The potential for LSE has been identified in relation to great skua (Table 5.266), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

3164. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

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

3165. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3166. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3167. Further information on this European site is presented in appendix 3A.

Table 5.266: Details on the Qualifying Features of the Fetlar SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable declining	22,000 individuals	Yes
Red-necked phalarope	Breeding	Favourable recovered	23 pairs	No
Arctic tern	Breeding	Unfavourable declining	1,065 pairs	No
Great skua	Breeding	Favourable maintained	508 pairs	Yes
Arctic skua*	Breeding	Unfavourable declining	130 pairs	No
Fulmar*	Breeding	Unfavourable declining	9,500 pairs	No

*Named components of the assemblage only.

Assessment for the great skua population

3168. Great skua only occur in the North Atlantic, nesting at relatively high latitudes and wintering south of their breeding sites. Most great skua nest in the eastern Atlantic, with an estimated global breeding population of 16,000 pairs, of which approximately 60% nest on islands in north and west Scotland. Great skua also nests in Faroes, Norway and Iceland and a small population breed in Ireland. Great skua forage on fish obtained via Kleptoparasitism from other seabird species and discards from fishing boats. They also predate on other seabird species. Great skua have a large foraging range when breeding, with the mean maximum foraging range reported as being 443.3 km (±487.9) (Woodward *et al.* 2019).

3169. The Fetlar SPA great skua population is currently estimated to number 852 Apparently Occupied Territories (1,836 individuals) based on the most recent count in 2017. Great skua are listed on the Fetlar SPA citation as a named component of the breeding seabird assemblage.

The potential for impacts on the great skua population

3170. Potential impacts on the Fetlar SPA great skua population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

3171. From published information on great skua foraging ranges it is apparent that during the breeding period great skua from the Fetlar SPA could, in theory, occur within the area of the Proposed Development and the 2 km buffer around the Proposed Development Array area (Woodward et al. 2019). The breeding period for great skua is defined as mid-April to mid-September, following the NatureScot (2020) guidance

3172. Great skuas move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa and also North America returning north in the spring (Furness 2015), so that the non-breeding season is divided into autumn and spring passage periods (defined as August to October and March to April, respectively, with the winter period from November to February). Given the above, the Proposed Development may have potential effects on the Fetlar SPA great skua population during breeding and non-breeding periods.

Project alone: operation and maintenance

Collision risk

3173. Predictions of the number of great skua at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, appendix 11.3 in Table 4.9). The assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014), an avoidance rates of 98.0% were applied to the outputs from option 2 and option 3, respectively. Annual great skua collision estimates are calculated.

3174. As outlined elsewhere (e.g. the St Abb's Head to Fast Castle SPA kittiwake CRM) the CRMs for great skua were undertaken following:

- The Scoping Approach of using the maximum monthly densities, and
- The Developer Approach of using the mean monthly densities.

3175. Based upon the Developer Approach option 2 of the deterministic CRM with a 98.0% avoidance rate applied, the total annual collision mortality of great skua is 0.18 adults. Based on the Scoping Approach option 2 and a 98% avoidance rate the total annual mortality of great skua is estimated to be 0.35 (Table 5.267 and Offshore EIA Report appendix 11.3 Table 4.9) for all modelled scenarios). The estimated impacts based on the use of option 3 were lower than 0.02 and 0.05 birds per year for Developer and Scoping Approaches respectively.

Table 5.267: Predicted Collision Effects from the Proposed Development on Great Skua Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98% Avoidance Rate

Approach	Seasonal Period	Total Estimated Number of Collisions All Ages
Scoping	Annual total	0.35
Developer	Annual total	0.18

3176. Based upon the estimates from option 2 of the CRM, the additional annual mortality of great skua is 0.18 birds per year based on the Developer Approach. Under a worst-case scenario all 0.18 collisions per year have been assumed to be adults and apportioned to the Fetlar SPA breeding population. On this highly precautionary and unrealistic worst-case scenario it is estimated that the predicted collisions represent approximately 0.009% of the number of adults currently estimated to breed at this colony (i.e. 1,836 individuals) as determined by the Developer Approach and approximately 0.019% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.09% and 0.17% for the Developer and Scoping Approaches, respectively.

3177. The estimated number of collisions per annum relates to impacts on the whole great skua population and not just adults from this SPA. Most impacts are predicted to occur during spring and autumn passage periods (Offshore EIA Report appendix 11.1: section 5.14) when approximately 6.1% of the North Sea great skua population are birds from Fetlar SPA (Furness 2015). Consequently, of the 0.18 collisions per year, 6.1% could be predicted to be on birds from this SPA, equating to collision mortality of 0.01 birds per year based on the Developers Approach and 0.02 birds per year based on Scoping Approach. This estimated number of collisions represent approximately 0.0005% of the number of adults currently estimated to breed at this colony (i.e. 1,836 individuals) as determined by the Developer Approach and approximately 0.001% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.005% and 0.01% for the Developer and Scoping Approaches, respectively.

Project alone: Conclusion

3178. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Fetlar SPA great skua population are predicted to be negligible, with the resultant population-level impacts also predicted to be negligible. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Collision risk

3179. As detailed above, any effects from the Proposed Development alone on the Fetlar SPA great skua population resulting from collision during operation and maintenance will be very small impacting on no more than 0.001% of the adult population and increasing the adult mortality by no more than 0.01%. Consequently, it is considered that there is no potential for an effect from the Proposed Development to add to impacts at a population level that could cause an in-combination adverse effect.

In-combination: Conclusion

3180. On the basis of the above considerations, it is concluded that the estimated small population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Fetlar SPA great skua population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the breeding seabird assemblage

3181. The breeding seabird assemblage for the Fetlar SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Great skua are amongst the species identified in the citation as having nationally important populations which contribute to the Fetlar SPA breeding seabird assemblage. No LSE was determined for the other species in relation to the Proposed Development (HRA Stage One Screening Report; SSER, 2021b).

3182. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the Developer Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA great skua population in relation to the Proposed Development alone and in-combination.

3183. Given the above, it is concluded that there is no potential for an adverse effect on the Fetlar SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3184. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Fetlar SPA population of breeding great skua and breeding seabird assemblage qualifying feature.

5.7.19. HERMANESS, SAXA VORD AND VALLA FIELD SPA

European site information and conservation objectives

3185. Hermaness, Saxa Vord and Valla Field SPA lies in the north-west corner of the island of Unst, Shetland, at the northernmost tip of Britain and approximately 507 km from the Proposed Development. The boundary of the SPA is coincident with that of the Hermaness SSSI, Saxa Vord SSSI, and Valla Field SSSI and the seaward extension extends approximately 2 km into the marine environment. The SPA was classified in 2001, with the marine extension classified in 2009.

3186. There is one annex I qualifying seabird feature and the site qualifies under Article 4.2 by regularly supporting three migratory seabird species and in excess of 20,000 breeding seabirds (Table 5.268). The potential for LSE has been identified in relation to great skua and gannet (Table 5.268), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

3187. The conservation objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2020) are:

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

3188. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3189. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3190. Further information on this European site is presented in appendix 3A.

Table 5.268: Details on the Qualifying Features of the Hermaness, Saxa Vord and Valla Field SPA

Qualifying Feature	Season	Site Condition	Citation Population Size	LSE
Seabird assemblage	Breeding	Unfavourable declining	157,500 individuals	Yes
Kittiwake*	Breeding	Unfavourable declining	922 pairs	No
Great skua	Breeding	Favourable maintained	788 pairs	Yes
Guillemot*	Breeding	Unfavourable declining	25,000 individuals	No
Puffin	Breeding	Unfavourable declining	55,000 individuals	No
Red-throated diver	Breeding	Unfavourable declining	26 pairs	No
Fulmar*	Breeding	Favourable recovered	19,539 pairs	No
Gannet	Breeding	Favourable maintained	16,400 pairs	Yes
Shag*	Breeding	Unfavourable no change	450 pairs	No

*Named components of the assemblage only

Assessment for the great skua population

3191. Great skua only occur in the North Atlantic, nesting at relatively high latitudes and wintering south of their breeding sites. Most great skua nest in the eastern Atlantic, with an estimated global breeding population of 16,000 pairs, of which approximately 60% nest on islands in north and west Scotland. Great skua also nests in Faroes, Norway and Iceland and a small population breed in Ireland. Great skua forage on fish obtained via Kleptoparasitism from other seabird species and discards from fishing boats. They also predate on other seabird species. Great skua have a large foraging range when breeding, with the mean maximum foraging range reported as being 443.3 km (±487.9) (Woodward *et al.* 2019).

3192. The Hermaness, Saxa Vord and Valla Field SPA great skua population is currently estimated to number 955 Apparently Occupied Territories (1,910 individuals) based on the most recent count in 2018.

3193. Potential impacts on the Hermaness, Saxa Vord and Valla Field SPA great skua population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

<u>The potential for impacts on the great skua population</u>

3194. Potential impacts on the Hermaness, Saxa Vord and Valla Field SPA great skua population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

3195. From published information on great skua foraging ranges it is apparent that during the breeding period great skua from the Hermaness, Saxa Vord and Valla Field SPA could, in theory, occur within the area of the Proposed Development and the 2 km buffer around the Proposed Development Array area (Woodward et al. 2019). The breeding period for great skua is defined as mid-April to mid-September, following the NatureScot (2020) guidance

3196. Great skuas move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa and also North America returning north in the spring (Furness 2015), so that the non-breeding season is divided into autumn and spring passage periods (defined as August to October and March to April, respectively, with the winter period from November to February). Given the above, the Proposed Development may have potential effects on the Hermaness, Saxa Vord and Valla Field SPA great skua population during breeding and non-breeding periods.

Project alone: operation and maintenance

Collision risk

3197. Predictions of the number of great skua at risk from collisions due to the Proposed Development were calculated using the deterministic version of the SOSS offshore collision risk model (Band 2012, Offshore EIA Report, volume 3, appendix 11.3 in Table 4.9). The assessment is based on the outputs from both options 2 and 3 of the CRM, which use the generic flight height data and for which option 2 assumes a uniform distribution of flight heights across the rotor swept zone and option 3 assumes the modelled flight height distribution (Band 2012, Johnston *et al.* 2014a,b). In accordance with the recommendations of the SNCBs (2014) avoidance rates of 98.0% were applied to the outputs from option 2 and option 3, respectively. Annual great skua collision estimates are calculated.

3198. Based upon the Developer Approach option 2 of the deterministic CRM with a 98.0% avoidance rate applied, the total annual collision mortality of great skua is 0.18 adults. Based on the Scoping Approach option 2 and a 98% avoidance rate the total annual mortality of great skua is estimated to be 0.35 (Table 5.269 and see Offshore EIA Report, volume 3, appendix 11.3 Table 4.9) for all modelled scenarios). The estimated impacts based on the use of option 3 were lower by 0.02 and 0.05 birds per year for Developer and Scoping Approaches respectively.

Table 5.269: Predicted Collision Effects From the Proposed Development on Great Skua Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98% Avoidance Rate

Approach	Seasonal Period	Total Estimated Number of Collisions
		All Ages
Scoping	Annual total	0.35
Developer	Annual total	0.18

3199. Based upon the estimates from option 2 of the CRM, the additional annual mortality of great skua is 0.18 birds per year based on the Developer Approach. Under a worst-case scenario all 0.18 collisions per year have been assumed to be adults and apportioned to the Hermaness, Saxa Vord and Valla Field SPA breeding population. On this highly precautionary and unrealistic worst-case scenario it is estimated that the predicted collisions represent approximately 0.009% of the number of adults currently estimated to breed at this colony (i.e. 1,910 individuals) as determined by the Developer Approach and approximately 0.018% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.08% and 0.16% for the Developer and Scoping Approaches, respectively.

3200. The estimated number of collisions per annum relates to impacts on the whole great skua population and not just adults from this SPA. Most impacts are predicted to occur during spring and autumn passage periods (Offshore EIA Report, volume 3 appendix 11.1: section 5.14) when approximately 10.2% of the North Sea great skua population are birds from Hermaness, Saxa Vord and Valla Field SPA (Furness 2015). Consequently, of the 0.18 collisions per year 10.2% could be predicted to be on birds from this SPA, equating to collision mortality of 0.02 birds per year based on the Developers Approach and 0.03 birds per year based on Scoping Approach. This estimated number of collisions represent approximately 0.001% of the number of adults currently estimated to breed at this colony (i.e. 1,910 individuals) as determined by the Developer Approach and approximately 0.002% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.112 – Robinson 2022), the predicted adult collision mortality equates to increases of 0.009% and 0.014% for the Developer and Scoping Approaches, respectively.

Project alone: Conclusion

3201. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Hermaness, Saxa Vord and Valla Field SPA great skua population are predicted to be negligible, with the resultant population-level impacts also predicted to be negligible respectively. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Collision risk

As detailed above, any effects from the Proposed Development alone on the Hermaness, Saxa Vord and Valla Field SPA great skua population resulting from collision during operation and maintenance will be very small impacting on no more than 0.002% of the adult population and increasing the adult mortality by no more than 0.014%. Consequently, it is considered that there is no potential for an effect from the Proposed Development to add to impacts at a population level that could cause an in-combination adverse effect.

In-combination: Conclusion

3202. On the basis of the above considerations, it is concluded that the population-level impacts resulting from the Proposed Development in-combination with the other UK North Sea wind farms would not produce an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA great skua population. This conclusion applies irrespective of whether effects are determined according to the Scoping Approach or the Developer Approach.

Assessment for the gannet population

3203. The Hermaness, Saxa Vord and Valla Field SPA gannet population is currently estimated to number 25,580 breeding pairs (Offshore EIA Report, volume 3, appendix 11.5) based on the most recent count in 2014. Gannet are listed on the Hermaness, Saxa Vord and Valla Field SPA citation as a named component of the breeding seabird assemblage.

3204. Potential impacts on the Hermaness, Saxa Vord and Valla Field SPA gannet population screened in for assessment are outlined in the HRA Stage One Screening Report (SSER, 2021b).

The potential for impacts on the gannet population

3205. The Proposed Development and associated buffers (e.g. as used in the estimation of displacement effects from the Proposed Development Array Area) do not overlap with the Hermaness, Saxa Vord and Valla Field SPA, so that potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3206. From published information on gannet foraging ranges it is possible that during the breeding period gannets from this SPA could occur within the area of the proposed development and the 2 km buffer around the Proposed Development Array area (Woodward *et al*. 2019). However, Hermaness, Saxa Vord and

Valla Field SPA is located 507 km from the Proposed development and therefore the use of the Proposed Development array area by gannet from this SPA during the breeding period is predicted to be relatively low. This is reflected in the findings of the apportioning exercise, which estimates that 0.5% of the gannets occurring on the Proposed Development Array area during the breeding season derive from this SPA colony (Table 4.4 in Offshore EIA Report, volume 3, appendix 11.5). The breeding period for gannet is defined as mid-March to September, following the NatureScot (2020) guidance

3207. During the non-breeding period gannets move south in autumn to winter at sea from the Bay of Biscay to the seas off west Africa, returning north in the spring (Fort *et al.* 2012), so that the non-breeding season is divided into autumn and spring passage periods (defined as October to November and December to mid-March, respectively, on the basis of applying the BDMPS defined periods within the context of the overall non-breeding period defined by NatureScot – Furness 2015, NatureScot 2020, (Table 3.4 in Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the Hermaness, Saxa Vord and Valla Field SPA gannet population during breeding and non-breeding periods.

Project alone: construction and decommissioning

Disturbance

3208. Direct disturbance to gannet during the maximum eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the wind turbine foundations, cables and other infrastructure (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Firth of Forth gannet population; Table 4.1).

3209. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

3210. Gannet breeding at the Hermaness, Saxa Vord and Valla Field SPA are predicted to utilise the Proposed Development during the breeding season to a relatively low extent (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, gannet distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). During the autumn and spring passage periods, the potential for effects of construction-related disturbance is lower than during the breeding season because the SPA gannets are essentially transiting through the waters within which the Proposed Development is located. The potential for effects of construction- and decommissioning-related disturbance is therefore low.

3211. Furthermore, given the low sensitivity of gannet to disturbance effects (Garthe and Hüppop 2004; Furness *et al*., 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project Alone: Construction and Decommissioning – Disturbance* for Forth Islands SPA gannet population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population.

Displacement

3212. Gannet are considered to have a low sensitivity to disturbance, whilst potential effects of disturbance during the construction and decommissioning phases will only extend across a small part of the wider foraging areas used by the Hermaness, Saxa Vord and Valla Field SPA gannet population and be limited to, at most, an eight year period during construction (and a likely similar or shorter period during decommissioning). Furthermore, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development Array Area or Proposed Development export cable corridor but will, rather, be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of gannet from this SPA will be limited to relatively small areas, with the potential effects also being of a temporary nature.

3213. Therefore, based upon the above, it is considered that there is no potential for the Hermaness, Saxa Vord and Valla Field SPA gannet population to be affected by displacement during the construction or decommissioning phases, with any such effects only extending across relatively small areas and tending to be temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population.

Changes to prey availability

3214. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence basis and context applies to the Hermaness, Saxa Vord and Valla Field SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3215. Given this, it is considered that there is relatively little potential for the Hermaness, Saxa Vord and Valla Field SPA gannet population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population.

Project alone: operation and maintenance

Disturbance

3216. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of gannets from Hermaness, Saxa Vord and Valla Field SPA during the breeding and non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Hermaness, Saxa Vord and Valla Field SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population during the breeding and non-breeding periods.

3217. Given the low sensitivity of gannet to disturbance effects at sea, the relatively small areas relative to the species' foraging range that will be subject intermittently to potentially disturbing activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population. This conclusion is consistent with the outcome of the EIA which 'screened' out gannet as a species for which detailed consideration of the effects of construction disturbance was required (volume 2, chapter 11 of the Offshore EIA Report).

Displacement/Barrier effects

3218. The approach used to derive predicted levels of mortality for Hermaness, Saxa Vord and Valla Field SPA gannets is as described in the section on *Project Alone: Operation and Maintenance –*

Displacement/Barrier effects for the Forth Islands SPA gannet population (and in the Offshore EIA Report, volume 3, appendix 11.4)

3219. Estimates of gannet mortality for Hermaness, Saxa Vord and Valla Field SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report, volume 3, appendix 11.4), with these estimates then apportioned to the Hermaness, Saxa Vord and Valla Field SPA gannet population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/Barrier effects* for the Forth Islands SPA gannet population (Table 5.270).

Table 5.270: The Mean Peak Abundance Estimates of Gannet in the Proposed Development Array Area and 2 km Buffer for Each Seasonal Period, Together With the Proportion of Birds Estimated to Belong to the Breeding Adult Age Class and to be From the Hermaness, Saxa Vord and Valla Field SPA Population in Each Period. The Proportion of Adults Assumed to be Sabbaticals During the Breeding Season is Also Presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	4,735	0.99	0.005	0.005	0.10
Autumn migration	1,500	N/A	0.050	0.000	N/A
Spring migration	269	N/A	0.047	0.038	N/A

Table 5.271: Estimated Potential Annual Mortality of Hermaness, Saxa Vord and Valla Field SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	70%	1%	0.2	0.0
	Autumn migration	70%	1%	0.5	0.0
	Spring migration	70%	1%	0.1	0.1
	Annual total	-	-	0.8	0.1
Scoping B	Breeding	70%	3%	0.4	0.0
	Autumn migration	70%	3%	1.6	0.0
	Spring migration	70%	3%	0.3	0.2
	Annual total	-	-	2.3	0.2
Developer	Breeding	70%	1%	0.2	0.0
	Autumn migration	70%	1%	0.5	0.0
	Spring migration	70%	1%	0.1	0.1
	Annual total	-	-	0.8	0.1

3220. Based upon the estimates and assumptions detailed above, the potential annual mortality amongst the SPA gannet population as a result of displacement is estimated as 0.8 adult and 0.1 immature birds based on the Developer Approach and the lower mortality rates for the Scoping Approach (i.e. Scoping Approach A) and 2.3 adult and 0.2 immature birds based upon the higher mortality rates for the Scoping Approach (i.e. Scoping Approach B) (Table 5.271).

3221. The additional annual mortality of adult gannets from the Hermaness, Saxa Vord and Valla Field SPA population predicted due to displacement from the Proposed Development Array represents 0.001% of the current adult breeding population at this colony (i.e. 51,160 individuals – Table 3.3 in Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach, and between approximately 0.001 – 0.004% of this population as determined by the lower and upper estimates from the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of approximately 0.03% for the Developer Approach and of 0.03 – 0.10% for the lower and upper estimates from the Scoping Approach.

3222. The potential levels of impact on the Hermaness, Saxa Vord and Valla Field SPA gannet population resulting from the mortality predicted from displacement and barrier effects associated with the Proposed Development array during the operation and maintenance phase are considered to be relatively very small compared to the breeding population and the loss of up to 2.3 adult gannets per year will not cause a population level effect.

Collision risk

3223. The approach used to derive predicted levels of mortality for Hermaness, Saxa Vord and Valla Field SPA gannet is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the Forth Islands SPA gannet population (and in the Offshore EIA Report, volume 3, appendix 11.3)

3224. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of gannet from the Hermaness, Saxa Vord and Valla Field SPA is predicted to be approximately 1.8 adults and 0.1 immatures as determined by the Scoping Approach, and approximately 1.3 adults and 0.1 immatures as determined by the Developer Approach (Table 5.272).

Table 5.272: Predicted Collision Effects From the Proposed Development on the Hermaness, Saxa Vord and Valla Field SPA Gannet Population, as Determined by the Scoping Approach and Developer Approach. Estimates are for the Maximum Design Scenario and are Based on Option 2 of the Deterministic CRM Using a 98.9% Avoidance Rate (See Text)

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.8	0.0
	Autumn migration	0.9	0.0
	Spring migration	0.1	0.1
	Annual total	1.8	0.1
Developer	Breeding	0.6	0.0
	Autumn migration	0.6	0.0
	Spring migration	0.1	0.1
	Annual total	1.3	0.1

3225. The additional annual mortality of adult gannets from the Hermaness, Saxa Vord and Valla Field SPA population predicted due to collisions with wind turbines in the Proposed Development Array represents approximately 0.002% of the number of adults currently estimated to breed at this colony (i.e. 51,160 individuals – Table 3.3 in Offshore EIA Report, volume 3, appendix 11.5) as determined by the Developer Approach and approximately 0.003% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying a mortality rate of 0.046 – see Table 2.7 of Offshore EIA Report, volume 3, appendix 11.6), the predicted adult collision mortality equates to increases of 0.05% and 0.08% for the Developer and Scoping Approaches, respectively.

3226. The potential levels of impact on the Hermaness, Saxa Vord and Valla Field SPA gannet population resulting from the mortality predicted from collisions associated with the Proposed Development during the operation and maintenance phase are relatively very small compared with the breeding population. The potential loss of up to 1.8 gannets per year is not predicted to cause a population level effect.

Changes to prey availability

3227. During the operation and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the Forth Islands SPA gannet population. The same evidence base and context applies to the Hermaness, Saxa Vord and Valla Field SPA gannet population as to the Forth Islands SPA population in relation to the potential for such effects to lead to impacts on the population.

3228. Given this, it is considered that there is relatively little potential for the Hermaness, Saxa Vord and Valla Field SPA gannet population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operation or maintenance related changes in prey availability to lead to an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population.

Project alone: population-level impacts

3229. Based on the Developers Approach the potential loss of up to 2.1 gannets per year from the combined impacts arising from displacement and collisions equates to 0.004% of the breeding adult population. This increases to up to 2.6 gannets per year; 0.005% of the adult population based on the Scoping A approach and 4.1 gannets per year based on Scoping B approach; equivalent to a 0.008% of the breeding adult population. These levels of impact could increase the baseline mortality rate from between 0.11% and 0.17%.

3230. This level of impact is not predicted to cause a population level effect to the breeding gannet population at the Hermaness, Saxa Vord and Valla Field SPA.

Project alone: Conclusion

3231. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the Hermaness, Saxa Vord and Valla Field SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be very small and at levels that would not impact on the population being of a similar size to that which would occur in the absence of the Proposed Development. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this population.

Effects in-combination

Effects of relevance to the in-combination assessment

3232. For the same reasons as described in *Effects in-combination* for the Forth Islands SPA gannet population, the potential for effects of the Proposed Development to act on the Hermaness, Saxa Vord and Valla Field SPA gannet population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

Displacement/Barrier effects – operation and maintenance

3233. The approach and methods for estimating in-combination displacement mortality are described in *Effects in-combination: Displacement/Barrier Effects – Operation and Maintenance* for Forth Islands SPA gannet population above and in the Offshore EIA Report, volume 3, appendix 11.6, annex E.

3234. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.273).

Table 5.273: Estimated Annual Mortality of Hermaness, Saxa Vord and Valla Field SPA Gannets as a Result of Displacement From the Proposed Development Array Area and 2 km Buffer as Determined by the Scoping Approach and Developer Approach, In-Combination With Other UK North Sea Wind Farms

In-Combination Region	Approach	Seasonal Period: Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.2	0.0	9.3	7.2	4.8	3.9	14.3	11.1
	Scoping B	0.4	0.0	27.9	21.5	14.4	11.8	42.8	33.3
	Developer	0.2	0.0	9.3	7.2	4.8	3.9	14.3	11.1

3235. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannet from the Hermaness, Saxa Vord and Valla Field SPA population predicted due to displacement represents between approximately 0.027% of the current adult breeding population at this colony (i.e. 51,160 individuals – Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report), as determined by Developers Approach and between 0.027% and 0.084% based on Scoping Approaches A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.61% for developers approach and 0.61 – 1.81% for the lower and upper estimates from the Scoping Approach.

The potential levels of impact on the Hermaness, Saxa Vord and Valla Field SPA gannet population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *Project Alone: population-level impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision risk - operation and maintenance

3236. The approach and methods for estimating in-combination collision mortality are described in *Effects in-combination: Collision – Operation and Maintenance* for Forth Islands SPA gannet population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3237. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.274).

Table 5.274: Predicted Collision Effects on the Hermaness, Saxa Vord and Valla Field SPA Gannet Population Due to the Proposed Development In-Combination with Other Projects in UK North Sea Waters. Estimates are Presented for Both the Scoping Approach and Developer Approach for Consented Designs.

In-Combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.8	0.0
		Autumn migration	35.2	28.0
		Spring migration	25.6	20.8
		Annual total	61.5	48.8
	Developer	Breeding	0.6	0.0
		Autumn migration	34.9	28.0
		Spring migration	25.5	20.8
		Annual total	61.0	48.8

3238. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult gannets from the Hermaness, Saxa Vord and Valla Field SPA population predicted due to collisions represents 0.12% of the current adult breeding population at this colony (i.e. 51,160 individuals –Table 3.3 in volume 3, appendix 11.5 of the Offshore EIA Report) as determined by both the Developer Approach and Scoping Approaches. In terms of percentage increases in the baseline annual adult mortality of the population the estimates of adult collision mortality equate to an increase of 2.59% for the Developer Approach and 2.61% for the Scoping Approach.

3239. The potential levels of impact on the Hermaness, Saxa Vord and Valla Field SPA gannet population resulting from the predicted collision mortality associated with the Proposed Development in-combination with either the other UK North Sea wind farms during the operation and maintenance phase are considered in more detail below in the In- combination: population-level impacts section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

In-combination: population-level impacts

3240. PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.273 and Table 5.274 above).

3241. The approach to the PVA and the metrics used to summarise the PVA outputs are as *described for In-combination: population-level impact*s for Forth Islands SPA gannet population above and in volume 3, appendix 11.6 of the Offshore EIA Report.

Table 5.275: Projected 35 Year Population Sizes and Associated PVA Metrics for the Hermaness, Saxa Vord and Valla Field SPA Gannet Population Under Different Impact Scenarios for the Proposed Development In-Combination With Other UK North Sea Wind Farms

Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 Centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
	Adults	Immatures				
Baseline	0	0	304501 (169278 – 510148)	1.000	1.000	50.0
Scoping A	76.81	60.11	286492 (159103 – 480063)	0.941	0.998	41.4
Scoping B	104.2	82.26	280252 (155580 – 469640)	0.920	0.998	38.3
Developer	75.30	60.07	286724 (159231 – 480445)	0.942	0.998	41.6

3242. The predicted in-combination population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. For Developer Approach the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development in-combination with estimated impacts with other North sea wind farms would result in a reduction of approximately 5.8% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.275). Based on the Scoping Approach B the estimated reduction in the size of the population increases to approximately 8% after 35 years, relative to that in the absence of any wind farm effects (Table 5.275). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be no greater than 0.2%, whilst the centile value of no less than 38.3 indicates a relatively large overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest smaller levels of impact (Table 5.275).

In-combination: Conclusion

3243. On the basis of the Scoping Approach, the potential effects from the Proposed Development in-combination with other UK North Sea wind farms on the Hermaness, Saxa Vord and Valla Field SPA gannet population are predicted to be small, with the resultant population-level impacts also predicted to be relatively small. In addition, the PVA metrics indicate that it is likely that the population would be of a similar size to that which would occur in the absence of the Proposed Development after 35 years. The metrics for the Developer Approach suggest even smaller levels of impact. Considering this within the context of a highly precautionary assessment, it is concluded that the in-combination scenario for both the Scoping and Developer Approaches would not result in adverse effect on the Hermaness, Saxa Vord and Valla Field SPA gannet population.

Assessment for the breeding seabird assemblage

3244. The breeding seabird assemblage for the Hermaness, Saxa Vord and Valla Field SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds. Great skua and gannet are amongst the species identified in the citation as having nationally important populations which contribute to the Hermaness, Saxa Vord and Valla Field SPA breeding seabird assemblage. No LSE was determined for the other species in relation to the Proposed Development (HRA Stage One Screening Report; SSER, 2021b).

3245. Potential impacts of the Proposed Development alone and in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for an adverse effect on the SPA great skua or gannet population in relation to the Proposed Development alone and in-combination.

3246. Given the above, it is concluded that there is no potential for an adverse effect on the Hermaness, Saxa Vord and Valla Field SPA breeding seabird assemblage. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Site conclusion

3247. Based on both the Developer Approach and Scoping Approach it is concluded that the possibility of adverse effects can be discounted for the Hermaness, Saxa Vord and Valla Field SPA population of breeding great skua, gannet and breeding seabird assemblage qualifying feature.

5.7.20. WEST WESTRAY SPA

European Site Information and Conservation Objectives

3248. The West Westray SPA covers an area of 37.8 km^2 and comprises an 8 km length of red sandstone cliffs on the western coast of the island of Westray, off the north coast of Orkney Mainland, approximately 355 km from the Proposed Development. The cliffed rocky coastline and maritime vegetation support large colonies of breeding seabirds. Approximately 91% of the SPA is marine environment with a seaward extension extending approximately 2 km into the marine environment. The SPA was classified in 1996, with the marine extension classified in 2009.

3249. The site qualifies under Article 4.2 by regularly supporting in excess of 20,000 breeding seabirds (Table 5.276). The potential for LSE has been identified in relation to kittiwake and seabird assemblage (Table 5.276), with the effect pathways associated with LSE for each of these detailed in Table 3.1 and set out in the assessment below.

3250. The Conservation Objectives of this SPA (as determined from NatureScot's SiteLink (NatureScot 2022) are:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site*
- *Distribution of the species within site*
- *Distribution and extent of habitats supporting the species*
- *Structure, function and supporting processes of habitats supporting the species*
- *No significant disturbance of the species*

3251. The Proposed Development does not overlap with the SPA, so that potential impacts on its qualifying features will only occur as a result of individuals from the colony occurring in the area (or vicinity) of the Proposed Development.

3252. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature because the other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3253. Further information on this European site is presented in Appendix 3A.

Table 5.276: **Details on the qualifying features of West Westray SPA**

Qualifying Feature	Season	Site Condition	Citation Population Size	Potential LSE
Seabird assemblage	Breeding	Unfavourable declining	113,000 individuals	Yes
Kittiwake*	Breeding	Unfavourable no change	23,900 pairs	Yes
Razorbill	Breeding	Unfavourable declining	1,946 individuals	No
Guillemot	Breeding	Favourable recovered	42,150 individuals	No
Fulmar*	Breeding	Unfavourable declining	1,400 pairs	No
Arctic skua**	Breeding	Unfavourable declining	78 pairs	No
Arctic tern*	Breeding	Favourable recovered	1,140 pairs	No

*Named components of the assemblage only.

Assessment for the Kittiwake Population

3254. The West Westray SPA kittiwake population is currently estimated to number 2,743, breeding pairs based on the most recent count in 2017. Kittiwake are listed on the West Westray SPA citation as a named component of the breeding seabird assemblage.

3255. Potential impacts on the West Westray SPA kittiwake population screened in for assessment are outlined in 3.1 and in the HRA Stage One Screening Report (SSE Renewables, 2021b).

<u>The Potential for Impacts on the Kittiwake Population</u>

3256. The breeding period for kittiwake is defined as mid-April to August, following the NatureScot (2020) guidance. From published information on kittiwake foraging ranges generally (Woodward *et al*., 2019) it is apparent that during the breeding period kittiwakes from West Westray SPA could occur in the vicinity of the Proposed Development. However, the findings of the apportioning exercise found that no kittiwakes occurring in the Proposed Development array area during the breeding season derived from this SPA (Offshore EIA Report, volume 3, appendix 11.5).

3257. In the non-breeding season kittiwakes are largely pelagic (Frederiksen *et al*., 2011), although most of those which breed on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the West Westray SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively - Furness 2015; NatureScot 2020; Offshore EIA Report, volume 3, appendix 11.5). Given the above, the Proposed Development may have potential effects on the West

Westray SPA kittiwake population during the non-breeding passage periods only (Offshore EIA Report volume 3, appendix 11.5).

Project Alone: Construction and Decommissioning

Disturbance

3258. Direct disturbance to kittiwakes during the assumed eight-year construction phase may arise within the Proposed Development as a result of increased vessel movements, as well as from other activities associated with the installation of the turbine foundations, cables and other infrastructure (see the section on *Project alone: construction and decommissioning disturbance* for St. Abb's Head to Fast Castle kittiwake population; Table 4.1).

3259. The potential for disturbance effects during decommissioning is assumed to be the same (or less) as for construction, noting that the duration of the decommissioning phase will not exceed that of construction, and may be shorter.

3260. Kittiwakes breeding at the West Westray SPA are not predicted to utilise the Proposed Development during the breeding season (Offshore EIA Report, volume 3, appendix 11.5). During the non-breeding periods, kittiwake distribution is not constrained by the location of the breeding colonies and birds from the SPA population are likely to occur across large expanses of oceanic and maritime waters (Frederiksen *et al.,* 2012, Furness 2015). The potential for effects of construction- and decommissioning-related disturbance is therefore low.

3261. Furthermore, given the low sensitivity of kittiwake to disturbance effects (Garthe and Hüppop 2004; Furness *et al.,* 2013), and the relatively small areas that will be subject to activities with the potential to result in intermittent, temporary disturbance (see the section on *Project alone: construction and decommissioning – Disturbance* for St. Abb's Head to Fast Castle kittiwake population), it is considered that there is no potential for construction or decommissioning related disturbance to lead to an adverse effect on the West Westray SPA kittiwake population. This conclusion is consistent with the outcome of the EIA which 'screened' out kittiwake as a species for which detailed consideration of the effects of construction disturbance was required (Offshore EIA Report, volume 2 Chapter 11).

Displacement

3262. As detailed above, kittiwake is considered to have a low sensitivity to disturbance (Garthe and Hüppop 2004; Furness *et al.,* 2013), and potential effects of disturbance during the construction and decommissioning phases will only extend across a very small part of the wider foraging areas used by the West Westray SPA kittiwake population during the non-breeding season. Furthermore, as detailed in the section on *Project alone: construction and decommissioning– Displacement* for St. Abb's Head to Fast Castle kittiwake population, potential effects of disturbance will not occur simultaneously across the entirety of the Proposed Development array area and offshore export cable corridor but will instead be carried out in different areas at different times. Thus, at any given time the potential for disturbance effects that could lead to displacement of kittiwake from this SPA during the non-breeding periods will be limited to relatively small areas, with the potential effects also being of a temporary nature.

3263. Therefore, it is considered that there is no potential for construction or decommissioning related displacement to lead to an adverse effect on the West Westray SPA kittiwake population.

Changes to Prey Availability

3264. During construction and decommissioning there are a number of ways in which effects on key prey species of seabirds may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to prey availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence basis and context applies to the West Westray SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

3265. Given this, it is considered that there is no potential for the West Westray SPA kittiwake population to be affected by changes to prey availability during the construction and decommissioning phases, with any such effects being largely intermittent across a relatively small spatial extent, with most effects temporary in nature. Consequently, it is considered that there is no potential for construction or decommissioning related changes in prey availability to lead to an adverse effect on the West Westray SPA kittiwake population.

Project Alone: Operation and Maintenance

Disturbance

3266. Vessel use and associated activities within the Proposed Development array area and export cable corridor during the operation and maintenance phase may lead to direct disturbance of kittiwakes from West Westray SPA during the non-breeding periods, as outlined in the section on *Project Alone: Operation and Maintenance – Disturbance* for the St. Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the West Westray SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population during the non-breeding periods.

3267. Given the discrete areas relative to the species' non-breeding season foraging range that will be subject intermittently to potential disturbance from vessel use and maintenance activities, and the fact that these potential effects will be reduced compared to the construction and decommissioning phases, it is considered that there is no potential for disturbance during operation and maintenance to lead to an adverse effect on the West Westray SPA kittiwake population.

Displacement / Barrier Effects

3268. The approach used to derive predicted levels of mortality for West Westray SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Displacement/barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report volume 3, appendix 11.4)

3269. Estimates of kittiwake mortality for West Westray SPA were produced using the SNCB matrix on the basis of both the Scoping Approaches and the Developer Approach (Offshore EIA Report volume 3, appendix 11.4), with these estimates then apportioned to the West Westray SPA kittiwake population as described in volume 3, appendix 11.5 of the Offshore EIA Report and in the section on *Project Alone: Operation and Maintenance – Displacement/barrier effects* for the St Abb's Head to Fast Castle SPA kittiwake population (Table 5.277).

Table 5.277: The mean peak abundance estimates of kittiwake in the Proposed Development array area and 2 km buffer for each seasonal period, together with the proportion of birds estimated to belong to the breeding adult age class and to be from the West Westray SPA population in each period. The proportion of adults assumed to be sabbaticals during the breeding season is also presented.

Seasonal Period	Mean Peak Estimate (Individuals)	Proportion Adult Birds	SPA Apportionment		Proportion of Sabbatical Adults
			Adults	Immatures	
Breeding	21,141	0.97	0.000	0.000	0.10
Autumn migration	11,190	N/A	0.017	0.010	N/A
Spring migration	13,766	N/A	0.023	0.010	N/A

Table 5.278: Estimated potential annual mortality of West Westray SPA kittiwakes as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach.

Approach	Seasonal Period	Displacement Rate	Mortality Rates	Additional Mortality	
				Breeding Adults	Immatures
Scoping A	Breeding	30%	1%	0.0	0.0
	Autumn migration	30%	1%	0.6	0.3
	Spring migration	30%	1%	0.9	0.4
	Annual total	-	-	1.5	0.8
Scoping B	Breeding	30%	3%	0.0	0.0
	Autumn migration	30%	3%	1.7	1.0
	Spring migration	30%	3%	2.9	1.2
	Annual total	-	-	4.6	2.3
Developer	Breeding	30%	2%	0.0	0.0
	Autumn migration	N/A	N/A	N/A	N/A
	Spring migration	N/A	N/A	N/A	N/A
	Annual total	-	-	0.0	0.0

3270. The potential annual mortality as a result of displacement is estimated as 1.5 adult and 0.8 immature birds based on Scoping Approach A and as 4.6 adult and 2.3 immature birds based Scoping Approach B (Table 5.278). All mortality was attributable to the non-breeding periods.

3271. No mortality from displacement was predicted using the Developer Approach for any age class or season (Table 5.278).

3272. The additional annual mortality of adult kittiwakes from the West Westray SPA population predicted due to displacement from the Proposed Development array area represents 0.03% of the current adult breeding population at this colony (i.e. 5,486 individuals) as determined by Scoping Approach A, and 0.08% as determined by Scoping Approach B. In terms of percentage increases in the baseline annual adult mortality of the population (based on applying a mortality rate of 0.188 see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the estimates of adult mortality equate to an increase of 0.14 – 0.44% for the lower and upper estimates from the Scoping Approach. As outlined above and in Table 5.278, no mortality was predicted using the Developer Approach.

Collision Risk

3273. The approach used to derive predicted levels of mortality for West Westray SPA kittiwakes is as described in the section on *Project Alone: Operation and Maintenance – Collision risk* for the St Abb's Head to Fast Castle SPA kittiwake population (and in Offshore EIA Report, volume 3, appendix 11.3)

3274. Based upon option 2 of the deterministic CRM with a 98.9% avoidance rate applied, the annual collision mortality of kittiwakes from the West Westray SPA is predicted to be approximately 5.4 adults and 2.5 immatures as determined by the Scoping Approach, and approximately 7.4 adults and 3.7 immatures as determined by the Developer Approach Table 5.279). All mortality was attributable to the non-breeding periods.

Table 5.279: Predicted collision effects from the Proposed Development on the West Westray SPA kittiwake population, as determined by the Scoping Approach and Developer Approach. Estimates are for the worst-case design and are based on option 2 of the deterministic CRM using a 98.9% avoidance rate.

Approach	Seasonal Period	Estimated Number of Collisions	
		Breeding Adults	Immatures
Scoping	Breeding	0.0	0.0
	Autumn migration	3.0	1.8
	Spring migration	4.4	1.9
	Annual total	7.4	3.7
Developer	Breeding	0.0	0.0
	Autumn migration	1.8	1.0
	Spring migration	3.6	1.5
	Annual total	5.4	2.5

3275. The additional annual mortality of adult kittiwakes from the West Westray SPA population predicted due to collision represents approximately 0.09% of the number of adults currently estimated to breed at this colony (i.e. 5,486 individuals) as determined by the Developer Approach and approximately 0.13% as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population (which is based on applying the mortality rate of 0.188 – see Table 2.13 of volume 3, appendix 11.6 of the Offshore EIA Report), the predicted adult collision mortality equates to increases of 0.52% and 0.71% for the Developer and Scoping Approaches, respectively.

3276. As outlined in the *Project Alone: Operation and Maintenance - Collision Risk* section for the St Abb's Head to Fast Castle SPA kittiwake population, using the collision estimates derived from the site-specific flight height data or from the stochastic CRM with avoidance rates as calculated for the bird collision-avoidance study (Bowgen and Cook 2018) would result in predicted collision mortalities on the West Westray SPA kittiwake population that are at least 50% lower than those presented in Table 5.279 above (and on which the assessment is based).

3277. The potential levels of impact on the West Westray SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area during the operation and maintenance phase are considered further below in the *Project Alone: Population-Level Impacts* section. This presents the outputs from PVAs of the combined effects of predicted displacement and collision mortality on the SPA population.

Changes to Prey Availability

3278. During the operational and maintenance phase there are a number of ways in which effects on key prey species may occur, which are outlined in the section on *Project Alone: Construction and Decommissioning – Changes to Prey Availability* for the St Abb's Head to Fast Castle SPA kittiwake population. The same evidence base and context applies to the West Westray SPA kittiwake population as to the St Abb's Head to Fast Castle SPA population in relation to the potential for such effects to lead to impacts on the population.

3279. Given this, it is considered that there is no potential for the West Westray SPA kittiwake population to be affected by changes to prey availability during the operation and maintenance phase, with any such effects being largely intermittent across a relatively small spatial extent. Consequently, it is considered that there is no potential for operational or maintenance related changes in prey availability to lead to an adverse effect on the West Westray SPA kittiwake population.

Project Alone: Population-Level Impacts

3280. As determined above, the effects from the Proposed Development alone which could lead to an adverse effect on the West Westray SPA kittiwake population are displacement (inclusive of barrier effects) and collision mortality during the operation and maintenance phase.

3281. PVA was therefore undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development, as determined by both the Scoping and Developer Approaches (see Table 5.278 and Table 5.279 above). The approach and methods to undertaking the PVA are as described in the section on *Project Alone: Project alone: population-level impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6 of the Offshore EIA Report. Mean annual productivity was calculated based on annual breeding success data from the West Westray SPA in the period 2010-2021. It should be noted that this period encapsulates a crash in kittiwake productivity in the early 2010s which was seen across Orkney breeding colonies. Productivity has subsequently increased, with productivity at the West Westray SPA back to pre-crash levels in recent years (SMP, 2022). Outputs of the PVA should therefore be viewed in this light. The starting population size was the 2021 count for the SPA (Offshore EIA Report, volume 3, appendix 11.5).

Table 5.280: Projected 35 year population sizes and associated PVA metrics for the West Westray SPA kittiwake population under different impact scenarios for the Proposed Development alone.

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	47 (6 – 295)	1.000	1.000	50.0
	Scoping A	9.04	4.52	44 (5 – 276)	0.934	0.998	47.2
	Scoping B	12.12	6.05	43 (5 – 270)	0.912	0.997	46.2
	Developer	5.10	2.64	45 (6 – 284)	0.962	0.999	48.5

3282. The PVA predicted a continuing population decrease for the West Westray SPA kittiwake population, irrespective of the effects from the Proposed Development. Thus, the population is predicted to be smaller than the current estimate of 5,486 adult birds under all scenarios, including baseline which assumes no wind farm effects (Table 5.280). However, this decrease is likely to be strongly influenced by the mean annual productivity rate used within the model, which does not capture the recovery of this breeding population seen in recent years (SMP, 2022).

3283. The predicted population-level impacts are small, irrespective of whether these are determined using the Developer or Scoping Approaches. Thus, for Scoping Approach B the CPS value indicates that the combined collision and displacement mortality associated with the Proposed Development alone would result in a reduction of approximately 8.8% in the size of the SPA population after 35 years, relative to that in the absence of any wind farm effects (Table 5.280). The associated reduction in annual population growth rate (relative to that predicted under baseline conditions) is estimated to be 0.3%, whilst the centile value of 46.2 indicates a considerable overlap in the distributions of the predicted impacted and unimpacted population sizes and, hence, a high likelihood of the impacted population being of a similar size to the unimpacted population after 35 years. As would be expected, the metrics for Scoping Approach A and the Developer Approach suggest smaller levels of impact (Table 5.280).

Project Alone: Conclusion

3284. For both the Developer and Scoping Approaches, the potential effects from the Proposed Development alone on the West Westray SPA kittiwake population are predicted to be small, with the resultant population-level impacts also predicted to be small. Any impacts are likely to be within the natural variation of the population. Given this, it is concluded that the effects from the Proposed Development alone would not result in an adverse effect on this SPA population.

Effects In-Combination

Effects of relevance to the in-combination assessment

3285. For the same reasons as described in *Effects In-Combination* for the St. Abb's Head to Fast Castle SPA kittiwake population, the potential for effects of the Proposed Development to act on the West Westray SPA kittiwake population in-combination with other plans and projects is limited to displacement/barrier effect and collision risk pathways during operation and maintenance.

3286. In-combination totals have been collated for all relevant SPA populations for all UK North Sea offshore wind farms in operation, construction, consented or planning (volume 3, appendix 11.6, annex E of the Offshore EIA Report). Separate in-combination totals for the Forth and Tay projects were not collated for the reasons outlined in *Effects in-combination* for the Farne Islands SPA kittiwake population volume 3, appendix 11.6, annex E and volume 3, appendix 11.8 of the Offshore EIA Report.

Displacement / Barrier Effects – Operation and Maintenance

3287. The approach and methods for estimating in-combination displacement mortality are described in *Effects In-Combination: Displacement/barrier effects – operation and maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in Offshore EIA Report volume 3, appendix 11.6, annex E.

3288. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approaches and Developer Approach (Table 5.281).

Table 5.281: Estimated annual mortality of West Westray SPA kittiwakes as a result of displacement from the Proposed Development array area and 2 km buffer as determined by the Scoping Approach and Developer Approach, in-combination with other UK North Sea wind farms.

In-combination Region	Approach	Seasonal Period							
		Breeding		Autumn Migration		Spring Migration		Annual Total	
		Adults	Immatures	Adults	Immatures	Adults	Immatures	Adults	Immatures
UK North Sea	Scoping A	0.0	0.0	3.1	1.8	4.8	2.1	7.9	3.9
	Scoping B	0.0	0.0	9.3	5.5	14.3	6.3	23.6	11.8
	Developer	0.0	0.0	N/A	N/A	N/A	N/A	0.0	0.0

3289. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the West Westray SPA population predicted due to displacement represents between approximately 0.14-0.43% of the current adult breeding population at this colony (i.e. 5,486 individuals), as determined by Scoping Approach A and B. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult displacement mortality equate to an increase of 0.76 - 2.27% for the lower and upper estimates from the Scoping Approach. No mortality of kittiwake from displacement effects is predicted to occur following the Developer Approach.

3290. The potential levels of impact on the West Westray SPA kittiwake population resulting from predicted displacement/barrier effects associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *Project In-combination: Population-Level Impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

Collision Risk - Operation and Maintenance

3291. The approach and methods for estimating in-combination collision mortality are described in *Effects In-Combination: Collision – Operation and Maintenance* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6, annex E of the Offshore EIA Report.

3292. The potential mortality estimates derived for the other projects were combined with those for the Proposed Development to give in-combination estimates for the UK North Sea wind farm scenario, according to both the Scoping Approach and Developer Approach (Table 5.282).

Table 5.282: Predicted collision effects on the West Westray SPA kittiwake population due to the Proposed Development in-combination with other projects in the UK North Sea waters. Estimates are presented for both the Scoping Approach and Developer Approach for consented designs.

In-combination Region	Approach	Seasonal Period	Estimated Number of Collisions	
			Breeding Adults	Immatures
UK North Sea	Scoping	Breeding	0.0	0.0
		Autumn migration	18.3	10.7
		Spring migration	24.2	10.6
		Annual total	42.5	21.3
	Developer	Breeding	0.0	0.0
		Autumn migration	17.0	10.0
		Spring migration	23.4	10.3
		Annual total	40.4	20.3

3293. For the Proposed Development in-combination with the other UK North Sea wind farms, the additional annual mortality of adult kittiwakes from the West Westray SPA population predicted due to collisions represents 0.74% of the current adult breeding population at this colony (i.e. 5,486 individuals) as determined by the Developer Approach, and 0.77% of this population as determined by the Scoping Approach. In terms of percentage increases in the baseline annual adult mortality of the population, the estimates of adult collision mortality equate to an increase of 3.89% for the Developer Approach and of 4.1% for the Scoping Approach.

3294. The potential levels of impact on the West Westray SPA kittiwake population resulting from predicted collision mortality associated with the Proposed Development array area in-combination with other UK North Sea wind farms during the operation and maintenance phase are considered further below in the *Project In-combination Population-Level Impacts* section. This presents the outputs from PVAs of the combined in-combination effects of predicted displacement and collision mortality on the SPA population.

In-Combination: Population-Level Impacts

3295. As for the Proposed Development alone, PVA was undertaken on the mortality to the adult and immature age classes predicted due to the combined displacement and collision effects associated with the Proposed Development in-combination with the other UK North Sea wind farms. This was on the basis of the potential mortality as determined by both the Scoping and Developer Approaches (see Table 5.281 and Table 5.282 above).

3296. The approach to the PVA and the metrics used to summarise the PVA outputs are as described for *In-Combination: Population-Level Impacts* for St Abb's Head to Fast Castle SPA kittiwake population above and in volume 3, appendix 11.6 of the Offshore EIA Report. As for the project alone PVA, mean annual productivity was calculated based on annual breeding success data from the West Westray SPA in the period 2010-2021. This period encapsulates a crash in kittiwake productivity in the early 2010s which was seen across Orkney breeding colonies. Productivity has subsequently increased, with productivity at the West Westray SPA back to pre-crash levels in recent years (SMP, 2022). Outputs of the in-combination PVA should therefore be viewed in this light (SMP, 2022).

3297. It is also noted that the predicted unimpacted population after 35 years of 47 adults will be significantly lower than the current population of 5,486 adults. Although the additional mortality caused by the Proposed Development in-combination may have a relatively large impact when measured against the Counterfactual Population Size the overall in-combination impact will not have any material effect to the size of colony when compared to the significant decline predicted by the PVA modelling to an unimpacted population.

Table 5.283: Projected 35 year population sizes and associated PVA metrics for the Coquet Island SPA kittiwake population under different impact scenarios for the Proposed Development in-combination with the other UK North Sea wind farms.

Period	Approach	Additional Annual Mortality		Median Number of Breeding Adults in Population (2.5 – 97.5 centiles)	Counterfactual of Population Size (CPS)	Counterfactual of Population Growth Rate (CPGR)	Centile of Baseline Population Matching Median of Impacted Population
		Adults	Immatures				
35 years	Baseline	0	0	47 (6 – 295)	1.000	1.000	50.0
	Scoping A	50.54	25.32	35 (4 – 203)	0.677	0.989	34.9
	Scoping B	66.32	33.25	28 (3 – 181)	0.599	0.986	30.6
	Developer	40.20	20.34	35 (4-219)	0.734	0.991	38.1

3298. Given that the in-combination effects are inevitably greater than those for the Proposed Development alone, the PVA metrics for the Proposed Development in-combination with other UK North Sea wind farms suggest greater population-level impacts than as predicted for the Proposed Development alone (compare Table 5.280 with Table 5.283). However, this these predicted impacts are likely to be strongly influenced by the mean annual productivity rate used within the model, which does not capture the recovery of this breeding population improved productivity seen in kittiwake colonies across Orkney in recent years (SMP, 2022).

3299. The CPS value for the Developer Approach indicates that the SPA population size would be reduced by 26.6% relative to the predicted population size under baseline conditions after 35 years, whilst the equivalent reduction for the Scoping Approach is 32.3 – 40.1% (Table 5.283). Reductions in the annual population growth rate (relative to that predicted under baseline conditions) are estimated to be 0.9% for the Developer Approach and 1.1 – 1.4% for the Scoping Approach. The values for the centile metric are estimated as 38.1 after 35 years for the Developer Approach and as 30.6 – 34.9 for the Scoping Approach, suggesting moderate levels of overlap in the distribution of the predicted impacted and unimpacted population sizes and, hence, a reasonable likelihood of the impacted population being smaller than the unimpacted population after 35 years (noting the influence of productivity rates on these outputs).

In-Combination: Conclusion

3300. For both the Scoping and Developer Approaches, the predicted levels of impact associated with the in-combination scenario represent a marked increase compared to those associated with the Proposed Development alone. These levels of impact suggest the potential for the in-combination effects to lead to a marked reduction in the size of the West Westray SPA population after 35 years relative to that which would occur in the absence of these effects. The predicted levels of impact are such that for the Developer Approach (which predicts lower levels of impact than the Scoping Approach), this potential reduction in population size is 26.6% for the Proposed Development in-combination with the other UK North Sea wind farms.

3301. The centile values indicate a moderate likelihood of the impacted population being similar in size to the un-impacted population after 35 years whilst the context that has been outlined in for both St. Abb's Head to Fast Castle SPA and Forth Islands SPA in relation to (i) the high levels of precaution incorporated in the assessment and (ii) the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population remains highly relevant.

3302. Furthermore, the outputs of the West Westray SPA are considered to be highly influenced by the mean productivity rate for the colony, which does not reflect the current levels of productivity recorded in recent years. Given that current productivity rates for this SPA are in line with those seen prior to the 2008 Orkney population crash (SMP, 2022), it is considered that the scale of the potential reduction in the size of the SPA population is an artefact of the PVA methodology.

3303. Consequently, it is concluded that there is the potential for an adverse effect on the West Westray SPA kittiwake population as a result of the predicted effects from the Proposed Development in-combination with the other UK North Sea wind farms. This conclusion applies to the assessments undertaken according to both the Developer Approach and the Scoping Approach.

Assessment for the Breeding Seabird Assemblage

3304. The breeding seabird assemblage for the West Westray SPA is a qualifying feature on the basis of the SPA supporting in excess of 20,000 individual seabirds (with the citation also noting that the SPA regularly supports 113,000 seabirds). Kittiwake comprise one of the six species identified in the citation as having populations which are considered to be of European or national importance and which contribute to the

West Westray SPA breeding seabird assemblage (no LSE was determined for the other five species in relation to the Proposed Development (HRA Stage One Screening Report; SSE Renewables, 2021b).

3305. Potential impacts of the Proposed Development in-combination with other UK North Sea wind farms on the breeding seabird assemblage for the SPA could arise via effects on the individual species within the assemblage feature. For the both the Developer Approach and Scoping Approach, the assessments undertaken above identify no potential for adverse effects on the SPA kittiwake population.

3306. For the in-combination scenario as determined by the Developer Approach and Scoping Approach, the outputs have been considered in light of the high levels of precaution incorporated in the assessment and with the issues surrounding the mean productivity rate for this SPA, together with the likelihood that the effects from wind farm developments will be of minor importance relative to other management and environmental factors in determining the future status of the SPA kittiwake population. On this basis it is considered that there is no potential adverse effect from in-combination impacts on the SPA kittiwake population in which could lead to a subsequent adverse effect on the seabird assemblage.

Site Conclusion

3307. It is concluded that an AEoI of the West Westray SPA can be excluded from the Proposed Development in-combination with other plans and projects.

5.8. APPROPRIATE ASSESSMENT: MIGRATORY WATERBIRDS SPAS

5.8.1. APPROACH

3308. In response to the 2020 Berwick Bank Scoping Report (SSER, 2020), NatureScot and MSS advised that assessment of collision risk to migratory species should be undertaken qualitatively with reference to the MSS commissioned strategic level report (WWT Consulting, 2014). NatureScot and MSS noted in their Scoping Opinion representations that MSS were in the process of commissioning a further strategic study of migratory species collision risk and that this should be used if available (MS-LOT, 2021).

3309. Subsequently, it was noted during Roadmap Meeting 4 (Offshore EIA Report, volume 3, appendix 11.8, annex A) that some species that are qualifying features of the designated sites screened in were not included within the MSS strategic level report (WWT Consulting, 2014). NatureScot advised that assessment for these missing species was still required and that this should be done on a qualitative basis (G.Holland, email 14/01/2022). Additional methodological work for these species was, therefore, developed in this assessment to allow similar qualitative summaries to be included for the species noted.

3310. The quantitative results presented within the MSS strategic level report are no longer accurate as a result of design changes for the offshore wind farms considered within that report during their development and consenting processes, along with updates on avoidance rate values for some of the species scoped into this report. Since an update to the MSS strategic level report has not been published to date, these changes are incorporated within the approach outlined in this assessment to ensure that the outcomes presented are more representative of the current scale of offshore wind farms present along the Scottish east coast.

3311. The MSS strategic level report provides estimations of the risk of collision to 38 migratory non-seabird species from 11 Scottish offshore wind farms, where details were available during the report's commissioning. Using a proportional overlap approach based on the footprint of offshore wind farms and the migratory routes of certain species, the MSS strategic level report provides estimates of annual collisions, allowing for an avoidance rate of 98%, of migratory species within Scotland from the given offshore wind farms. The MSS strategic level report uses total passage population to consider total birds that may be exposed to potential effects from wind farm developments during the spring and autumn migrations. The passage population size is, therefore, not directly attributable to local SPAs, with individuals within the passage populations potentially associating with SPAs within the UK and Ireland, but not screened in for the Proposed Development, or breeding on mainland Europe. The outcomes of the MSS strategic level report were used to calculate the increase above the natural baseline mortality for each migratory population. Increases above baseline mortality were calculated by dividing the number of predicted collisions from the MSS strategic level report by the number of expected natural baseline mortalities, which were calculated using the population size and adult survival rates available within the British Trust for Ornithology's (BTO) BirdFacts (Robinson, 2005).

3312. Several of the offshore wind farms used in the MSS strategic level report have since changed key design parameters (i.e. number of wind turbine generators (wind turbines) and/or the offshore wind farm footprint), which has direct effects on collision risk mortality estimates. Updated values were, therefore, collated to enable this assessment to qualitatively assess species' risk within the Proposed Development array area both alone and in the context of potential in-combination effects as described within the MSS strategic level report. Table 5.284 details the changes in wind turbine numbers that were available within the relevant development's published documents. Increases in baseline mortality and the comparative decreases wind turbine associated with the number of wind turbines used for these estimates are used to determine whether further analysis is required. The details for the Proposed Development are added to the updated values for the wind farms contained within the MSS strategic level report for this report only, the Proposed Development was not included within the MSS strategic level report (Table 5.284).

3313. Due to the substantial decrease in the number of wind turbines and the likely associated decreases in collision risk if the MSS strategic level report was to be fully revised, the increase in baseline mortality values calculated for each species were multiplied by 0.7 to account for the decrease in wind turbines. A threshold of 0.95% adjusted increased baseline mortality was then used as a threshold for species to be assessed further. A value slightly under the 1% additional mortality threshold used within the MSS strategic level report was considered to be suitably precautionary. Details on species-specific survival rates, sourced from BTO online data, can be found in appendix 3A.

3314. Calculating the mortality rates based on the passage population and estimated collision numbers presented within the MSS strategic level report would provide increased mortality rates of significantly lower (approximately half) of the true effect on the population. It is reasonable to assume that the majority of the same individuals migrate through the area twice, and not as a single exposure. Therefore, to ensure that the approach is fully precautionary and to appropriately calculate the increase in baseline mortality, only one seasonal passage population should be used. Here, we used whichever seasonal migration was the largest for the given species.

3315. For species above the 0.95% adjusted threshold, further literature reviews were undertaken to understand the risk posed by the Proposed Development. The literature review focussed on updated avoidance rates for the species of concern as the values used within the MSS strategic level report are now considered overly precautionary (Natural England, 2022) along with available population information. Any potential impacts are considered within the context of consented or proposed developments within the region and the size of the screened in SPA populations within the context of the passage population used within the MSS strategic level report.

3316. There were 17 species screened in for this assessment that were not included within the MSS strategic level report full analysis. As detailed within the MSS strategic level report, this is predominantly due to a lack of data on population numbers in Scotland during spring and autumn passage periods and therefore no collision risk modelling work could be undertaken. For those species, the migratory routes obtained from BTO SOSS 05 (Wright *et al*., 2012), SPA population size, extent of migratory path and collision risk outputs for proxy species within the MSS strategic level report are considered to inform the risk.

3317. For these species, it was assumed that all colonies received a uniform selection of individuals using the migratory route. This enabled a calculation of the percentage the migratory front overlapped with the Proposed Development (overlap proportion). The most recently available avoidance rates were then considered to assess whether any reductions in the number of annual estimated collisions would be likely if migratory collisions were re-analysed using the most up to date values. The number of birds was then considered against the passage population size used within the MSS strategic level report and the population size of the SPA, along with migratory routes and other offshore wind farms to allow a qualitative analysis to be presented. Further analysis to the collision risk modelling level is not considered due to the advice received (G.Holland, email 14/01/2022) as well as uncertainties in the specific migratory behaviours of the screened in SPA populations.

3318. For species which had no robust estimates of migratory paths (one of the criteria for being dropped from the MSS strategic level report), migratory front information or other missing data were used from a proxy species. Proxies were determined based on species similarity, UK population sizes, and utilisation of the same protected sites. It is emphasised that the outputs of these are qualitative and are constrained by data availability limiting full analysis. For barrier effects, spatial overlaps were reviewed regarding migration direction and the Proposed Development array area used to consider potential increases in migration distance.

Table 5.284: Details on the Offshore Wind Farms Assessed Under the MSS Strategic Level Report. Updated Details are Obtained from the Most Recent Assessment and Consenting Documents Available Online

Offshore Wind Farm	Number of Wind Turbines Used in MSS Strategic Level Report	Updated Number of Wind Turbines
Beatrice	277	84
Moray R3 Telford *	139	53
Moray R3 Stevenson *	100	53
Moray R3 MacColl *	100	53
EOWDC	11	11
Seagreen Alpha and Bravo	150	114
Inch Cape	213	72
Neart na Gaoithe	73	54
Robin Rigg	60	58
Berwick Bank	-	307
Total	**1,123**	**806**

* Moray Firth Round 3 sites as described in MSS strategic level report. Turbine numbers updated with developments that most closely match the area used within the MSS strategic level report analysis.

5.8.2. BARRIER EFFECTS FOR MIGRATORY NON-SEABIRDS

3319. Barrier effects are not thought likely to cause an Adverse Effect on Integrity with regards to any of the migratory non-seabird species that are features of any of the SPA or Ramsar sites screened in for assessment. The maximum barrier effect of a migratory waterbird following the perimeter of the Proposed Development array area would cause an increase of a maximum of 60 km in migration distance, representing a small percentage (12%) of the migration path from those species crossing the North Sea from Scandinavia (490 km) and to a lesser extent (5%) from the Icelandic (1,125 km) coastlines. In reality, an increase of 60 km is unlikely as birds will most likely take a path of least increase, either by flying higher or navigating around the Proposed Development array area in a more efficient manner. It should also be noted that for the majority of species their migratory start/end points are further than the nearest coastlines of Scandinavia or Iceland (as the distance above are calculated from). For many species they will migrate for over double these distances with birds breeding in Canada to the west and northern Russia to the east, so these values are overestimates of the percentage increase to each species' overall migratory pathway. At worst, this is a small increase in total flight distance and would be insignificant compared to unsuitable wind conditions or other natural variation (Masden *at al.*, 2010). Therefore, it is reasonable to conclude no Adverse Effect on Integrity of any SPA and Ramsar site features as a result of a barrier effect.

5.8.3. FIRTH OF FORTH SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3320. The Firth of Forth SPA and Ramsar site consists of numerous disjoint sites around the Firth of Forth in Scotland, UK (in the region of 55.9 – 56.2°N and 2.5 – 3.8°W) and comprising an area of 63.18 km^2.

3321. The Firth of Forth SPA qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004411) are:

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

3322. The Proposed Development does not overlap with the Firth of Forth SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA or Ramsar site occurring in the area (or vicinity) of the Proposed Development.

3323. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3324. Further information on this European site is presented in appendix 3A.

3325. The potential for LSE has been identified in relation to 27 of 27 qualifying features for this SPA and Ramsar site for this SPA and Ramsar site.

<u>Project alone and in-combination: operation and maintenance</u>

<u>Collision risk</u>

3326. Of the 27 features screened in, 14 were considered within the MSS strategic level report (Table 5.285). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species except curlew (Table 5.285). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Firth of Forth SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for bar-tailed godwit, common scoter, dunlin, golden plover, grey plover, long-tailed duck, oystercatcher, pink-footed goose, redshank, scaup, turnstone, velvet scoter and wigeon.

3327. For the remaining 13 species, lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Firth of Forth SPA and Ramsar site are shown in Table 5.286. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these 13 species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (maximum 0.26% for great crested grebe). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Firth of Forth SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for cormorant, eider, goldeneye, great crested grebe, knot, lapwing, mallard, red-breasted merganser, red throated diver, ringed plover, Sandwich tern, shelduck and Slavonian grebe.

Additional assessment for curlew

3328. For curlew, as shown in Table 5.284, the Proposed Development is expected to account for 307 out of the total of 748 wind turbines on the Scottish east coast (Robin Rigg being the only west coast offshore wind farm considered in the MSS strategic level report to have been taken forward). Therefore, based on the number of wind turbines, an approximation of 41% of the collisions for this species could be attributed to the Proposed Development. On this basis, the increase in mortality compared to baseline attributed to the Proposed Development alone is 0.69%, which is below the 0.95% threshold considered for further assessment.

3329. Across all offshore wind farms included in the MSS strategic level report and the Proposed Development, after adjusting for the as built/as consented number of wind turbines, the predicted increase in baseline mortality is 1.67% (Table 5.285). This value is based on an estimated avoidance rate of 98% which derived from studies of bird behaviour at onshore wind farms (NatureScot 2018, Natural England 2022b). This is likely to be highly precautionary for a wader during migration, during which time birds are known to fly at high altitudes above the likely rotor swept height (Schwemmer *et al*., 2021). Furthermore, the broad-front migration pattern assumed by the MSS strategic level report is unlikely to reflect the more complex migratory behaviours undertaken by many bird species; most migratory non-seabirds are likely to choose the shortest distance across open water, which means fewer individuals may interact with offshore wind farms than assumed.

3330. Furthermore, the approach within this report when calculating potential increases in baseline mortality is highly precautionary in comparison to the approach taken within for other consented developments. The MSS strategic level report concluded that only the wintering population is expected to be at risk from offshore wind farms on the east coast of Scotland. In their scoping representations for the revised Forth and Tay developments, NatureScot advice indicates that the approach taken within the MSS strategic level report and its subsequent outcomes can be viewed as sufficient, and therefore curlew in the wintering period would show a maximum of 0.84% increase in baseline mortality when assessed in-combination with all other sites along the Scottish east coast.

3331. Given that the site condition for curlew if favourable, maintained, together with the considerations outlined above, a conclusion of no Adverse Effect on Integrity with regards to the Firth of Forth SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for curlew can be made.

Site conclusion

3332. In summary, with reference to the conservation objectives set for the features screened in for assessment, it can be concluded that there is no potential for an Adverse Effect on Integrity on any of the 27 of the migratory waterbird features of the Firth of Forth SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination with other plans and projects for migratory collision risk and barrier effects.

Table 5.285: Qualifying Features of the Firth of Forth SPA and Ramsar Site, with Calculations of Additional Mortality (MSS Strategic Level Report (MSSLR)) and Corrected Additional Mortality with Updated Wind Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	SPA Population Size (Updated 2018)	Increase in Baseline Mortality (MSSLR) (%)	Adjusted Increased Mortality (%)
Bar-tailed godwit	Favourable maintained	1,974	0.646	0.452
Common scoter	Unfavourable declining	2,880	0.009	0.006
Curlew (breeding)*	Favourable maintained	1,928	1.485	1.040
Curlew (wintering)*	Favourable maintained	1,928	2.391	1.674
Dunlin **	Favourable declining	9,514	0.191-0.536	0.134-0.375
Golden plover	Unfavourable declining	2,949	0.204	0.143
Grey plover	Favourable declining	724	0.571	0.400
Long-tailed duck	Unfavourable declining	1,045	0.167	0.117
Oystercatcher	Favourable maintained	7,846	0.677	0.474
Pink-footed goose	Favourable maintained	10,852	1.306	0.914
Redshank (*robusta*) ***	Favourable maintained	4,341	0.527	0.369
Redshank (*totanus*) breeding ***	Favourable maintained	4,341	0.857	0.600
Redshank (*totanus*) breeding ***	Favourable maintained	4,341	0.877	0.614
Scaup	Unfavourable declining	437	0.072	0.050
Turnstone	Favourable maintained	860	0.429	0.300
Velvet scoter	Favourable maintained	635	0.625	0.438
Wigeon	Favourable maintained	2,139	0.089	0.063

* Separate population sizes for curlew for the Firth of Forth SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

** Dunlin is presented as a summary of the three subspecies alpina, arctica and schinzii as all three are presented within the MSS strategic level report but seasonal population sizes for dunlin for the Firth of Forth SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

*** Redshank is presented as separate lines for subspecies as associated seasons (breeding or passage) as presented within the MSS strategic level report. Separate population sizes for redshank for the Firth of Forth SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

Table 5.286: Qualifying Features of the Firth of Forth SPA and Ramsar Site not Included in the MSS Strategic Level Report. Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Site Condition	SPA Population Size (Updated 2018)	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Cormorant	Favourable maintained	682	531	40	7.5	0.15
Eider	Favourable declining	9,400	524	40	7.6	0.15
Goldeneye	Unfavourable declining	3,004	531	40	7.5	0.15
Great crested grebe	Unfavourable declining	720	304	40	13.2	0.26
Knot	Unfavourable declining	9,258	1100	40	3.6	0.13
Lapwing	Favourable declining	4,148	528	40	7.6	0.15
Mallard	Favourable declining	2,564	533	40	7.5	0.15
Red-breasted merganser	Unfavourable declining	670	564	32	5.7	0.11
Red throated diver	Favourable maintained	90	490	40	8.2	0.15
Ringed plover	Favourable maintained	328	524	32	6.1	0.12
Sandwich tern	Favourable maintained	1617	1100	40	3.6	0.07
Shelduck	Favourable maintained	4,509	530	40	7.5	0.15
Slavonian grebe	Unfavourable declining	84	1100	40	3.6	0.07

5.8.4. MONTROSE BASIN SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3333. Montrose Basin SPA and Ramsar Site consists of two disjointed areas in Scotland, UK (in the region of 56.71 – 56.73°N and 2.47 – 2.56 °W) and comprises a total area of 9.81 km^2. The Montrose Basin qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3334. The conservation objectives (as determined from NatureScot's SiteLink SPA Citation UK9004031) of this SPA are:

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

3335. The Proposed Development does not overlap with the Montrose Basin SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3336. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3337. Further information on this European site is presented in appendix 3A.

3338. The potential for LSE has been identified in relation to nine of nine qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3339. Of the nine features screened in, six were considered within the MSS strategic level report. Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species (Table 5.287). Therefore, a conclusion can be made of no Adverse Effect on Integrity of the Montrose Basin SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for dunlin, greylag goose, oystercatcher, pink-footed goose, redshank and wigeon (Table 5.287).

3340. For the remaining three species, lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Montrose Basin SPA and Ramsar site are shown in Table 5.288. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these three species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (maximum 0.15% for eider and shelduck). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Montrose Basin SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for eider, knot, and shelduck.

Site conclusion

3341. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Montrose Basin SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.287: Qualifying Features of the Montrose Basin and Ramsar Site, With Calculations of Additional Mortality (MSS Strategic Level Report) and Corrected Additional Mortality With Updated Wind Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Dunlin *	Favourable	2,244	0.191-0.536	0.375
Greylag goose	Unfavourable	1,080	0.501	0.351
Oystercatcher	Favourable	3,100	0.677	0.474
Pink-footed goose	Favourable	21,800	1.306	0.914
Redshank (robusta) **	Favourable	2,240	0.527	0.369
Redshank (totanus) breeding **	Favourable	2,240	0.857	0.600
Redshank (totanus) breeding **	Favourable	2,240	0.877	0.614
Wigeon	Favourable	5270	0.089	0.063

* Dunlin is presented as a summary of the three subspecies alpina, arctica and schinzii as all three are presented within the MSS strategic level report but seasonal population sizes for dunlin for the Montrose Basin SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

** Redshank is presented as separate lines for subspecies as associated seasons (breeding or passage) as presented within the MSS strategic level report. Separate population sizes for redshank for the Montrose Basin SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

Table 5.288: Qualifying Features of the Montrose Basin and Ramsar Site Not Included in the MSS Strategic Level Report. Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Condition	Population Size	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Eider	Favourable	2,240	524	40	7.6	0.15
Knot	Unfavourable	2,790	1,100	72	6.5	0.13
Shelduck	Favourable	1,069	530	40	7.5	0.15

5.8.5. NORTHUMBRIA COAST SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3342. Northumbria Coast SPA and Ramsar Site are located within the region of 55.4°N, 1.59°W, and comprises an area of 10.97 km². The two designations are significantly overlapped and are considered together The Northumbria Coast qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3343. The conservation objectives (as determined from NatureScot's SiteLink SPA Data form UK9006131) of this SPA are:

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

3344. The Proposed Development does not overlap with the Northumbria Coast SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3345. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3346. Further information on this European site is presented in appendix 3A.

3347. The potential for LSE has been identified in relation to two of four qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3348. Of the two features screened in, one species (turnstone) was considered within the MSS strategic level report (Table 5.289). From this, the adjusted increase in baseline mortality was under the 0.95% threshold for turnstone (Table 5.289). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Northumbria Coast SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for turnstone.

3349. For the remaining species, purple sandpiper, lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Northumbria Coast SPA and Ramsar site are shown in Table 5.290. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for purple sandpiper, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of this feature considered vulnerable to collision (0.13% for purple sandpiper). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Northumbria Coast SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for purple sandpiper.

Site conclusion

3350. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Northumbria Coast SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.289: Qualifying Features of the Northumbria Coast SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Turnstone	Not assessed	1,739	0.429	0.300

Table 5.290: Qualifying Features of the Northumbria Coast SPA and Ramsar Site Not Included in the MSS Strategic Level Report. Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Condition	Population Size	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Purple sandpiper	Not assessed	787	1,100	72	6.5	0.13

5.8.6. FIRTH OF TAY AND EDEN ESTUARY SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3351. Firth of Tay and Eden Estuary SPA and Ramsar site are located in the region of 56.4°N, 3.14°W, and comprises an area of 69.47 km². The two designations are significantly overlapped and are considered together. The Firth of Tay qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3352. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004121) are:

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

3353. The Proposed Development does not overlap with the Firth of Tay and Eden Estuary SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3354. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3355. Further information on this European site is presented in appendix 3A.

3356. The potential for LSE has been identified in relation to 17 of 20 qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3357. Of the 17 features screeded in, 12 were considered within the MSS strategic level report (Table 5.291). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species (Table 5.291). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Firth of Tay and Eden Estuary SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for bar-tailed godwit, common scoter, dunlin, grey plover, greylag goose, Icelandic black tailed godwit, long-tailed duck, oystercatcher, pink-footed goose, redshank, sanderling, and velvet scoter.

3358. For the remaining five species (eider, goldeneye, goosander, red-breasted merganser, and shelduck), lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Firth of Tay and Eden Estuary SPA and Ramsar site are shown in Table 5.292. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these five species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (0.15% for eider, goldeneye, goosander, and shelduck). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Firth of Tay and Eden Estuary SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for eider, goldeneye, goosander, red-breasted merganser, and shelduck.

Site conclusion

3359. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Firth of Tay and Eden Estuary SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.291: Qualifying Features of the Firth of Tay and Eden Estuary SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Bar-tailed godwit	Favourable	2,400	0.646	0.452
Common scoter	Unfavourable	3,100	0.009	0.006
Dunlin *	Favourable	5,200	0.191-0.536	0.375
Grey plover	Favourable	920	0.571	0.400
Greylag goose	Unfavourable	1,200	0.501	0.351
Icelandic black tailed godwit	Favourable	150	0.99	0.69

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Long-tailed duck	Unfavourable	560	0.*167*	0.1*17*
Oystercatcher	Favourable	5,100	0.339	0.237
Pink-footed goose	Favourable	2,800	1.*306*	0.9*14*
Redshank (*robusta*) **	Favourable	1,800	0.*527*	0.*369*
Redshank (*totanus*) breeding **	Favourable	1,800	0.*857*	0.*600*
Redshank (*totanus*) breeding **	Favourable	1,800	0.*877*	0.*614*
Sanderling	Favourable	220	0.162	0.110
Velvet scoter	Unfavourable	730	0.313	0.217

* Dunlin is presented as a summary of the three subspecies alpina, arctica and schinzii as all three are presented within the MSS strategic level report but seasonal population sizes for Dunlin for the Firth of Tay and Eden Estuary SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

** Redshank is presented as separate lines for subspecies as associated seasons (breeding or passage) as presented within the MSS strategic level report. Separate population sizes for redshank for the Firth of Tay and Eden Estuary SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

Table 5.292: Qualifying Features of the Firth of Tay and Eden Estuary SPA and Ramsar Site Not Included in the MSS Strategic Level Report. Information for Goldeneye was Used for Goosander (See *Appendix B*). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Condition	Population Size	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Eider	Favourable	13,800	524	40	7.6	0.15
Goldeneye	Unfavourable	230	531	40	7.5	0.15
Goosander	Favourable	220	531	40	7.5	0.15
Red-breasted merganser	Unfavourable	470	564	32	5.7	0.11
Shelduck	Unfavourable	1,200	530	40	7.5	0.15

5.8.7. LINDISFARNE SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3360. The Lindisfarne SPA and Ramsar site are located within the region of 55.67°N, 1.84°W and comprises an area of 36.71 km^2. The two designations are significantly overlapped and are considered together. The Lindisfarne SPA qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3361. The conservation objectives of this SPA (as determined from SPA Data form UK9006011) are:

- To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - *The extent and distribution of the habitats of the qualifying features;*
  - *The structure and function of the habitats of the qualifying features;*
  - *The supporting processes on which the habitats of the qualifying features rely;*
  - *The population of each of the qualifying features, and, No significant disturbance of the species; and*
  - *The distribution of the qualifying features within the site.*

3362. The Proposed Development does not overlap with the Lindisfarne SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3363. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3364. Further information on this European site is presented in appendix 3A.

3365. The potential for LSE has been identified in relation to 16 of these 18 qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3366. Of the 16 features screened in, 12 were considered within the MSS strategic level report (Table 5.293). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species (Table 5.293). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Lindisfarne SPA and Ramsar Site on protected waterbird features during migration with respect to the Proposed Development acting alone or in combination for bar-tailed godwit, common scoter, dunlin, golden plover, grey plover, greylag goose, light-bellied brent goose, long-tailed duck, redshank, sanderling, whooper swan and wigeon (Table 5.293).

3367. For the remaining four species (eider, red-breasted merganser, ringed plover, and shelduck), lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Lindisfarne SPA and Ramsar site are shown in Table 5.294. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these four species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (maximum 0.20% for ringed plover). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Lindisfarne SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for eider, red-breasted merganser, ringed plover, and shelduck.

Additional assessment of light-bellied brent goose

3368. The MSS strategic level report details two populations for Light-bellied brent goose that are migrate to or transit through Scotland, one larger population from Canada (1,900) and a smaller population from Svalbard (350). The MSS strategic level report notes that the Svalbard population is a “scarce and uncommon winter visitor”, with previous studies recording 60-150 wintering birds (Forrester *et al*. 2007). These two populations of significantly differing sizes, therefore, require a professional judgement call when viewing the increase in baseline mortality values used as a benchmark for assessments of other species.

The outcome of the MSS strategic level report detail <1 annual collision estimates for the Svalbard light-bellied brent goose. Taking a precautionary approach the estimated value of 1 was used in estimating the increase baseline mortality making this value an overestimate due to the level of detail within the MSS strategic level report. The larger Canadian light-bellied brent goose population returned a value of 1 annual collision from the larger population size.

3369. Being assessed as one population, based on the MSS strategic level report, the total migratory population of light-bellied brent goose would be 2,250 with a maximum annual collision estimate of two birds. This returns an increase on baseline mortality of 0.89% based on MSS strategic level report wind turbine parameters, with an adjusted increase in baseline mortality of 0.62% accounting for as built wind turbine parameters.

3370. Considering that the presence of the birds from within the Svalbard population is likely to limited due to them being scarce and data quality constraints being known regarding the movements of that population, it is more reasonable to combine the two populations to assess the risk to all light-bellied brent geese. Therefore, when assessing the risk from collision mortality against the total population of light-bellied brent geese it results in an increase in baseline mortality of below the 0.95% threshold (Table 5.293).

Additional assessment of whooper swan

3371. As in the MSS strategic level report, the total migratory population of whooper swan assessed is 22,000 birds in both the spring and autumn migration periods. From this the MSS strategic report estimated 83 collisions, which after adjustment for updated number of wind turbines as presented in this report resulted in a calculation of increased baseline mortality of 1.33%. However, the MSS strategic report used a precautionary avoidance rate of 98%. Recently published guidance recommends using an avoidance rate of 99.5% for swan species (Nature Scot 2018), which would theoretically result in approximately a 75% reduction in collisions. This would subsequently reduce whooper swan increased baseline mortality to less than the 0.95% threshold presented here. Whooper swan is therefore scoped out of further analysis as it is thought unlikely for there to be Adverse Effect on Integrity on this species for Proposed Development alone or in-combination.

Site conclusion

3372. In summary, with reference to the conservation objectives set for the features screened in for assessment, it can be concluded that there is no potential for an Adverse Effect on Integrity on the migratory waterbird features of the Lindisfarne SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination with other plans and projects for migratory collision risk and barrier effects.

Table 5.293: Qualifying Features of the Lindisfarne SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). * See *Additional Assessment of Light Bellied Brent Goose.* Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Bar-tailed godwit	Not available	2,946	0.646	0.452
Common scoter	Not available	263	0.009	0.006
Dunlin*	Not available	7,703	0.191-0.536	0.375
Golden plover	Not available	5,300	0.204	0.143
Grey plover	Not available	1,570	0.571	0.400
Greylag goose	Not available	1,416	0.501	0.351
Light bellied brent goose	Not available	1,844	0.526 - 2.86	0.37 - 2.00
Long-tailed duck	Not available	59	0.167	0.117
Redshank (*robusta*) **	Not available	904	0.527	0.369
Redshank (*totanus*) breeding **	Not available	904	0.857	0.600
Redshank (*totanus*) breeding **	Not available	904	0.877	0.614
Sanderling	Not available	218	0.16	0.11
Whooper swan	Not available	53	1.896	1.327
Wigeon	Not available	7,857	0.089	0.063

* Dunlin is presented as a summary of the three subspecies alpina, arctica and schinzii as all three are presented within the MSS strategic level report but seasonal population sizes for dunlin for the Lindisfarne SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

** Redshank is presented as separate lines for subspecies as associated seasons (breeding or passage) as presented within the MSS strategic level report. Separate population sizes for redshank for the Lindisfarne SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

Table 5.294: Qualifying Features of the Lindisfarne SPA and Ramsar Site Not Included in the MSS Strategic Level Report. Population Data as Available in Most Recently Updated in Most Recent Site Data Form.

Species	Condition	Population Size	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Eider	Not available	1,568	524	40	7.6	0.15
Red-breasted merganser	Not available	18	564	32	5.7	0.11
Ringed plover	Not available	163	722	72	10.0	0.20
Shelduck	Not available	899	530	40	7.5	0.15

5.8.8. YTHAN ESTUARY, SANDS OF FORVIE AND MEIKLE LOCH SPA, YTHAN ESTUARY AND MEIKLE LOCH RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3373. Ythan Estuary, Sand of Forvie and Meikle Loch SPA and the Ythan Estuary and Meikle Loch Ramsar site are located in the region of 57.32°N, 1.94°W and comprises an area of 70.62 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3374. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9002221) are:

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

3375. The Proposed Development does not overlap with the Ythan Estuary, Sands of Forvie and Meikle Loch SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3376. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3377. Further information on this European site is presented in Appendix 3A.

3378. The potential for LSE has been identified in relation to four of seven qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3379. Of the four features screened in, two were considered within the MSS strategic level report (Table 5.295). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for both species (Table 5.295). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose and redshank.

3380. For the remaining two species (eider and lapwing), lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ramsar site are shown in Table 5.296. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these two species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (maximum 0.15% for eider and lapwing). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for eider and lapwing.

Site conclusion

3381. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.295: Qualifying Features of the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ythan Estuary and Meikle Loch Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink footed goose	Favourable	17,213	1.306	0.914
Redshank (*robusta*) *	Favourable	1,149	0.527	0.369
Redshank (*totanus*) breeding *	Favourable	1,149	0.857	0.600
Redshank (*totanus*) breeding *	Favourable	1,149	0.877	0.614

* Redshank is presented as separate lines for subspecies as associated seasons (breeding or passage) as presented within the MSS strategic level report. Separate population sizes for redshank for the Ythan Estuary, Sand of Forvie and Meikle Loch SPA and Ramsar site are not available therefore the SPA population counts are presented. Passage population data is available in appendix 3A.

Table 5.296: Qualifying features of the Ythan Estuary, Sand of Forvie and Meikle Loch SPA, Ythan Estuary and Meikle Loch Ramsar Site Not Included in the MSS Strategic Level Report. Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Condition	Population Size	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Eider	Favourable	1,860	524	40	7.6	0.15
Lapwing	Favourable	2,542	528	40	7.6	0.15

5.8.9. CAMERON RESERVOIR SPA AND RAMSAR SITE (INLAND WATERBODY)

European site information and conservation objectives

3382. Cameron Reservoir SPA and Ramsar site are located in the region of 56.29°N, 2.85 W and comprises an area of 63.18 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3383. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004131) are:

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

3384. The Proposed Development does not overlap with the Cameron Reservoir SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3385. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3386. Further information on this European site is presented in appendix 3A.

3387. The potential for LSE has been identified in relation to one of one qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3388. A single species was screened in (pink-footed goose), which was considered within the MSS strategic level report (Table 5.297). The adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.297). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Cameron Reservoir SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose.

Site conclusion

3389. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Cameron Reservoir SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.297: Qualifying Features of the Cameron Reservoir SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2022)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Favourable	6,760	1.306	0.914

5.8.10. HOLBURN LAKE AND MOSS SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3390. Holburn Lake and Moss SPA and Ramsar site are located in the region of 55.62°N, 1.91°W and comprises an area of 0.28 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3391. The conservation objectives of this SPA (as determined from SPA Data form UK9004131) are:

- Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; The extent and distribution of the habitats of the qualifying features
  - *The structure and function of the habitats of the qualifying features;*
  - *The supporting processes on which the habitats of the qualifying features rely;*
  - *The population of each of the qualifying features;*
  - *The distribution of the qualifying features within the site; and*
  - *No significant disturbance of the species.*

3392. The Proposed Development does not overlap with the Holburn Lake and Moss SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3393. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3394. Further information on this European site is presented in appendix 3A.

3395. The potential for LSE has been identified in relation to one of one qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3396. A single species was screened in (greylag goose), which was considered within the MSS strategic level report (Table 5.298). The adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.298). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Holburn Lake and Moss SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for greylag goose.

Site conclusion

3397. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Holburn Lake and Moss SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.298: Qualifying Features of the Holburn Lake and Moss SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form.

Qualifying Feature	Site Condition	Population Size (Updated 2015)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Greylag goose	Not available	2,150	0.501	0.351

5.8.11. GREENLAW MOOR SPA AND RAMSAR SITE

European site information and conservation objectives

3398. Greenlaw Moor SPA and Ramsar site are located in the region of 5.74°N, 2.45°W and comprises an area of 63.18 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3399. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004281) are:

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

3400. The Proposed Development does not overlap with the Greenlaw Moor SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3401. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3402. Further information on this European site is presented in appendix 3A.

3403. The potential for LSE has been identified in relation to one of one qualifying features for this SPA and Ramsar site.

<u>Project alone and in-combination: operation and maintenance</u>

<u>Migratory collision risk</u>

3404. A single species was screened in (pink-footed goose), which was considered within the MSS strategic level report (e). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.299). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Greenlaw Moor SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose.

Site conclusion

3405. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Greenlaw Moor SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.299: Qualifying Features of the Greenlaw Moor SPA and Ramsar, Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2022)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Favourable maintained	14,200	1.306	0.914

5.8.12. LOCH OF KINNORDY SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3406. Loch of Kinnordy SPA and Ramsar site are located in the region of 56.67°N, 3.04°W and comprises an area of 0.85 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3407. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004051) are:

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

3408. The Proposed Development does not overlap with the Loch of Kinnordy SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3409. Consequently, the focus of the assessment for this SPA and Ramsar population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3410. Further information on this European site is presented in appendix 3A.

3411. The potential for LSE has been identified in relation to two of two qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3412. Two species were screened in (greylag goose and pink-footed goose), which were both considered within the MSS strategic level report (Table 5.300). For both species the adjusted increase in baseline mortality was under the 0.95% threshold (Table 5.300). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Loch of Kinnordy SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for greylag goose and pink-footed goose.

Site conclusion

3413. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Loch of Kinnordy SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.300: Qualifying Features of the Loch of Kinnordy SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Greylag goose	Unfavourable unchanged	3,500	0.501	0.351
Pink-footed goose	Unfavourable declining	1,650	1.*306*	0.*914*

5.8.13. DIN MOSS - HOSELAW LOCH SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3414. Din Moss – Hoselaw Loch SPA and Ramsar sites are located in the region of 55.57°N, 2.308°W and comprises an area of 0.50 km^2. The two designations are significantly overlapped and are considered together. The Firth of Forth qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed in below.

3415. The conservation objectives of this SPA (SPA Citation UK9004241) are:

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

3416. The Proposed Development does not overlap with the Din Moss – Hoselaw Loch SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3417. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3418. Further information on this European site is presented in appendix 3A.

3419. The potential for LSE has been identified in relation to two of these two qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3420. The two features screened in (greylag goose and pink-footed goose) were considered within the MSS strategic level report (Table 5.301). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species (Table 5.301). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Din Moss – Hoselaw Loch SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for greylag and pink-footed goose.

Site conclusion

3421. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Din Moss – Hoselaw Loch SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.301: Qualifying Features of the Din Moss – Hoselaw Loch SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Greylag goose	Unfavourable unchanged	3,500	0.501	0.351
Pink-footed goose	Unfavourable declining	1,650	1.*306*	0.*914*

5.8.14. FALA FLOW SPA AND RAMSAR SITE

European site information and conservation objectives

3422. Fala Flow SPA and Ramsar site are located 55.81°N, 2.90°W and comprises an area of 3.17 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3423. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004241) are:

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

3424. The Proposed Development does not overlap with the Fala Flow SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3425. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3426. Further information on this European site is presented in appendix 3A.

3427. The potential for LSE has been identified in relation to one of one qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3428. A single species was screened in (pink-footed goose), which was considered within the MSS strategic level report (Table 5.302). The adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.302). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Fala Flow SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose.

Site conclusion

3429. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Fala Flow SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.302: Qualifying Features of the Fala Flow SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2022)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Favourable	2,400	1.306	0.914

5.8.15. LOCH LEVEN SPA AND RAMSAR SITE

European site information and conservation objectives

3430. Loch Leven SPA and Ramsar site are located in the region of 56.196°N, 3.37°W and comprises an area of 63.18 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3431. The conservation objectives of this (as determined from NatureScot's SiteLink SPA Citation UK9004111) are:

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

3432. The Proposed Development does not overlap with the Loch Leven SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3433. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3434. Further information on this European site is presented in appendix 3A.

3435. The potential for LSE has been identified in relation to eight of these nine qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3436. Of the eight features screened in, five (pink-footed goose, pochard, teal, tufted duck, and whooper swan) were considered within the MSS strategic level report (Table 5.303). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species except whooper swan (Table 5.303). Whooper swan was therefore taken forward for additional assessment. For the other four species, a conclusion can be made of no Adverse Effect on Integrity with regards to the Loch Leven SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose, pochard, teal, tufted duck, and whooper swan.

For the remaining three species (gadwall, goldeneye, and shoveler), lengths of migration fronts derived from the BTO SOSS Migration data for each species within the Loch Leven SPA and Ramsar site are shown in

3437. Table 5.304. The footprint length for species migrating from Scandinavia was 40 km and for Iceland 32 km. Scottish-specific data are missing for these three species, with data availability limitations likely to be the reason they were not considered in the MSS strategic level report. Assuming uniform migratory distributions and a 98% avoidance rate (as used within the MSS strategic level report), the proportion of the population considered vulnerable to collision was considered low, with well under 1% of the population of any feature considered vulnerable to collision (0.26%). Based on this low proportion being vulnerable to collision, a conclusion can be made of no Adverse Effect on Integrity with regards to the Loch Leven SPA and Ramsar site as a result of collision risk from the Proposed Development both alone or in-combination with other plans and projects for gadwall, goldeneye, and shoveler.

Additional assessment of whooper swan

3438. As in the MSS strategic level report, the total migratory population of whooper swan assessed is 22,000 birds in both the spring and autumn migration periods. From this the MSS strategic report estimated 83 collisions, which after adjustment for updated number of wind turbines as presented in this report resulted in a calculation of increased baseline mortality of 1.33%. However, the MSS strategic report used a precautionary avoidance rate of 98%. Recently published guidance recommends using an avoidance rate of 99.5% for swan species (Nature Scot 2018), which would theoretically result in approximately a 75% reduction in collisions. This would subsequently reduce whooper swan increased baseline mortality to less than the 0.95% threshold presented here. Whooper swan is therefore scoped out of further analysis as it is thought unlikely for there to be Adverse Effect on Integrity on this species for Proposed development alone or in-combination.

Site conclusion

3439. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Loch Leven SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.303: Qualifying Features of the Loch Leven SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2015)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Favourable maintained	17,163	1.306	0.914
Pochard	Favourable maintained	1,095	0.333	0.233
Teal	Favourable maintained	2,771	0.083	0.058
Tufted duck	Favourable maintained	3,636	0.113	0.079
Whooper swan	Favourable maintained	97	1.896	1.327

Table 5.304: Qualifying Features of the Loch Leven SPA and Ramsar Site Not Included in the MSS Strategic Level Report. Information for Goldeneye was Used for Calculating Shoveler, Information for Mallard was Used for Gadwell (See *Appendix B*). Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Species	Condition	Population Size (Updated 2015)	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)	Potential Proportion Vulnerable to Collision (%)
Gadwall	Favourable maintained	245	533	40	7.5	0.15
Goldeneye	Favourable maintained	339	531	40	7.5	0.15
Shoveler	Favourable maintained	509	531	40	7.5	0.15

5.8.16. GLADHOUSE RESERVOIR SPA AND RAMSAR SITE

European site information and conservation objectives

3440. Gladhouse Reservoir SPA and Ramsar site are located in the region of 55.77°N, 3.117°W and comprises an area of 1.86 km^2. The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3441. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004231) are:

- To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - *Population of the species as a viable component of the site;*
  - *Distribution of the species within site;*
  - *Distribution and extent of habitats supporting the species;*

- *Structure, function and supporting processes of habitats supporting the species; and*
- *No significant disturbance of the species.*

3442. The Proposed Development does not overlap with the Gladhouse Reservoir SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3443. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3444. Further information on this European site is presented in appendix 3A.

3445. The potential for LSE has been identified in relation to one of one qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3446. A single species was screened in (pink-footed goose), which was considered within the MSS strategic level report (Table 5.305). The adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.305). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Gladhouse Reservoir SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose.

Site conclusion

3447. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Gladhouse Reservoir SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.305: Qualifying Features of the Gladhouse Reservoir SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Unfavourable declining	10,500	1.306	0.914

5.8.17. SOUTH TAYSIDE GOOSE ROOSTS SPA AND RAMSAR SITE

European site information and conservation objectives

3448. South Tayside Goose Roosts SPA and Ramsar site are located in the region of 56.26°N, 3.83°W and comprises an area of 3.32 km². The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3449. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004401) are:

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

3450. The Proposed Development does not overlap with the South Tayside Goose roosts SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3451. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3452. Further information on this European site is presented in appendix 3A.

3453. The potential for LSE has been identified in relation to three of the three qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3454. All three features screened in (greylag goose, pink-footed goose and wigeon) were considered within the MSS strategic level report (Table 5.306). Of these, the adjusted increase in baseline mortality was under the 0.95% threshold for all species (Table 5.306). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the South Tayside Goose roosts SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for all three species.

Site conclusion

3455. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the South Tayside Goose roosts SPA and Ramsar site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.306: Qualifying Features of the South Tayside Goose roosts SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Greylag goose	Unfavourable declining	9,700	0.501	0.351
Pink-footed goose	Unfavourable declining	31,800	1.*306*	0.9*14*
Wigeon	Not assessed	16	0.089	0.063

5.8.18. WESTWATER SPA AND RAMSAR SITE (ESTUARINE)

European site information and conservation objectives

3456. Westwater SPA and Ramsar site are located 55.75°N, 3.40W° and comprises an area of 0.49 km^2. The two designations are significantly overlapped and are considered together. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3457. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004251) are:

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

3458. The Proposed Development does not overlap with the Westwater SPA and Ramsar site, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3459. Consequently, the focus of the assessment for this SPA and Ramsar site population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3460. Further information on this European site is presented in appendix 3A.

3461. The potential for LSE has been identified in relation to one of these 25 qualifying features for this SPA and Ramsar site.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3462. A single species was screened in (pink-footed goose), which was considered within the MSS strategic level report (Table 5.307). The adjusted increase in baseline mortality was under the 0.95% threshold for this species (Table 5.307). Therefore, a conclusion can be made of no Adverse Effect on Integrity with regards to the Westwater SPA and Ramsar site as a result of collision risk from the Proposed Development either alone or in-combination with other plans and projects for pink-footed goose.

Site conclusion

3463. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Westwater SPA and Ramsar Site. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.307: Qualifying Features of the Westwater SPA and Ramsar Site, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2018)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Pink-footed goose	Favourable maintained	29,600	1.306	0.914

5.8.19. SLAMANNAN PLATEAU SPA (ESTUARINE)

European site information and conservation objectives

3464. The Slamannan Plateau SPA is located at 55.94°N, 3.90°W and comprises an area of 5.90 km^2. The area qualifies under Article 4.1 by regularly supporting populations of waterbird species as detailed below.

3465. The conservation objectives of this SPA (as determined from NatureScot's SiteLink SPA Citation UK9004441) are:

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

3466. The Proposed Development does not overlap with the Slamannan SPA, so potential impacts on its qualifying features will only occur as a result of individuals from the SPA occurring in the area (or vicinity) of the Proposed Development.

3467. Consequently, the focus of the assessment for this SPA population is concerned with the conservation objective to maintain or restore the populations of each qualifying feature. The other conservation objectives either apply to the site itself, and not to areas beyond the boundary, or are encompassed by the assessment of this conservation objective.

3468. Further information on this European site is presented in appendix 3A.

3469. The potential for LSE has been identified in relation to one of the one qualifying features for this SPA.

Project alone and in-combination: operation and maintenance

Migratory collision risk

3470. A single species was screened in (Taiga bean goose), which was considered within the MSS strategic level report (Table 5.308). The adjusted increase in baseline mortality was over the 0.95% threshold for this species (Table 5.308). Therefore, Taiga bean goose was taken forward for additional assessment within this report.

Additional assessment of taiga bean goose

3471. The Scottish population of Taiga bean geese consists predominantly of overwintering birds (c.250) with 10-100 individuals observed during migration passage each year. In the MSS strategic level report, these counts were totalled to give 350 individuals at risk each migration periods, with no accounting for the known variability in migrating individuals. It is currently unknown how populations of Taiga bean geese migrate across Scotland and the North Sea, with the limited tracking data suggesting a proportion of individuals present at the Slamannan Plateau SPA may transit through England and not directly from Scandinavia (Michell *et al*., 2016). This would affect the outcomes of the assessment process undertaken within this report and the MSS strategic level report.

3472. The values presented here based on the outputs on the MSS strategic level report assume that the entire Scottish population transits the migration front used within the MSS strategic level report analysis, however the limited tracking data available suggests this is likely not the case, especially during the autumn migration (Figure 4, Michell *et al*., 2016). Consequently, it is likely the true numbers migrating close to the Proposed Development are lower than currently used in the MSS strategic level report, and therefore collisions would be expected to be fewer than currently estimated.

3473. As in the MSS strategic level report, the total migratory population of Taiga bean goose assessed is 700 birds in both the spring and autumn migration periods. From this the MSS strategic report estimated 3 collisions, which after adjustment for updated number of wind turbines as presented in this report resulted in a calculation of increased baseline mortality of 2.6%. However, the MSS strategic report used a precautionary avoidance rate of 98%. Recently published guidance recommends using an avoidance rate of 99.8% for goose species (NatureScot, 2018), which would theoretically result in approximately an 87.5% reduction in collisions. This would subsequently reduce Taiga bean goose increased baseline mortality to less than the 0.95% threshold presented here. Taiga bean goose is therefore scoped out of further analysis as it is thought unlikely for there to be Adverse Effect on Integrity on this species for Proposed development alone or in-combination.

3474. This would therefore decrease the number of potential collisions, likely bringing any potential increased baseline mortality estimates from this report and the MSS strategic level report to below levels of no significance. Taiga bean goose is therefore screened out of further assessment.

Site conclusion

3475. In conclusion, with reference to the conservation objectives set for the features of this site, it can be concluded that there is no potential for an Adverse Effect on Integrity on the Slamannan Plateau SPA. This finding is in relation to potential impacts associated with the Proposed Development in any or all phases, acting alone and or in-combination for migratory collision and barrier effects.

Table 5.308: Qualifying Features of the Slamannan Plateau SPA, With Calculations of Additional Mortality (From MSS Strategic Level Report) and Corrected Additional Mortality With Updated Turbine Numbers) Population Data as Available in Most Recently Updated in Most Recent Site Data Form

Qualifying Feature	Site Condition	Population Size (Updated 2019)	Increase in Baseline Mortality (%)	Adjusted Increased Mortality (%)
Taiga bean goose	Favourable maintained	221	3.727	2.609

*see additional assessment of aiga bean goose.

6. CONCLUSIONS

Table 6.1: Summary of Potential Adverse Effect on Integrity (AEoI) for Breeding Seabird SPAs for Proposed Development alone (Alone) and in-combination with i) other Forth and Tay offshore wind farms (F&T) and ii) other UK North Sea offshore windfarms (UK N Sea) according to the Developer and Scoping Approaches to assessment. ✓ = potential for AEoI, × = no potential for AEoI.

Species	SPA	Current population (individuals)	Predicted mortality			Developer Approach AEoI			Scoping Approach AEoI		
			Developer	Scoping A	Scoping B	Alone	F&T	UK N.Sea	Alone	F&T	UK N.Sea
Gannet	Fair Isle	9,942	0.5	0.6	0.8	×	×	×	×	×	×
Gannet	Flamborough and Filey Coast	26,784	2.7	3.2	4.6	×	×	×	×	×	×
Gannet	Forth Islands	15,0518	154.8	183.0	245.2	×	×	×	×	×	×
Gannet	Hermaness, Saxa Vord and Valla Field	51,160	2.2	2.6	4.1	×	×	×	×	×	×
Gannet	Sule Skerry and Sule Stack	18,130	0.5	0.6	0.9	×	×	×	×	×	×
Gannet	North Rona and Sula Sgeir	22,460	0.4	0.5	0.8	×	×	×	×	×	×
Gannet	Noss	27,530	1.4	1.7	2.6	×	×	×	×	×	×
Guillemot	Buchan Ness to Collieston Coast	39,553	5.0	9.6	21.5	×	×	×	×	×	×
Guillemot	Farne Islands	85,816	36.6	79.4	167.2	×	×	×	×	×	×
Guillemot	Forth Islands	34,580	37.2	91.3	180.5	×	×	×	✓	✓	✓
Guillemot	Fowlsheugh	91,358	89.0	259.9	473.3	×	×	×	✓	✓	✓
Guillemot	St. Abb's Head to Fast Castle	61,408	110.8	310.3	576.1	×	×	×	✓	✓	✓
Guillemot	Troup, Pennan and Lion's Heads	31,893	2.5	5.2	11.1	×	×	×	×	×	×
Herring gull	Farne Islands	1,496	0.5	0.9	0.9	×	×	×	×	×	×
Herring gull	Forth Islands	11,868	10.2	17.1	17.1	×	×	×	×	×	×
Herring gull	Fowlsheugh	1,414	0.6	1.0	1.0	×	×	×	×	×	×
Herring gull	St. Abb's Head to Fast Castle	612	0.4	0.8	0.8	×	×	×	×	×	×
Kittiwake	Buchan Ness to Collieston Coast	22,590	11.4	16.5	21.0	×	×	×	×	×	✓
Kittiwake	Coquet Island	932	0.3	0.5	0.6	×	×	×	×	×	×
Kittiwake	East Caithness Cliffs	48,920	18.4	30.7	41.1	×	×	✓	×	×	✓
Kittiwake	Farne Islands	8,804	23.3	29.3	35.2	×	×	×	×	×	✓
Kittiwake	Flamborough and Filey Coast	91,008	17.0	28.5	38.2	×	×	✓	×	×	✓
Kittiwake	Forth Islands	9,034	28.9	36.2	43.3	×	✓	✓	×	✓	✓
Kittiwake	Fowlsheugh	26,542	87.0	109.0	130.5	×	✓	✓	×	✓	✓
Kittiwake	St. Abb's Head to Fast Castle	10,904	253.3	312.6	371.3	✓	✓	✓	✓	✓	✓
Kittiwake	Troup, Pennan and Lion's Heads	21,232	9.0	14.1	18.4	×	×	×	×	×	✓
Kittiwake	West Westray	5,486	5.4	9.0	12.1	×	×	×	×	×	×
Kittiwake	North Caithness Cliffs	7,712	4.5	7.6	10.2	×	×	×	×	×	×
Kittiwake	Hoy	608	0.3	0.4	0.4	×	×	×	×	×	×
Kittiwake	Copinsay	1,910	0.3	0.5	0.6	×	×	×	×	×	×
Lesser black-backed gull	Coquet Island	40	0.0	0.0	0.0	×	×	×	×	×	×
Lesser black-backed gull	Farne Islands	1,362	0.5	0.7	0.7	×	×	×	×	×	×
Lesser black-backed gull	Forth Islands	4,006	2.0	2.8	2.8	×	×	×	×	×	×
Puffin	Coquet Island	50,058	1.01	3.61	6.00	×	×	×	×	×	×
Puffin	Farne Islands	87,504	3.6	12.9	21.4	×	×	×	×	×	×

Puffin	Forth Islands	87,240	5.1	18.2	30.2	×	×	×	×	✓	✓
Puffin	Hoy	361	0.0	0.0	0.0	×	×	×	×	×	×
Puffin	North Caithness Cliffs	3,034	0.0	0.0	0.1	×	×	×	×	×	×
Puffin	Flamborough and Filey Coast SPA	958	0	0.08	0.14	×	×	×	×	×	×
Razorbill	East Caithness Cliffs	40,117	3.9	5.3	14.8	×	×	×	×	×	✓
Razorbill	Farne Islands	572	0.1	0.2	0.5	×	×	×	×	×	×
Razorbill	Flamborough and Filey Coast	37,476	3.0	3.8	11.0	×	×	×	×	×	×
Razorbill	Forth Islands	7,878	3.6	10.6	19.0	×	×	×	×	✓	✓
Razorbill	Fowlsheugh	1,7817	4.3	12.7	23.0	×	×	×	×	✓	✓
Razorbill	St. Abb's Head to Fast Castle	3,928	2.6	8.3	14.4	×	×	×	×	×	✓
Razorbill	Troup, Pennan and Lion's Heads	6,054	0.8	1.5	3.2	×	×	×	×	×	×
Great skua	Hoy	2,082	0.18	0.35	0.35	×	×	×	×	×	×
Great skua	Foula	3,600	0.18	0.35	0.35	×	×	×	×	×	×
Great skua	Fetlar	1,836	0.18	0.35	0.35	×	×	×	×	×	×
Arctic tern	Forth Islands SPA	1,664	0	0.13	0.13	×	×	×	×	×	×
Common tern	Forth Islands SPA	60	0	0.50	0.50	×	×	×	×	×	×

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APPENDIX 3A: EUROPEAN SITE INFORMATION

This Appendix provides site-specific information for all of the designated sites considered in the draft RIAA, including site characterisations, current conservation condition and the conservation objectives. This appendix is provided as a standalone document.

APPENDIX 3B: LIST OF SPECIES AND ASSOCIATED POPULATION, SURVIVAL AND MORTALITY PARAMETERS FOR SPECIES WITHIN MS STRATEGIC ASSESSMENT

Species	UK Population	Adult Survival	Baseline Mortality Rate	Baseline Mortality Count	Predicted Collisions (98% AR, MS Strategic Ass.)	Increase in Baseline Mortality	Adjusted Increase in Baseline Mortality
Bar tailed godwit	38,000	0.715	0.285	10,830	70	0.646%	0.452%
Black tailed godwit (Icelandic)	43,000	0.940	0.060	2,580	51	1.977%	1.384%
Common scoter	100,000	0.783	0.217	21,700	2	0.009%	0.006%
Curlew (breeding)	116,000	0.899	0.101	11,716	174	1.485%	1.040%
Curlew (wintering)	85,700	0.899	0.101	8,655.7	207	2.391%	1.674%
Dunlin (alpina)	340,000	0.740	0.260	88,400	474	0.536%	0.375%
Dunlin (arctica)	280,000	0.740	0.260	72,800	139	0.191%	0.134%
Dunlin (schinzii)	15,000	0.740	0.260	3,900	18	0.462%	0.323%
Golden plover	60,000	0.730	0.270	16,200	33	0.204%	0.143%
Grey plover	10,000	0.860	0.140	1,400	8	0.571%	0.400%
Icelandic greylag goose	111,500	0.830	0.170	18,955	95	0.501%	0.351%
Long-tailed duck	15,000	0.720	0.280	4,200	7	0.167%	0.117%
Oystercatcher	80,000	0.880	0.120	9,600	65	0.677%	0.474%
Pink footed goose	360,000	0.829	0.171	61,560	804	1.306%	0.914%
Pochard	6,000	0.650	0.350	2,100	7	0.333%	0.233%
Redshank robusta	140,000	0.740	0.260	36,400	192	0.527%	0.369%
Redshank totanus breeding	35,000	0.740	0.260	9,100	78	0.857%	0.600%
Redshank totanus passage	25,000	0.740	0.260	6,500	57	0.877%	0.614%
Sanderling	50,000	0.830	0.170	8,500	22	0.259%	0.181%
Scaup	8,000	0.480	0.520	4,160	3	0.072%	0.050%
Light bellied brent goose (Canadian)	1,300	0.900	0.100	130	1	0.769%	0.538%
Light bellied brent goose (Svalbard)	300	0.900	0.100	30	1	3.333%	2.333%
Light bellied brent goose (combined)	1,600	0.900	0.100	160	2	1.250%	0.875%
Taiga bean goose	350	0.770	0.230	80.5	3	3.727%	2.609%
Teal	100,000	0.530	0.470	47,000	39	0.083%	0.058%
Tufted duck	213,000	0.710	0.290	61,770	70	0.113%	0.079%
Turnstone	50,000	0.860	0.140	7,000	30	0.429%	0.300%

Species	UK Population	Adult Survival	Baseline Mortality Rate	Baseline Mortality Count	Predicted Collisions (98% AR, MS Strategic Ass.)	Increase in Baseline Mortality	Adjusted Increase in Baseline Mortality
Velvet scoter	1,000	0.840	0.160	160	1	0.625%	0.438%
Whooper swan	22,000	0.801	0.199	4,378	83	1.896%	1.327%
Wigeon	214,000	0.530	0.470	100,580	90	0.089%	0.063%

APPENDIX 3C: LIST OF SPECIES SCREENED IN BUT NOT CONTAINED WITHIN THE MS STRATEGIC LEVEL REPORT AND ASSOCIATED PARAMETERS

Species	Proxy Species	Migration Front (km)	Footprint Length (km)	Proportion of Overlap Between Fronts (%)
Cormorant	-	531	40	0.15
Gadwall	Mallard	533	40	7.5
Shoveler	Goldeneye	531	40	7.5
Shelduck	-	530	40	7.5
Goosander	Goldeneye	531	40	7.5
Purple sandpiper	-	1100	72	6.5
Eider	-	524	40	7.6
Goldeneye	-	531	40	7.5
Great crested grebe	-	304	40	13.2
Knot	-	1100	72	6.5
Lapwing	-	528	40	7.6
Mallard	-	533	40	7.5
Red-breasted merganser	-	564	32	5.7
Red-throated diver	-	490	40	8.2
Ringed plover	-	524	32	6.1
Sandwich tern	-	1100	40	3.6
Slavonian grebe	-	1100	40	3.6