codling wind park

Environmental Impact Assessment Report

Volume 4

Appendix 10.1 Cumulative Effects Assessment


codling
wind park

Table of contents

List of tables

Abbreviations

Abbreviation	Term in Full
CWP	Codling Wind Park
CEA	Cumulative Effects Assessment
CGR	Counterfactual Growth Rate
CPS	Counterfactual Population Size
CRM	Collision Risk Modelling
cSPA	Candidate Special Protection Area
DD	Density Dependence
DAERA	Department of Agriculture, Environment and Rural Affairs
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
ES	Environmental Statement
EU	European Union
JNCC	Joint Nature Conservation Committee
LoD	Limits of Deviation
MAC	Maritime Area Consent
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NA	Not Applicable
OECC	Offshore Export Cable Corridor
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PVA	Population Viability Analysis
SD	Standard Deviation
SE	Standard Error
SID	Strategic Infrastructure Development
SPA	Special Protection Area
TTS	Temporary Threshold Shift
UI	User Interface
ZoI	Zone of Influence

Definitions

Glossary	Meaning
the Applicant	The developer, Codling Wind Park Limited (CWPL).
array site	The area within which the wind turbine generators (WTGs), inter-array cables (IACs) and the offshore substation structures (OSSs) are proposed.
Codling Wind Park (CWP) Project	The proposed development as a whole is referred to as the Codling Wind Park (CWP) Project, comprising of the offshore infrastructure, the onshore infrastructure and any associated temporary works.
Codling Wind Park Limited (CWPL)	A joint venture between Fred. Olsen Seawind (FOS) and Électricité de France (EDF) Renewables, established to develop the CWP Project.
Environmental Impact Assessment (EIA)	A systematic means of assessing the likely significant effects of a proposed project, undertaken in accordance with the EIA Directive and the relevant Irish legislation.
Environmental Impact Assessment Report (EIAR)	The report prepared by the Applicant to describe the findings of the EIA for the CWP Project.
export cables	The cables, both onshore and offshore, that connect the offshore substations with the onshore substation.
interconnector cables	The subsea electricity cables between OSSs
landfall	The point at which the offshore export cables are brought onshore and connected to the onshore export cables via the transition joint bays (TJB).
limit of deviation (LoD)	Locational flexibility of permanent and temporary infrastructure is described as a LoD from a specific point or alignment.
Maritime Area Consent (MAC)	A Maritime Area Consent (MAC) provides State authorisation for a prospective developer to undertake a maritime usage and occupy a specified part of the maritime area. A MAC is required to be in place before planning consent can be sought.
offshore development area	The entire footprint of the offshore infrastructure and associated temporary works that will form the offshore boundary for the planning application.
offshore export cables	The cables which transport electricity generated by the wind turbine generators (WTGs) from the offshore substation structures (OSSs) to the landfall.
offshore export cable corridor (OECC)	The area between the array site and the landfall, within which the offshore export cables will be installed along with cable protection and other temporary infrastructure for construction.
offshore infrastructure	The offshore infrastructure, comprising of the WTGs, IACs, OSSs, interconnector cables, offshore export cables and other associated infrastructure such as cable and scour protection.

Glossary	Meaning
Operations and maintenance (O&M) activities	Activities (e.g., monitoring, inspections, reactive repairs, planned maintenance) undertaken during the O&M phase of the CWP Project.
O&M phase	This is the period of time during which the CWP project will be operated and maintained.
parameters	Set of parameters by which the CWP Project is defined and which are used to form the basis of assessments.
Phase 1 Project	On 19 of May 2020, the Government announced that seven offshore renewable energy projects had been designated as Relevant Projects, namely Oriel Wind Park, Arklow Bank II, Bray Bank, Kish Bank. North Irish Sea Array, Codling Wind Park and Skerd Rocks. These projects are now known as Phase 1 Projects.
planning application boundary	The area subject to the application for development consent, including all permanent and temporary works for the CWP Project.
Strategic Infrastructure Development (SID)	Strategic Infrastructure Development includes development which would: - contribute significantly to meeting any of the objectives of the National Planning Framework, or - contribute significantly to meeting any regional spatial and economic strategy for an area, or - have a significant effect on the area of more than one planning authority.
wind turbine generator (TWG)	All the components of a wind turbine, including the tower, nacelle and rotor.
Zone of Influence (ZoI)	Spatial extent of potential impacts resulting from the project.

1 APPENDIX 10.1 CUMULATIVE EFFECTS ASSESSMENT

1.1 Introduction

1. Codling Wind Park Limited (hereafter 'the Applicant') is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish sea approximately 13–22 km off the east coast of Ireland, at County Wicklow.

2. The Environmental Impact Assessment Report (EIAR) for the CWP Project provides the decision-maker, stakeholders and all interested parties with the environmental information required to develop an informed view of any likely significant effects resulting from the CWP Project, as required by the European Union (EU) Directive 2011/92/EU (as amended by Directive 2014/52/EU) (the EIA Directive). These provisions are transposed into Irish legislation in Part X of the Planning and Development Act 2000, as amended, and in Part 10 of the Planning and Development Regulations 2001, as amended.

3. A fundamental component of the EIA is to consider and assess the potential for cumulative effects of the project with other projects, plans and activities (hereafter referred to as 'other development').

4. The Environmental Protection Agency (EPA) Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022) defines cumulative effects as:

> *'The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.*
>
> *While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or insignificant), result in a cumulative impact that is collectively significant. For example, effects on traffic due to an individual industrial project may be acceptable; however, it may be necessary to assess the cumulative effects taking account of traffic generated by other permitted or planned projects.'*

5. This appendix presents the findings of the Cumulative Effects Assessment (CEA) for ornithology which considers the residual effects presented in **Chapter 10 Ornithology** alongside the potential effects of other proposed and reasonably foreseeable development. Cumulative effects are considered in this document across the construction and operation and maintenance phases of the CWP Project.

6. Project alone impacts during the decommissioning phase of the CWP Project are assessed in **Chapter 10 Ornithology**. It is anticipated that the impacts will be no greater than those identified for the construction phase, and therefore no separate assessment of cumulative impacts during the decommissioning phase is presented within this CEA.

7. Due to the differing spatial scales of the effect-receptor pathways, and ecological distinctions between receptor groups, this This document presents the CEA for offshore and intertidal first before then presenting the CEA for onshore ornithological receptors. This Appendix is therefore presented in the following way:

- **Section 1.2** - CEA methodology
- **Section 1.2.1** - Guidance
- **Section 1.2.2** - Consultation
- **Section 1.2.3** - Identification of 'other' development
- **Section 1.3** - CEA Impact Screening – offshore and intertidal
- **Section 1.4** - CEA 'other' development' screening – offshore and intertidal
- **Section 1.5** - CEA Assessment of cumulative effects – offshore and intertidal
- **Section 1.6** - CEA Impact Screening – onshore
- **Section 1.7** - CEA 'other' development' screening – onshore

- **Section 1.8** - CEA Assessment of cumulative effects – onshore
- **Section 1.9** - CEA summary
- **Section 1.10** - References
- **Annex A** - Abundance of receptors at projects considered in CEA in relation to disturbance and displacement
- **Annex B -** Cumulative displacement matrices
- **Annex C -** Collision mortality of receptors at projects considered in CEA in relation to collision
- **Annex D -** Cumulative PVA parameters

1.2 CEA methodology

1.2.1 Guidance

8. This section summarises the approach to the assessment of cumulative effects for the CWP Project. Further details on the approach to the CEA is provided in **Appendix 5.1 Cumulative Effects Assessment Methodology**.

9. The principal guidance document that has informed the approach to the CEA is the Planning Inspectorate (PINS) for England 'Advice Note 17: Cumulative Effects Assessment' (PINS, 2019), which provides a four-stage process for the assessment of cumulative effects which has been applied here.

10. This guidance has been applied for a number of both OWF and non-OWF projects in the UK, and is considered to provide developers with a structured approach to assessing cumulative effects. The guidance is also regularly applied in Ireland for large scale projects, noting that there is no single, industry standard approach to CEA in Ireland which often varies between projects.

11. In developing the CEA methodology, EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022) and Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission, 1999) have also been considered.

1.2.2 Consultation

12. **Table 1** provides a summary of stakeholder and regulator feedback received during the consultation process that is relevant to the CEA for ornithology.

Table 1 Consultation responses relevant to the CEA for ornithology

Consultee	Comment	How issues have been addressed
Scoping responses		
Department of Agriculture, Environment and Rural Affairs (DAERA) 23 February 2021	Retention of some concerns regarding collision risk mortality during non-breeding season, particularly during migration periods, which could also contribute to a wider cumulative risk in-combination with other Irish Sea projects. Chief concerns relate to terns, kittiwake (*Rissa*	Collision Risk Modelling (CRM) has been carried out, with collision mortality being estimated during all months of the year. Further information on CRM carried out can be found in the **Appendix 10.3: Collision Risk Modelling**.

Consultee	Comment	How issues have been addressed
	tridactyla) and lesser black-backed gull (*Larus fuscus*).	Cumulative collision impacts to kittiwake, great black-backed gull, herring gull, gannet and common tern are assessed here. Other tern species and lesser black-backed gull were screened out from CEA on the basis of project only collision impacts being imperceptible and non-significant in EIA terms.
Topic specific meetings		
National Parks and Wildlife Service (NPWS) 27 February 2020	For CEA advised using min / max scenarios, where min includes only consented projects, and max also includes projects that could be consented between assessment and works commencing.	The methods used for the CEA are presented here. A tiered approach to incorporate cumulative scenarios in relation to consented and non-consented projects is followed.
Other		
Irish east coast Phase 1 projects (CWP, NISA, Dublin Array, Arklow Phase 2, Oriel) 13 October 2023	To facilitate the development of a consistent approach to be followed by Irish east coast Phase 1 projects to undertake CEA, an agreed list of regional OWF projects to be considered within CEA and their associated annual collision mortalities and peak abundances (to inform cumulative displacement assessment) was developed.	The agreed list formed the basis of OWF projects included in the CEA (see **Section 1.2.3**, below)

1.2.3 Identification of 'other development'

13. Stage 1 of the process involved establishing the long list of other development with the potential to result in cumulative effects with the CWP Project. This included all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to other OWF projects.

14. The long list of other development (presented in **Chapter 5**, **Appendix 5.1 Cumulative Effects Assessment Methodology**) was then subject to additional screening criteria to establish a short list of other development for each topic. It should be noted that the approach to the CEA attempts to incorporate an appropriate level of pragmatism. Only projects which are well described and sufficiently advanced, with sufficient detail available with which to undertake a meaningful and robust assessment, have been screened into the CEA.

15. In accordance with PINS Advice Note 17, each development considered alongside the CWP Project as part of the CEA has been assigned to a tier, reflecting their current status in the planning and development process.

16. The purpose of the tiered approach is to give consideration to the level of certainty that a cumulative project will be built and therefore contribute to cumulative effects. For example, there can be greater certainty that other development approved and under construction are likely to contribute to cumulative effects, whereas other development at early phases of development (i.e., pre-planning) are less likely to proceed to construction and contribute to cumulative effects. Furthermore, sufficient detail about these projects is unlikely to be available with which to undertake a detailed cumulative assessment.

17. The proposed tiering structure is presented in **Table 2** and described in more detail in **Appendix 5.1 Cumulative Effects Assessment Methodology**. The tiers are listed in descending order of level of detail likely to be available (and, correspondingly, certainty of effects arising).

Table 2 Tiered structure for other development considered for CEA (modified from PINS advice note 17 (PINS, 2019))

Tier	Description
Tier 1	• Constructed projects with a continuing effect. • Under construction. • Permitted applications, but not yet implemented. • Offshore applications submitted six months or more in advance of the CWP Project planning application, but not yet determined. • Onshore applications submitted six months or more in advance of the CWP Project planning application, but not yet determined.
Tier 2a	• Offshore projects in receipt of a Maritime Area Consent (MAC) and an ORESS contract.
Tier 2b	• Offshore projects in receipt of a Maritime Area Consent (MAC). • Offshore Projects in the public domain where an EIA scoping report has been issued. • Onshore Projects in the public domain where an EIA scoping report has been issued.
Tier 3	• Projects in the public domain where an EIA scoping report has not been issued. • Projects that have been identified in the relevant development plans and programmes, which set the framework for future development consents / approvals, where such development is reasonably likely to come forward.

1.3 CEA impact screening – offshore and intertidal

18. The following sections present the CEA for offshore followed by onshore for ease of presentation.

19. The first step in the CEA for ornithology is the identification of which residual impacts assessed for the CWP Project alone have the potential for a cumulative impact with other development (described as 'impact screening'). This screening exercise is set out below.

20. Only potential impacts assessed in **Chapter 10 Ornithology** with a significance level of 'not significant' or above are included in the CEA (i.e., those assessed as 'imperceptible' are not taken forward as there is no potential for them to contribute to a cumulative effect).

21. In summary, **Table 3** shows that there is the potential for cumulative effects on:

- Guillemot, razorbill, puffin red-throated diver and gannet as a result of disturbance and displacement in the form of indirect habitat loss within the array site and surrounding area during the construction phase.

- Red-throated diver as a result of disturbance and displacement in the form of indirect habitat loss within the offshore part (<MLWS) of the OECC during the construction phase.
- Oystercatcher, curlew, black-headed gull (LoD scenario only), red-breasted merganser, herring gull (LoD scenario only), little egret, *Sterna* terns (common, Arctic and roseate) and sandwich tern as a result of disturbance and displacement in the form of indirect habitat loss within the intertidal part (MLWS to MHWS) of the OECC during the construction phase.
- Common tern, Arctic tern, red-throated diver, cormorant and shag as a result of impacts upon prey availability within the array site and surrounding area and / or offshore part (<MLWS) of the OECC during the construction phase.
- Guillemot, razorbill, puffin, red-throated diver and gannet as a result of disturbance and displacement in the form of indirect habitat loss within the array site and surrounding area during the operation and maintenance phase.
- Kittiwake, great black-backed gull, herring gull, common tern and gannet as a result of collision within the array site during the operation and maintenance phase.

22. Other potential impacts, including direct effects on habitat, pollution and introduction of invasive non-native species were screened out of the CEA on the basis that project only residual impacts to all receptors were assessed to be imperceptible.

Table 3 CEA impact screening

Impact	Potential for cumulative effect	Rationale
Construction		
Impact 1 - Direct effects on offshore and intertidal habitats during construction phase activities.	Array site: No	Impacts extremely localised in relation to seabird offshore habitat use extents. Residual 'project only' impacts to all receptors assessed to be of imperceptible significance level.
	Offshore Export Cable Corridor (OECC) (Below MLWS): No	
	OECC (MLWS to MHWS): No	Intertidal impacts localised and short duration. Residual 'project only' impacts to all receptors assessed to be of imperceptible significance level.
Impact 2 - Disturbance and displacement to ornithological receptors in offshore and intertidal habitats during construction phase activities.	Array site: Indirect habitat loss and barrier effects to seabirds – Yes, for **guillemot, razorbill, puffin, red-throated diver and gannet. All other receptors screened out.**	For all receptors, with the exception of those listed, 'project only' impacts are either screened out (on the basis of receptor insensitivity to the impact, or low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). For guillemot, razorbill, puffin, red-throated diver and gannet residual project only impact significance levels are assessed to be not significant or greater and therefore further consideration of cumulative effects is required.
	Array site: Barrier effects to migrant species: No	Potential impact magnitude negligible for all receptors. Residual 'project only' impacts to all receptors assessed to be of imperceptible significance level.
	OECC (Below MLWS): Indirect habitat loss and barrier effects to seabirds – Yes for **red-throated diver. All other receptors screened out.**	For all receptors, with the exception of those listed, 'project only' impacts are either screened out (on the basis of receptor insensitivity to the impact, or low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). For red-throated diver residual 'project only' impact significance levels are assessed to be not significant and therefore further consideration of cumulative effects is required.
	OECC (MLWS to MHWS):Yes, for the following receptors only **oystercatcher, curlew, black-headed gull (LoD scenario only), red-breasted**	For all receptors, with the exception of those listed, project only impacts are either screened out (on the basis of low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).

Impact	Potential for cumulative effect	Rationale
	merganser, herring gull (LoD scenario only), little egret, Sterna terns (common, Arctic and roseate) and sandwich tern	For oystercatcher, curlew, red-breasted merganser, little egret, Sterna terns (common, Arctic and roseate) and sandwich tern residual 'project only' impact significance levels are assessed to be slight or not significant and therefore further consideration of cumulative effects is required. For black headed gull and herring gull, while impacts associated with the preferred alignment cable route through the intertidal area of South Dublin Bay are assessed to be of negligible magnitude and imperceptible significance (and therefore not progressed for consideration in the CEA), impacts associated with the Limit of Deviation (LoD) scenario are assessed to be not significant and therefore further consideration of cumulative effects is required for the LoD scenario.
Impact 3 - Changes in prey availability for ornithological receptors in offshore and intertidal habitats from construction phase activities.	Array site and OECC (Below MLWS): Yes, for **common tern, Arctic tern, red-throated diver, cormorant and shag. All other receptors screened out.**	For all receptors, with the exception of those listed, 'project only' impacts are either screened out (on the basis of receptor insensitivity to the impact, or low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). For common tern, Arctic tern, red-throated diver, cormorant and shag residual project only impact significance levels are assessed to be not significant or greater.
	OECC (MLWS to MHWS): No	Intertidal impacts localised and short duration. Residual 'project only' impacts to all receptors assessed to be of imperceptible significance level.
Impact 4 - Accidental pollution in offshore and intertidal habitats during construction phase activities.	Array site, OECC (Below MLWS) and OECC (MLWS to MHWS): No	No impact after primary mitigation
Impact 5 - Accidental introduction or spread of invasive species in offshore and intertidal habitats during	Array site, OECC (Below MLWS) and OECC (MLWS to MHWS): No	No impact after primary mitigation

Impact	Potential for cumulative effect	Rationale
construction phase activities.		
Operation		
Impact 1 - Direct effects on offshore and intertidal habitats during the operational phase.	Array site: No	Potential impact magnitudes negligible for all receptors. Residual 'project only' impacts to all receptors assessed to be of imperceptible significance level.
	OECC (Below MLWS): No	
	OECC (MLWS to MHWS): No	
Impact 2 - Disturbance and displacement to ornithological receptors in offshore and intertidal habitats during operational phase activities.	Array site: Indirect habitat loss and barrier effects to seabirds – Yes, for **guillemot, razorbill, puffin, red-throated diver and gannet. All other receptors are screened out.**	For all receptors, with the exception of those listed, 'project only' impacts are either screened out (on the basis of receptor insensitivity to the impact, or low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). For guillemot, razorbill, puffin, red-throated diver and gannet residual 'project only' impact significance levels are assessed to be not significant or greater.
	Array site: Barrier effects to migrant species: No	Potential impact magnitudes negligible for all receptors. Residual project only impacts to all receptors assessed to be of imperceptible significance level.
	OECC (Below MLWS): Indirect habitat loss and barrier effects to seabirds – No	Potential impact magnitudes negligible for all receptors. Residual project only impacts to all receptors assessed to be of imperceptible significance level.
	OECC (MLWS to MHWS): No	
Impact 3 - Changes in prey availability for ornithological receptors in offshore and intertidal habitats during the operational phase.	Array site and OECC (Below MLWS): No	Potential impact magnitudes negligible for all receptors. Residual project only impacts to all receptors assessed to be of imperceptible significance level.
	OECC (MLWS to MHWS): No	

Impact	Potential for cumulative effect	Rationale
Impact 4 - Accidental pollution in offshore and intertidal habitats during operational phase activities.	Array site, OECC (Below MLWS) and OECC (MLWS to MHWS): No	No impact after primary mitigation
Impact 5 - Accidental introduction or spread of invasive species in offshore and intertidal habitats during operational phase activities.	Array site, OECC (Below MLWS) and OECC (MLWS to MHWS): No	No impact after primary mitigation
Impact 6 - For Array Site only. Collision with operational WTGs.	Array site: Yes, for **kittiwake, great black-backed gull, herring gull, common tern and gannet. All other receptors screened out.**	For all receptors, with the exception of those listed, 'project only' impacts are either screened out (on the basis of receptor insensitivity to the impact, or low receptor abundance within impacted areas), or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). For kittiwake, great black-backed gull, herring gull, common tern and gannet residual project only impact significance levels are assessed to be not significant or greater.
Decommissioning		
	Project alone impacts during the decommissioning phase of the CWP Project are assessed in **Chapter 10 Ornithology**. It is anticipated that the impacts will be no greater than those identified for the construction phase, and therefore no separate assessment of cumulative impacts during the decommissioning phase is presented within this CEA.	

1.4 CEA 'other development' screening – offshore and intertidal

23. The second step in the CEA for ornithology is the identification of other plans and projects that may contribute to cumulative effects considered within the CEA (described as 'project screening'). This information is set out in **Table 4** below, together with a consideration of the relevant details of each development, including the tier (see **Table 2**), proximity to the CWP Project development area and a rationale for including or excluding from the assessment.

24. The other development included in the table below are taken from the long list of other development (presented in **Appendix 5.1**). Information gathering for the other development screened in at Stage 2 of the CEA, along with a greater understanding of the potential effects of the CWP Project, has enabled further refinement of the short list.

25. For the project screening process a Zone of Influence (ZOI) was applied around the project area to ensure that direct and indirect cumulative effects on offshore, intertidal and onshore ornithological receptors were appropriately identified and assessed.

26. The offshore ornithological receptors the ZOI was defined as the area encompassed by the maximum of the mean-max foraging range (plus one standard deviation) of all receptors considered within CEA. For the key offshore ornithology receptors considered in CEA gannet has the largest foraging range at 509 km (Woodward et al., 2019) and thus this distance was used to define the ZOI for all receptors.

27. For intertidal receptors within the South Dublin Bay Area the ZOI was defined as within the South Dublin Bay part of the South Dublin Bay and River Tolka Estuary SPA.

28. For the terrestrial and estuarine / Liffey receptors, the ZOI was defined based on a precautionary maximum disturbance distance of 300 m as outlined by Cutts et al., (2013).

29. Planned and operational projects were screened out of further consideration for potential cumulative effects on ornithology based on there not being a potential impact-receptor-pathway across development phases for the following reasons:

- There is no potential impact-receptor-pathway due to the project being outside of the ZOI;
- There is no temporal overlap between plans / projects;
- The plan / project is ongoing and is part of the current baseline. This includes commercial fishing and shipping and many other marine projects identified below, but specifically does not include offshore wind farm projects on the basis that impacts to ornithological receptors, particularly collision and displacement at array sites is considered to occur through the operation and maintenance phases of these projects;
- Data are not available.

30. For offshore ornithological receptors the long list (**Chapter 5**, **Appendix 5.1**) included the following other plans and projects within the ZOI:

- 117 offshore wind energy projects. 24 of these were screened into the short-list and 93 screened out as detailed in **Table 4**.
- 49 other offshore renewable energy projects. Five of these were screened into the short-list on account of construction being scheduled to occur between 2023 and 2028, inclusive. 43 of these were screened out as they are either operational and therefore considered to be existing impacts already included within the baseline, or had no timeline information available. One of these (Perpetuus Tidal Energy Centre, Isle of Wight, England – a tidal energy project due for construction between 2022 and 2026, inclusive) was screened out on the basis that, although within the ZOI range of 509 km, there is considered to be no potential impact-receptor-pathway, as the 'by sea' distance (i.e., the distance a seabird would travel without crossing land) between projects is greater than 509 km.

- 545 disposal projects. None of these were screened into the short-list as they are either operational and therefore considered to be existing impacts already included within the baseline, or disused or closed.
- 54 aggregate projects. None of these were screened into the short-list as they are either operational and therefore considered to be existing impacts already included within the baseline, or no longer operational.
- 46 dumping at sea projects. None of these were screened into the short-list as they are either operational and therefore considered to be existing impacts already included within the baseline, or no longer operational.
- 300 oil and gas pipeline projects. None of these were screened into the short-list as they are either operational and therefore considered to be existing impacts already included within the baseline, or no longer operational or due to be decommissioned.
- 1,771 oil and gas infrastructure projects. None of these were screened into the short-list as they are either operational and therefore considered to be existing impacts already included within the baseline, or no longer in use.
- 244 subsea cable projects. Three of these were screened into the short-list on account of construction being scheduled to occur between 2023 and 2028, inclusive. 241 of these were screened out as they are either operational and therefore considered to be existing impacts already included within the baseline, or disused.
- 137 shipping and port projects. None of these were screened into the short-list as they are all operational and therefore considered to be existing impacts already included within the baseline.
- 1,081 aquaculture projects. None of these were screened into the short-list as they are all operational and therefore considered to be existing impacts already included within the baseline.
- Eight carbon capture and storage projects. None of these were screened into the short-list as they were either active or had no timeline information available.
- 43 coastal assets projects. Four of these were screened into the short-list on account of construction being scheduled to occur between 2023 and 2028, inclusive. 39 of these were screened out as they are either operational and therefore considered to be existing impacts already included within the baseline, or had no timeline information available.
- 34 survey projects. None of these were screened into the short-list as they were all categorised as active / in operation and therefore considered to be existing impacts already included within the baseline.

31. The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the Irish Sea and surrounding areas which have the potential to have a cumulative impact upon receptors, few have comparable datasets upon which to base an assessment. Many of the older developments did not address cumulative effects as fully as is required presently whilst those developments which are not fully realised have not released their data into the public domain. As such the CEA is carried out with the fullest dataset available whilst acknowledging that further cumulative effects may occur from existing or planned developments.

    A summary of other projects screened into the CEA for offshore ornithology is provided in **Table 4**.

Table 4 Summary of other projects screened into the CEA for offshore ornithology

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Offshore wind energy projects						
Dublin Array (CEA-0037)	OWF	2.8	2	2a	Yes	Projects within ZOI, with potential impact-receptor-pathway and with temporal overlap. Agreed cumulative project list identified in consultation between Irish Phase 1 projects (excluding Sceirde Rocks)
Arklow Bank Phase 2 (CEA-0004)	OWF	9.8	9.9	2b	Yes	
Arklow Bank Phase 1 (CEA-0003)	OWF	21.4	31	1	Yes	
North Irish Sea Array OWF (CEA-0094)	OWF	40.8	23	2a	Yes	
Oriel (CEA-0096)	OWF	84.3	62	2b	Yes	
Mona (CEA-0081)	OWF	125	132	1	Yes	
Morgan (CEA-0084)	OWF	140	147	1	Yes	
Awel-y-Mor (CEA-0007)	OWF	121	129	1	Yes	
Rhyl Flats (CEA-0105)	OWF	138	146	1	Yes	
Gwynt y Mor (CEA-0049)	OWF	140	148	1	Yes	
Morecambe (CEA-0083)	OWF	152	159	1	Yes	
Walney Extension 3 + 4 (CEA-0128)	OWF	163	169	1	Yes	
North Hoyle (CEA-0093)	OWF	153	161	1	Yes	
Burbo Bank Extension (CEA-0015)	OWF	162	170	1	Yes	
Walney 2 (CEA-0130)	OWF	163	169	1	Yes	
West of Duddon Sands (CEA-0132)	OWF	174	180	1	Yes	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Walney 1 (CEA-0129)	OWF	176	183	1	Yes	
Burbo Bank (CEA-0014)	OWF	172	180	1	Yes	
Ormonde (CEA-0097)	OWF	184	190	1	Yes	
Erebus (CEA-0044)	OWF	168	179	1	Yes	
Barrow (CEA-0009)	OWF	186	195	1	Yes	
Robin Rigg (CEA-0106)	OWF	222	223	1	Yes	
White Cross (CEA-0136)	OWF	205	216	1	Yes	
Twin Hub (CEA-0125)	OWF	291	301	1	Yes	
Banba Wind (CEA-0008)	OWF	0	0	3	No	Data are not available
Sunrise Wind (CEA-0119)	OWF	0	2	3	No	
Réalt na Mara (CEA-0104)	OWF	0	3	3	No	
Sea Stacks (CEA-0108)	OWF	0.6	2.5	3	No	
Wicklow Sea Wind (CEA-0137)	OWF	2.2	11.9	3	No	
Latitude 52 (CEA-0068)	OWF	4.8	16.9	3	No	
Greystones (CEA-0045)	OWF	4.9	5.1	3	No	
Inis Offshore Wind Leinster (Inis East 1) (CEA-0058)	OWF	12.5	18.6	3	No	
South Irish Sea (CEA-0118)	OWF	23.1	31	3	No	
Mac Lir (CEA-0076)	OWF	25	34	3	No	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Kilmichael Point (CEA-0064)	OWF	25.7	34.5	3	No	
Shelmalere (CEA-0114)	OWF	26.8	34	3	No	
Loch Garman (CEA-0074)	OWF	30.5	32.3	3	No	
Lir (future development)	OWF	34.4	43.5	3	No	
Lir Offshore Array (CEA-0070)	OWF	48.6	50.5	3	No	
Setanta Wind Park (Braymore Wind Park) (CEA-0112)	OWF	52.9	27	3	No	
Draig y Mor (CEA-0035)	OWF	64	72	3	No	
Clogherhead (CEA-0031)	OWF	68.2	61.7	3	No	
Dublin Northeast (CEA-0036)	OWF	69.4	46.8	3	No	
Bore Array Offshore Wind (CEA-1370)	OWF	98	106	3	No	
Wexford (CEA-0135)	OWF	112	121	3	No	
Blackwater (CEA-0011)	OWF	120	132	3	No	
North Celtic Sea (CEA-0090)	OWF	129	135	3	No	
Helvick Head (CEA-0051)	OWF	134	134	3	No	
Isle of Man (CEA-0061)	OWF	159	165	3	No	
Celtic Sea (CEA-0028)	OWF	212	220	3	No	
North Channel Wind 2 (CEA-0092)	OWF	175	160	3	No	
Celtic One (CEA-0019)	OWF	170	175	3	No	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
North Channel Wind 1 (CEA-0091)	OWF	204	187	3	No	
Valorous (CEA-0127)	OWF	176	185	3	No	
Llyr 1 (CEA-0071)	OWF	184	180	3	No	
Llyr 2 (CEA-0072)	OWF	185	179	3	No	
Emerald (CEA-0042)	OWF	208	213	3	No	
ANIAR Offshore Array - Phase 1 (CEA-0001)	OWF	220	188	3	No	
Kinsale (CEA-0067)	OWF	228	262	3	No	
Malin Sea Wind (CEA-0078)	OWF	276	241	3	No	
ANIAR Offshore Array - Phase 2 (CEA-0002)	OWF	220	188	3	No	
Sceirde Rocks (CEA-0107)	OWF	273	247	2a	No	
Shearwater One (CEA-0113)	OWF	288	261	3	No	
Clarus (CEA-0030)	OWF	237	232	3	No	
Machair Wind (CEA-0077)	OWF	302	278	3	No	
Moneypoint One (CEA-0082)	OWF	295	279	3	No	
Atlantic Marine Energy Test Site (CEA-0005)	OWF	303	273	1	No	
Teesside (CEA-0121)	OWF	347	354	1	No	Although within the ZOI range of 509 km, there is considered to be no potential
Blyth (CEA-0012)	OWF	360	368	1	No	
Blyth Demo Phase 2(CEA-0013)	OWF	265	375	1	No	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Forthwind (CEA-2763)	OWF	375	381	1	No	impact-receptor-pathway, as the 'by sea' distance (i.e., the distance a seabird would travel without crossing land) between projects is greater than 509 km.
Methil Demo / Levenmouth (CEA-2764)	OWF	357	381	1	No	
Neart Na Gaoithe (CEA-0088)	OWF	407	410	1	No	
Westermost Rough (CEA-0133)	OWF	392	401	1	No	
Humber Gateway (CEA-0054)	OWF	402	408	1	No	
Berwick Bank (CEA-0010)	OWF	434	439	1	No	
Inch Cape (CEA-0055)	OWF	432	435	1	No	
Inner Dowsing (CEA-0060)	OWF	411	420	1	No	
Lynn (CEA-0075)	OWF	411	420	1	No	
Lincs (CEA-0069)	OWF	412	420	1	No	
Seagreen Phase 1 (CEA-0109)	OWF	433	429	1	No	
Triton Knoll (CEA-0123)	OWF	429	438	1	No	
Race Bank (CEA-0101)	OWF	434	441	1	No	
Rampion 2 (CEA-0103)	OWF	437	448	1	No	
Outer Dowsing (CEA-0098)	OWF	450	458	1	No	
Sheringham Shoal Extension (CEA-0116)	OWF	451	458	1	No	
Hornsea Project Four (CEA-0052)	OWF	455	467	1	No	
Sheringham Shoal (CEA-0115)	OWF	454	462	1	No	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Rampion (CEA-0102)	OWF	450	461	1	No	
Dudgeon Extension (CEA-0039)	OWF	460	470	1	No	
Dudgeon (CEA-0038)	OWF	470	481	1	No	
Morven (CEA-0085)	OWF	490	498	3	No	
Kincardine (CEA-0065)	OWF	501	506	1	No	
Dogger Bank South (West) (CEA-0033)	OWF	511	520	1	No	
Hornsea Project Two (CEA-0053)	OWF	483	491	1	No	
Bowdun (CEA-2765)	OWF	480	479	3	No	
Parc eolien pose au large de la Normadie (CEA-2972)	OWF	452	463	3	No	
Aberdeen (EOWDC) (CEA-2767)	OWF	512	505	1	No	
Centre-Manche 1 (CEA-2768)	OWF	486	497	3	No	
Ossian (CEA-2769)	OWF	500.8	509	3	No	
Hornsea Project One (CEA-2770)	OWF	500	510	1	No	
Gunfleet Sands I (CEA-0046)	OWF	492	502	1	No	
Gunfleet Sands Demo (CEA-0047)	OWF	493	503	1	No	
Centre-Manche 2 (CEA-2773)	OWF	488	499	3	No	
Gunfleet Sands II (CEA-2775)	OWF	494	504	1	No	
Kentish Flats Extension (CEA-0063)	OWF	492	504	1	No	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
Kentish Flats (CEA-0062)	OWF	493	506	1	No	
Dogger Bank - Creyke Beck B (CEA-2777)	OWF	510	520	1	No	
Dogger Bank South (East) (CEA-2778)	OWF	511	518	3	No	
Scroby Sands (CEA-2779)	OWF	506	515	1	No	
Dogger Bank - Creyke Beck A (CEA-2780)	OWF	515	525	1	No	
London Array (CEA-2781)	OWF	509	519	1	No	
Saint-Brieuc (CEA-2782)	OWF	515	525	1	No	
Bellrock (CEA-2783)	OWF	542	547	3	No	
Other offshore projects						
Morlais Demonstrator (CEA-0231)	Tidal	64	75	1	Yes	Projects within ZOI, with potential impact-receptor-pathway and with planned construction phase temporal overlap.
Fair Head Phase 2 (CEA-2944)	Tidal	299	206	1	Yes	
Swansea Bay Tidal Lagoon (CEA-0248)	Tidal	198	208	1	Yes	
Cardiff Bay Tidal Lagoon (CEA-0251)	Tidal	246	258	1	Yes	
West Somerset Tidal Lagoon (CEA-0265)	Tidal	254	265	1	Yes	
Mares Connect (CEA-1359)	Subsea cable	30	9.5	1	Yes	
Celtix Connect - Sea Fibre (CEA-0190)	Subsea cable	46.2	22.45	1	Yes	
Greenlink Interconnector (CEA-2076)	Subsea cable	116	123	1	Yes	

Development	Type	Distance from Array Site (km)	Distance from OECC (km)	Tier	Included in the CEA? (Yes/No)	Rationale
North Wall Emergency Power Generation Plant (CEA-0283)	Coastal assets	33.5	1.3	1	Yes	
Dublin Port Company MP2 (CEA-1323 & CEA-1328)	Coastal assets	31.6	0	1	Yes	
Arklow Waste Water Treatment (CEA-1380)	Coastal assets	31	36	1	Yes	
Maintenance dredging River Boyne, Drogheda (CEA-2712)	Coastal assets	67	36	1	Yes	

32. A summary of other projects screened into the CEA for intertidal ornithology is provided in **Table 5**.

Table 5 Summary of other development screened into the CEA for intertidal ornithology

Development	Distance from OECC (km)	Distance from onshore development area (km)	Tier	Included in the CEA (Yes/No)	Rationale
Dublin Port Capital Dredging Project	0.5	0.5	1	Yes	Projects within ZOI, with potential impact-receptor-pathway and with temporal overlap.
Dublin Port Company MP2 Project	1.0	1.0	1	Yes	
Grand Canal Storm Water Outfall Extension	1.7	1.9	1	Yes	
New Terminal building (St Michael's Pier)	1.6	5.8	1	Yes	
Dublin Array (export cable corridor option through South Dublin Bay)	2.0	2.0	2a	Yes	

1.5 CEA Assessment of cumulative effects – offshore and intertidal

1.5.1 Construction phase

Offshore and intertidal – construction: impact 2 – disturbance and displacement

33. Disturbance and subsequent displacement of seabirds during the construction phase is centred around where construction vessels and piling activities are occurring and the potential avoidance of built infrastructure as the construction phase progresses. The activities may displace individuals that would normally reside within and around the area of sea where the CWP Project is proposed to be developed. This in effect represents indirect habitat loss, which will potentially reduce the area available to those seabirds to forage, loaf and / or moult.

Array site

34. Construction phase activity and the presence of built infrastructure within the array site is considered to result in potential cumulative disturbance and displacement effects with other projects for four seabird receptors where residual project only impact significance levels are assessed to be greater than imperceptible:

- Guillemot;
- Razorbill;
- Red-throated diver; and
- Gannet.

35. The estimated abundances of each receptor within each project considered in CEA and an appropriate surrounding buffer (2 km for auks and gannet, 4 km for red-throated diver) are presented in Appendix A (for Tier 2 projects, including CWP Project, abundance values presented for each species are the sum of the mean peak bio-seasonal abundances. Abundances are summed for all sites within each individual tier in **Table 6** and also for cumulative scenarios, where CWP Project is considered in addition to projects additively with other tiers, in **Table 7**.

Table 6 Summed abundances of each receptor within turbine array displacement areas for all projects within each tier

Receptor	Area	Abundance in tier				
		1	2a			2b
			CWP only	2a excluding CWP	all 2a	
Guillemot	Array site + 2 km buffer	83,070	16,964	52,328	69,292	11,602
Razorbill	Array site + 2 km buffer	23,147	6,084	9,998	16,082	10,999
Red-throated diver	Array site + 4 km buffer	183	458	10	468	375
Gannet	Array site + 2 km buffer	5,022	265	1,366	1,631	803

Table 7 Summed abundances of each receptor within turbine array displacement areas for CWP Project alone and summed to present CWP Project cumulatively with projects from other tiers

	Total abundance for each cumulative scenario			
Species	**CWP**	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Guillemot	16,964	100,034	152,362	163,964
Razorbill	6,084	29,231	39,229	50,228
Red-throated diver	458	641	651	1,026
Gannet	265	5,287	6,653	7,456

36. To quantify cumulative disturbance and displacement impacts, as described in the impact assessment for offshore and intertidal – Construction: Impact 2 – Disturbance and displacement within **Chapter 10: Ornithology**, in the general absence of construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel Y Mor EIAR, 2022), impact magnitudes have been determined as per during the operational phase, but with displacement values as half of those used in the operational phase assessment.

37. As the construction phase of CWP Project is assumed to happen largely concurrently with the construction phase of other Tier 2 projects, construction displacement estimate rates equal to half of those during the operational phase are therefore applied to all Tier 2 projects. As Tier 1 projects are assumed to be within their operational phase during the period in which Tier 2 projects are constructed, full operational displacement estimate rates are applied to all Tier 1 projects.

38. **Table 8**, outlines species and species group-specific displacement and mortality rates, taken from Construction: Impact 2 – Disturbance and displacement within, **Chapter 10: Ornithology**, which have been used to describe cumulative construction phase displacement impacts.

Table 8 Species and species group-specific displacement and mortality proportions during construction phase cumulative impact assessment

Species / Species group	**Displacement**		**Mortality**
	Operational projects (Tier 1)	**Construction phase projects (Tier 2)**	
Auks	50%	25%	1%
Red-throated diver	100%	50%	1%
Gannet	70%	35%	1%

Guillemot

39. **Table 9** provides the predicted mortality resulting from array site construction phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led construction and operational phase displacement rates of 25% and 50% respectively with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 9 Cumulative guillemot construction phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**42.41**	**457.76**	**588.58**	**617.59**
35:1 Tier 2 / 70:1 Tier 1	59.37	640.86	824.01	864.62
25:2 Tier 2 / 50:2 Tier 1	84.82	915.52	1,177.16	1,235.17
35:2 Tier 2 / 70:2 Tier 1	118.75	1,281.73	1,648.02	1,729.24

40. The minimum average regional annual mortality of guillemot, taken as the average annual mortality rate (13.6%) multiplied by the maximum regional bio-seasonal population (1,332,663 individuals), is estimated to 181,242 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 10**.

Table 10 Cumulative guillemot construction phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**0.023%**	**0.253%**	**0.325%**	**0.341%**
35:1 Tier 2 / 70:1 Tier 1	0.033%	0.354%	0.455%	0.477%
25:2 Tier 2 / 50:2 Tier 1	0.047%	0.505%	0.649%	0.682%
35:2 Tier 2 / 70:2 Tier 1	0.066%	0.707%	0.909%	0.954%

41. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of, **Chapter 10: Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 11**.

Table 11 Cumulative guillemot construction phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**Negligible**	**Low**	**Low**	**Low**
35:1 Tier 2 / 70:1 Tier 1	Negligible	Low	Low	Low
25:2 Tier 2 / 50:2 Tier 1	Negligible	Low	Low	Low

35:2 Tier 2 / 70:2 Tier 1	Negligible	Low	Low	Low

42. As described in **Offshore and intertidal – construction: impact 2 – disturbance and displacement** within **Chapter 10: Ornithology**, the receptor sensitivity of guillemot to disturbance and displacement from construction phase activity within the array site and OECC is assessed to be High.

43. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10: Ornithology**, the impact significance of cumulative scenarios is provided in **Table 12**.

Table 12 Cumulative guillemot construction phase disturbance and displacement impact significance levels

Impact scenarios **Displacement % : Mortality %**	**Significance level of impact**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
25:1 Tier 2 / 50:1 Tier 1	**Not Significant**	**Slight**	**Slight**	**Slight**
35:1 Tier 2 / 70:1 Tier 1	Not Significant	Slight	Slight	Slight
25:2 Tier 2 / 50:2 Tier 1	Not Significant	Slight	Slight	Slight
35:2 Tier 2 / 70:2 Tier 1	Not Significant	Slight	Slight	Slight

44. When evidence-led displacement rates of 25% for construction phase (Tier 2) projects and 50% for operational projects (Tier 1) and resultant mortality rates of 1% are applied, construction phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

45. Therefore, in conclusion, cumulative disturbance and displacement impacts to guillemot from construction phase activities within the array site are assessed to be slight and not significant in EIA terms.

Razorbill

46. **Table 13** provides the expected mortality resulting from array site construction phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led construction and operational phase displacement rates of 25% and 50% respectively with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 13 Cumulative razorbill construction phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**15.21**	**130.95**	**155.94**	**183.44**
35:1 Tier 2 / 70:1 Tier 1	21.29	183.32	218.32	256.81
25:2 Tier 2 / 50:2 Tier 1	30.42	261.89	311.88	366.88
35:2 Tier 2 / 70:2 Tier 1	42.59	366.65	436.63	513.63

47. The minimum average regional annual mortality of razorbill, taken as the average annual mortality rate (12.9%) multiplied by the maximum regional bio-seasonal population (632,448 individuals), is estimated to 181,242 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 14**.

Table 14 Cumulative razorbill construction phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	0.019%	0.160%	0.191%	0.225%
35:1 Tier 2 / 70:1 Tier 1	0.026%	0.225%	0.268%	0.315%
25:2 Tier 2 / 50:2 Tier 1	0.037%	0.321%	0.382%	0.450%
35:2 Tier 2 / 70:2 Tier 1	0.052%	0.449%	0.535%	0.630%

48. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10: Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 15**.

Table 15 Cumulative razorbill construction phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**Negligible**	**Low**	**Low**	**Low**
35:1 Tier 2 / 70:1 Tier 1	Negligible	Low	Low	Low
25:2 Tier 2 / 50:2 Tier 1	Negligible	Low	Low	Low
35:2 Tier 2 / 70:2 Tier 1	Negligible	Low	Low	Low

49. As described in Offshore and intertidal – Construction: Impact 2 – Disturbance and displacement within **Chapter 10: Ornithology**, the receptor sensitivity of razorbill to disturbance and displacement from construction phase activity within the array site and OECC is assessed to be High.

50. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10: Ornithology**, the impact significance of cumulative scenarios is provided in **Table 16**.

Table 16 Cumulative razorbill construction phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
25:1 Tier 2 / 50:1 Tier 1	**Not Significant**	**Slight**	**Slight**	**Slight**
35:1 Tier 2 / 70:1 Tier 1	Not Significant	Slight	Slight	Slight
25:2 Tier 2 / 50:2 Tier 1	Not Significant	Slight	Slight	Slight
35:2 Tier 2 / 70:2 Tier 1	Not Significant	Slight	Slight	Slight

51. When evidence-led displacement rates of 25% for construction phase (Tier 2) projects and 50% for operational projects (Tier 1) and predicted mortality rates of 1% are applied, construction phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35%

for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% (and 35% for construction phase projects) and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

52. Therefore, in conclusion, cumulative disturbance and displacement impacts to razorbill from construction phase activities within the array site are assessed to be slight and not significant in EIA terms.

Red-throated Diver

53. **Table 17** provides the expected mortality resulting from array site construction phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led construction and operational phase displacement rates of 50% and 100% respectively with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 17 Cumulative red-throated diver construction phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
45:1 Tier 2 / 90:1 Tier 1	2.06	3.71	3.75	5.44
50:1 Tier 2 / 100:1 Tier 1	**2.29**	**4.12**	**4.17**	**6.05**
45:2 Tier 2 / 90:2 Tier 1	4.12	7.42	7.51	10.88
50:2 Tier 2 / 100:2 Tier 1	4.58	8.24	8.34	12.09

54. The minimum average regional annual mortality of red-throated diver taken as the average annual mortality rate (22.4%) multiplied by the maximum regional bio-seasonal population (12,717 individuals), is estimated to 2,849 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 18**.

Table 18 Cumulative red-throated diver construction phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
45:1 Tier 2 / 90:1 Tier 1	0.072%	0.130%	0.132%	0.191%

50:1 Tier 2 / 100:1 Tier 1	**0.080%**	**0.145%**	**0.146%**	**0.212%**
45:2 Tier 2 / 90:2 Tier 1	0.145%	0.260%	0.264%	0.382%
50:2 Tier 2 / 100:2 Tier 1	0.161%	0.289%	0.293%	0.424%

55. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10: Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 19**.

Table 19 Cumulative red-throated diver construction phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	**Magnitude of impact based upon consequence to regional population mortality rate**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
45:1 Tier 2 / 90:1 Tier 1	Negligible	Low	Low	Low
50:1 Tier 2 / 100:1 Tier 1	**Negligible**	**Low**	**Low**	**Low**
45:2 Tier 2 / 90:2 Tier 1	Low	Low	Low	Low
50:2 Tier 2 / 100:2 Tier 1	Low	Low	Low	Low

56. As described in **Offshore and intertidal – construction: impact 2 – disturbance and displacement** within **Chapter 10: Ornithology**, the receptor sensitivity of red-throated diver to disturbance and displacement from construction phase activity within the array site and OECC is assessed to be High.

57. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10: Ornithology**, the impact significance of cumulative scenarios is provided in **Table 20**.

Table 20 Cumulative red-throated diver construction phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	**Significance level of impact**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
45:1 Tier 2 / 90:1 Tier 1	Not significant	Slight	Slight	Slight
50:1 Tier 2 / 100:1 Tier 1	**Not significant**	**Slight**	**Slight**	**Slight**
45:2 Tier 2 / 90:2 Tier 1	Slight	Slight	Slight	Slight
50:2 Tier 2 / 100:2 Tier 1	Slight	Slight	Slight	Slight

58. When evidence-led displacement rates of 50% for construction phase (Tier 2) projects and 100% for operational projects (Tier 1) and predicted mortality rates of 1% are applied, construction phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels increase to slight, which is also not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

59. Therefore, in conclusion, cumulative disturbance and displacement impacts to red-throated diver from construction phase activities within the array site are assessed to be slight and not significant in EIA terms.

Gannet

60. **Table 21** provides the expected mortality resulting from array site construction phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led construction and operational phase displacement rates of 35% and 70% respectively with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 21 Cumulative gannet construction phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
30:1 Tier 2 / 60:1 Tier 1	0.80	30.93	35.03	37.43
35:1 Tier 2 / 70:1 Tier 1	**0.93**	**36.08**	**40.86**	**43.67**
40:1 Tier 2 / 80:1 Tier 1	1.06	41.24	46.70	49.91

61. The minimum average regional annual mortality of gannet, taken as the average annual mortality rate (18.1%) multiplied by the maximum regional bio-seasonal population (643,713 individuals), is estimated to be 116,512 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 22**.

Table 22 Cumulative gannet construction phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement %: Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
30:1 Tier 2 / 60:1 Tier 1	0.000%	0.012%	0.012%	0.012%
35:1 Tier 2 / 70:1 Tier 1	**0.001%**	**0.017%**	**0.017%**	**0.017%**
40:1 Tier 2 / 80:1 Tier 1	0.001%	0.024%	0.024%	0.024%

62. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10: Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be Negligible (i.e., <0.1% increase to regional mortality rate), as shown in **Table 23**.

Table 23 Cumulative gannet construction phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement %: Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
30:1 Tier 2 / 60:1 Tier 1	Negligible	Negligible	Negligible	Negligible
35:1 Tier 2 / 70:1 Tier 1	**Negligible**	**Negligible**	**Negligible**	**Negligible**
40:1 Tier 2 / 80:1 Tier 1	Negligible	Negligible	Negligible	Negligible

63. As described in **Offshore and intertidal – construction: impact 2 – disturbance and displacement** within **Chapter 10: Ornithology**, the receptor sensitivity of gannet to disturbance and displacement from construction phase activity within the array site is assessed to be High.

64. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10: Ornithology**, the impact significance of cumulative scenarios is provided in **Table 24**.

Table 24 Cumulative gannet construction phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
30:1 Tier 2 / 60:1 Tier 1	Not significant	Not significant	Not significant	Not significant
35:1 Tier 2 / 70:1 Tier 1	**Not significant**	**Not significant**	**Not significant**	**Not significant**
40:1 Tier 2 / 80:1 Tier 1	Not significant	Not significant	Not significant	Not significant

65. When evidence-led displacement rates of 35% for construction phase (Tier 2) projects and 70% for operational projects (Tier 1) and predicted mortality rates of 1% are applied, construction phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80% (and 40% for construction phase projects), impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80% (and 40% for construction phase projects), impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80% (and 40% for construction phase projects), impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80% (and 40% for construction phase projects), impact significance levels remain not significant, which is not significant in EIA terms.

66. Therefore, in conclusion, cumulative disturbance and displacement impacts to gannet from construction phase activities within the array site are assessed to be not significant and not significant in EIA terms.

Offshore OECC (<MLWS)

Red-throated diver

67. Construction phase vessel activity within the offshore part of the OECC is considered to result in potential cumulative disturbance and displacement effects with other projects for red-throated diver, for which residual project only impact significance levels are assessed to be not significant, which is not significant in EIA terms.

68. For the CWP Project alone, as detailed for Offshore and Intertidal – Construction: Impact 2 – Disturbance and displacement within **Chapter 10: Ornithology**, the magnitude of residual red-throated diver displacement impacts associated with construction phase activity within the OECC is assessed to be negligible. This is due to:

- The limited spatial and temporal extent of cable installation works within the offshore area of the OECC, i.e., activity by up to five vessels at one time to install each of the three export cables over an estimated total of 63 days within a 27-month window, and associated seabed preparation activities;
- Construction phase works within the offshore area of the OECC occurring within an area where baseline levels of vessel activity (and resultant disturbance of red-throated divers) are very high; and
- Works being undertaken in accordance with additional mitigation in the form of a Construction Environmental Management Plan, and Ecological Vessel Management Plan (EVMP) containing measures intended to further reduce the non significant effects of disturbance and displacement effects to red-throated diver. Specifically, the avoidance, where possible, of designated areas for red-throated divers (i.e., The Murrough SPA and the North-West Irish Sea SPA) during transit and preferential transit routing along existing shipping lanes (where baseline levels of vessel activity are already high), so as to minimise additional vessel traffic within areas where baseline vessel activity levels and associated potential disturbance levels to red-throated diver are lower.

69. Although precise quantification of potential mortality resulting from disturbance and displacement from construction phase vessel activity within the offshore part of the OECC is not possible, it is assumed

that the addition of any such negligible impact to regional cumulative displacement mortality estimates during the construction phase (as presented in **Table 17**, above) does not have any potential to materially alter conclusions relating to consequences upon regional populations (i.e., cumulative impact significance levels summarised in **Table 19** above). As such, cumulative disturbance and displacement impacts to red-throated diver associated with operation and maintenance phase activities within the OECC are assessed to be non-significant in EIA terms.

Intertidal OECC (MLWS to MHWS)

Sterna terns (common, Arctic and roseate) and Sandwich tern

70. Construction phase activity within and surrounding the intertidal part of the OECC is considered to result in potential cumulative disturbance and displacement effects with other projects for Sterna terns (common, Arctic and roseate) and Sandwich tern, for which residual project only impact significance levels are assessed to be slight or not significant, respectively, and not significant in EIA terms.

71. For the CWP Project alone, as detailed for **Offshore and Intertidal – construction: impact 2 – disturbance and displacement** within **Chapter 10 Ornithology**, the magnitude of residual disturbance and displacement impacts to these receptors associated with construction phase activity within the intertidal part of the OECC is assessed to be Low. This is due to:

- Works being undertaken in accordance with additional mitigation in the form of seasonal restrictions to construction phase activity within and surrounding intertidal areas (limiting such works to the April to August, inclusive, period) and temporal restrictions preventing works in such areas during crepuscular and nocturnal periods within the post-breeding period in which internationally important tern aggregations utilise South Dublin Bay as roosting site (mid-July to August, inclusive).
- The limited number of individuals predicted to experience visual and / or acoustic disturbance stimuli associated with construction phase activities within and surrounding the intertidal part of the OECC when works are conducted outside of restricted periods.

72. Although information relating to potential displacement of Sterna terns and Sandwich terns associated with construction phase activities within and surrounding the intertidal part of the OECC export cable installation of other projects listed in **Table 5** (which would potentially occur concurrently with export cable installation activities for CWP Project) is presently unavailable, it is assumed that where other projects identify potential non-negligible displacement impacts, similar mitigation measures will be implemented to minimise potential disturbance.

73. In the absence of information relating to potential displacement of red-throated diver associated with other projects listed in **Table 5**, the addition of negligible magnitude CWP Project only construction phase disturbance and displacement impacts within the intertidal part of the OECC to cumulative disturbance and displacement impacts of other relevant plans and projects to regional Sterna tern and Sandwich tern populations is not considered to have any potential to materially alter conclusions relating to consequences upon regional populations. As such, cumulative disturbance and displacement impacts to Sterna terns and sandwich terns associated with construction phase activities within the intertidal part of the OECC are assessed to be non-significant in EIA terms.

1.5.2 Operation and maintenance

Cumulative impact 1: disturbance and displacement

Array site

74. Operation and maintenance phase activity and the presence of built infrastructure within the array site is considered to result in potential cumulative disturbance and displacement effects with other projects for four seabird receptors where residual project only impact significance levels are assessed to be greater than imperceptible:

- Guillemot;
- Razorbill;
- Red-throated diver; and
- Gannet.

75. The estimated abundances of each receptor within each project considered in CEA and an appropriate surrounding buffer (2 km for auks and gannet, 4 km for red-throated diver) are presented in Appendix A (for Tier 2 projects, including CWP Project, abundance values presented for each species are the sum of the mean peak bio-seasonal abundances. Abundances are summed for sites within each tier in **Table 25** and also for cumulative scenarios, where CWP Project is considered in addition to projects from other tiers, in **Table 26**.

Table 25 Abundances of each receptor within turbine array displacement areas for all projects, summed by tier

Receptor	Area	Abundance in tier				
		1	2a			2b
			CWP only	2a excluding CWP	all 2a	
Guillemot	Array site + 2 km buffer	83,070	16,964	52,328	69,292	11,602
Razorbill	Array site + 2 km buffer	23,147	6,084	9,998	16,082	10,999
Puffin	Array site + 2 km buffer	2,722	200	22	222	30
Red-throated diver	Array site + 4 km buffer	183	458	10	468	375
Gannet	Array site + 2 km buffer	5,022	265	1,366	1,631	803

Table 26 Summed abundances of each receptor within turbine array displacement areas for CWP Project alone and CWP Project cumulatively with projects from other tiers additively

Species	Total abundance for each cumulative scenario			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Guillemot	16,964	100,034	152,362	163,964
Razorbill	6,084	29,231	39,229	50,228
Puffin	200	2,922	2,944	2,974

Red-throated diver	458	641	651	1,026
Gannet	265	5287	6,653	7,456

76. **Table 27** outlines species and species group-specific displacement and mortality rates, taken from Operation and Maintenance: Impact 2 – Disturbance and displacement within **Chapter 10 Ornithology**, which have been used to describe cumulative operation and maintenance phase displacement impacts.

Table 27 Species and species group-specific displacement and mortality proportions during operation and maintenance phase cumulative impact assessment

Species / Species group	Displacement	Mortality
	Operational projects (Tier 1 and Tier 2)	
Auks	50%	1%
Red-throated diver	100%	1%
Gannet	70%	1%

Guillemot

77. **Table 28** provides the predicted mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led operational phase displacement rate of 50%, with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 28 Cumulative guillemot operation and maintenance phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios	Predicted displacement mortality for Cumulative scenarios			
Displacement % : Mortality %	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**84.82**	**500.17**	**761.81**	**819.82**
70:1 Tiers 1 and 2	118.75	700.24	1,066.53	1,147.75
50:2 Tiers 1 and 2	169.64	1,000.34	1,523.62	1,639.64
70:2 Tiers 1 and 2	237.50	1,400.48	2,133.07	2,295.50

78. The minimum average regional annual mortality of guillemot, taken as the average annual mortality rate (13.6%) multiplied by the maximum regional bio-seasonal population (1,332,663 individuals), is estimated to 181,242 individuals. Proportional increases to the annual mortality rate resultant from

predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 29**.

Table 29 Cumulative guillemot operation and maintenance phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**0.047%**	**0.276%**	**0.420%**	**0.452%**
70:1 Tiers 1 and 2	0.066%	0.386%	0.588%	0.633%
50:2 Tiers 1 and 2	0.094%	0.552%	0.841%	0.905%
70:2 Tiers 1 and 2	0.131%	0.773%	1.177%	1.267%

79. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, with the exception of the 70% displacement and 2% resultant mortality impact scenario, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 36**.

80. For the 70% displacement and 2% resultant mortality impact scenario, as cumulative impact magnitudes are predicted to result in a greater than 1% increase to regional mortality rates, Population Viability Analysis (PVA) is required to support impact magnitude conclusions to inform if levels of impact are likely to result in significant impacts to regional populations.

81. Using the online version of the Natural England and JNCC Seabird PVA tool (http://ec2-34-243-66-127.eu-west-1.compute.amazonaws.com/shiny/seabirds/PVATool_Nov2022/R/), a Density Independent PVA of cumulative impacts to the regional guillemot population was undertaken using the parameters outlined in **Annex D**.

82. Proportional impacts to the regional population, calculated as displacement mortality divided by the maximum regional bio-seasonal population (1,332,663 individuals), are provided in **Table 30**.

Table 30 Proportional impacts to regional populations used in PVA for operation and maintenance phase cumulative disturbance and displacement impacts to guillemot

Impact scenario	Density independent PVA outputs			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
70:2 Tiers 1 and 2	0.00018	0.00105	0.00160	0.00172

83. Counterfactual outputs from PVA models for each cumulative scenario are presented in **Table 31**. Counterfactual Growth Rate (CGR) values are considered the most appropriate reference values for interpretation of density independent PVA model outputs (Jitlal et al., 2017); however, Counterfactual Population Size (CPS) values (after a 25-year impact period, 2028–2053) are also presented.

Table 31 Counterfactual output values from PVA for operation and maintenance phase cumulative disturbance and displacement impacts to guillemot

Impact scenario	Density independent PVA outputs							
	CWP		CWP + 1		CWP + 1 + other 2a		CWP + 1 + other 2a + 2b	
	CGR	CPS	CGR	CPS	CGR	CPS	CGR	CPS
70:2 Tiers 1 and 2	0.99980	0.99481	0.99883	0.97008	0.99822	0.95472	0.99809	0.95144

84. The local breeding population of guillemot has increased from a total of 64,641 individuals breeding within Dublin and Wicklow counties during surveys for the third Irish and UK seabird census (Seabird 2000 – with surveys between 1998 and 2002), to a total of 67,414 individuals for the fourth Irish and UK seabird census (Seabirds Count, Burnell et al., 2023 – with surveys between 2015 and 2021).

85. In the context of an increasing regional population, CGR values exceeding 0.995 are considered to indicate no significant adverse effect to the regional guillemot population. As such, cumulative displacement mortality impacts are assessed to be negligible or low, as described in **Table 32**.

Table 32 Cumulative guillemot operation and maintenance phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**Negligible**	**Low**	**Low**	**Low**
70:1 Tiers 1 and 2	Negligible	Low	Low	Low
50:2 Tiers 1 and 2	Negligible	Low	Low	Low
70:2 Tiers 1 and 2	Low	Low	Low	Low

86. As described in **Offshore and intertidal – operation and maintenance: impact 2 – disturbance and displacement** within **Chapter 10 Ornithology**, the receptor sensitivity of guillemot to disturbance and displacement from operation and maintenance phase activity within the array site is assessed to be High.

87. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 33**.

Table 33 Cumulative guillemot operation and maintenance phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**Not significant**	**Slight**	**Slight**	**Slight**
70:1 Tiers 1 and 2	Not significant	Slight	Slight	Slight
50:2 Tiers 1 and 2	Not significant	Slight	Slight	Slight
70:2 Tiers 1 and 2	Slight	Slight	Slight	Slight

88. When evidence-led displacement rates of 50% for operational projects (Tier 1 and Tier 2) and predicted mortality rates of 1% are applied, operation and maintenance phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% or mortality rates be doubled to 2%, impact significance levels remain not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% and mortality rates be doubled to 2%, impact significance levels increase to slight, which remains not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

89. Therefore, in conclusion, cumulative disturbance and displacement impacts to guillemot from operation and maintenance phase activities within the array site are assessed to be slight and not significant in EIA terms.

Razorbill

90. **Table 34** provides the predicted mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led operational phase displacement rate of 50%, with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 34 Cumulative razorbill operation and maintenance phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**30.42**	**146.16**	**196.15**	**251.14**
70:1 Tiers 1 and 2	42.59	204.62	274.60	351.60
50:2 Tiers 1 and 2	60.84	292.31	392.29	502.28
70:2 Tiers 1 and 2	85.18	409.23	549.21	703.19

91. The minimum average regional annual mortality of razorbill, taken as the average annual mortality rate (12.9%) multiplied by the maximum regional bio-seasonal population (632,448 individuals), is estimated to 81,586 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 35**.

Table 35 Cumulative razorbill operation and maintenance phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**0.037%**	**0.179%**	**0.240%**	**0.308%**
70:1 Tiers 1 and 2	0.052%	0.251%	0.337%	0.431%
50:2 Tiers 1 and 2	0.075%	0.358%	0.481%	0.616%
70:2 Tiers 1 and 2	0.104%	0.502%	0.673%	0.862%

92. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 36**.

Table 36 Cumulative razorbill operation and maintenance phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
50:1 Tiers 1 and 2	**Negligible**	**Low**	**Low**	**Low**

70:1 Tiers 1 and 2	Negligible	Low	Low	Low
50:2 Tiers 1 and 2	Negligible	Low	Low	Low
70:2 Tiers 1 and 2	Low	Low	Low	Low

93. As described in Offshore and intertidal – Operation and maintenance: Impact 2 – Disturbance and displacement within **Chapter 10 Ornithology**, the receptor sensitivity of razorbill to disturbance and displacement from operation and maintenance phase activity within the array site is assessed to be High.

94. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 37**.

Table 37 Cumulative razorbill operation and maintenance phase disturbance and displacement impact significance levels

Impact scenarios	**Significance level of impact**			
Displacement % : Mortality %	**CWP**	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
50:1 Tiers 1 and 2	**Not significant**	**Slight**	**Slight**	**Slight**
70:1 Tiers 1 and 2	Not significant	Slight	Slight	Slight
50:2 Tiers 1 and 2	Not significant	Slight	Slight	Slight
70:2 Tiers 1 and 2	Slight	Slight	Slight	Slight

95. When evidence-led displacement rates of 50% for operational projects (Tier 1 and Tier 2) and predicted mortality rates of 1% are applied, operation and maintenance phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% or mortality rates be doubled to 2%, impact significance levels remain not significant, which is not significant in EIA terms. Should displacement rates be increased to 70% and mortality rates be doubled to 2%, impact significance levels increase to slight, which remains not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should displacement rates be increased to 70% and / or mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

96. Therefore, in conclusion, cumulative disturbance and displacement impacts to razorbill from operation and maintenance phase activities within the array site are assessed to be slight and not significant in EIA terms.

Red-throated diver

97. **Table 38** provides the predicted mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led operational phase displacement rate of 100%, with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 38 Cumulative red-throated diver operation and maintenance phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement % : Mortality %	Predicted displacement mortality for cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
90:1 Tiers 1 and 2	4.12	5.77	5.86	9.23
100:1 Tiers 1 and 2	**4.58**	**6.41**	**6.51**	**10.26**
90:2 Tiers 1 and 2	8.24	11.54	11.72	18.47
100:2 Tiers 1 and 2	9.16	12.82	13.02	20.52

98. The minimum average regional annual mortality of red-throated diver, taken as the average annual mortality rate (22.4%) multiplied by the maximum regional bio-seasonal population (12,717 individuals), is estimated to 2,849 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 39**.

Table 39 Cumulative red-throated diver operation and maintenance phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
90:1 Tiers 1 and 2	0.145%	0.203%	0.206%	0.324%
100:1 Tiers 1 and 2	**0.161%**	**0.225%**	**0.229%**	**0.360%**
90:2 Tiers 1 and 2	0.289%	0.405%	0.411%	0.648%
100:2 Tiers 1 and 2	0.322%	0.450%	0.457%	0.720%

99. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be Low (i.e., 0.1 - 1% increase to regional mortality rate) as shown in **Table 40**.

Table 40 Cumulative red-throated diver operation and maintenance phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement % : Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
90:1 Tiers 1 and 2	Low	Low	Low	Low
100:1 Tiers 1 and 2	**Low**	**Low**	**Low**	**Low**
90:2 Tiers 1 and 2	Low	Low	Low	Low
100:2 Tiers 1 and 2	Low	Low	Low	Low

100. As described in **Offshore and intertidal – operation and maintenance: impact 2 – disturbance and displacement** within **Chapter 10 Ornithology**, the receptor sensitivity of red-throated diver to disturbance and displacement from operation and maintenance phase activity within the array site is assessed to be High.

101. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 41**.

Table 41 Cumulative red-throated diver operation and maintenance phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
90:1 Tiers 1 and 2	Slight	Slight	Slight	Slight
100:1 Tiers 1 and 2	**Slight**	**Slight**	**Slight**	**Slight**
90:2 Tiers 1 and 2	Slight	Slight	Slight	Slight
100:2 Tiers 1 and 2	Slight	Slight	Slight	Slight

102. When evidence-led displacement rates of 100% for operational projects (Tier 1 and Tier 2) and predicted mortality rates of 1% are applied, construction phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be slight, which is not significant in EIA terms. Should mortality rates be doubled to 2% impact significance levels remain slight, which is not significant in EIA terms.

103. Therefore, in conclusion, cumulative disturbance and displacement impacts to red-throated diver from operation and maintenance phase activities within the array site are assessed to be slight and not significant in EIA terms.

Gannet

104. **Table 42** provides the expected mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for the evidence-led operational phase displacement rate of 70%, with 1% resultant mortality (highlighted bold), plus a range of additional potential impact scenarios (shown in grey). These additional potential impact scenarios are presented to support cumulative assessment conclusions insofar that even where higher, although still potentially feasible, displacement and / or mortality rates are used, conclusions in relation to cumulative impact assessment are unaffected.

Table 42 Cumulative gannet operation and maintenance phase disturbance and displacement mortality from evidence-led impact ratios (bold) and for alternative impact scenarios

Impact scenarios Displacement %: Mortality %	Predicted displacement mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
60:1 Tiers 1 and 2	1.59	31.72	39.92	44.74
70:1 Tiers 1 and 2	1.86	37.01	46.57	52.19
80:1 Tiers 1 and 2	2.12	42.30	53.22	59.65

105. The minimum average regional annual mortality of gannet, taken as the average annual mortality rate (18.1%) multiplied by the maximum regional bio-seasonal population (643,713 individuals), is estimated to 116,512 individuals. Proportional increases to the annual mortality rate resultant from predicted displacement mortalities associated with each impact and cumulative scenario is presented in **Table 43**.

Table 43 Cumulative gannet operation and maintenance phase disturbance and displacement impacts as proportional increases to regional annual mortality rates

Impact scenarios Displacement %: Mortality %	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
60:1 Tiers 1 and 2	0.001%	0.027%	0.034%	0.038%
70:1 Tiers 1 and 2	0.002%	0.032%	0.040%	0.045%
80:1 Tiers 1 and 2	0.002%	0.036%	0.046%	0.051%

106. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be Negligible (i.e., <0.1 increase to regional mortality rate) as shown in **Table 44**.

Table 44 Cumulative gannet operation and maintenance phase disturbance and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Impact scenarios Displacement %: Mortality %	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
60:1 Tiers 1 and 2	Negligible	Negligible	Negligible	Negligible
70:1 Tiers 1 and 2	**Negligible**	**Negligible**	**Negligible**	**Negligible**
80:1 Tiers 1 and 2	Negligible	Negligible	Negligible	Negligible

107. As described in **Offshore and intertidal – operation and maintenance: impact 2 – disturbance and displacement** within **Chapter 10 Ornithology**, the receptor sensitivity of gannet to disturbance and displacement from operation and maintenance phase activity within the array site is assessed to be High.

108. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 45**.

Table 45 Cumulative gannet operation and maintenance phase disturbance and displacement impact significance levels

Impact scenarios Displacement % : Mortality %	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
60:1 Tiers 1 and 2	Not significant	Not significant	Not significant	Not significant
70:1 Tiers 1 and 2	**Not significant**	**Not significant**	**Not significant**	**Not significant**
80:1 Tiers 1 and 2	Not significant	Not significant	Not significant	Not significant

109. When evidence-led displacement rates of 70% for operational projects (Tier 1 and Tier 2) and predicted mortality rates of 1% are applied, operation and maintenance phase disturbance and displacement impacts for each cumulative scenario are as follows:

- For CWP Project alone, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80%, impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80%, impact significance levels remain not significant, which is not significant in EIA terms.

- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80%, impact significance levels remain not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be not significant, which is not significant in EIA terms. Should displacement rates be increased to 80%, impact significance levels remain not significant, which is not significant in EIA terms.

110. Therefore, in conclusion, cumulative disturbance and displacement impacts to gannet from operation and maintenance phase activities within the array site are assessed to be not significant and not significant in EIA terms.

Offshore OECC (<MLWS)

Red-throated diver

111. Operation and maintenance phase vessel activity within the offshore part of the OECC is considered to result in potential cumulative disturbance and displacement effects with other projects for red-throated diver, for which residual project only impact significance levels are assessed to be not significant, which is not significant in EIA terms.

112. For the CWP Project alone, as detailed for Offshore and Intertidal – Operation and maintenance: Impact 2 – Disturbance and displacement within **Chapter 10 Ornithology**, the magnitude of residual red-throated diver displacement impacts associated with operation and maintenance phase activity within the OECC is assessed to be negligible. This is due to levels of vessel activity associated with the Project being very low within the OECC during the operation and maintenance phase, as such activities would be limited to monitoring of cable routes and potential repair activities should these be required.

113. Although precise quantification of potential mortality resulting from disturbance and displacement from operation and maintenance phase vessel activity within the offshore part of the OECC is not possible, it is assumed that the addition of any such negligible impacts to regional cumulative displacement mortality estimates during the operation and maintenance phase (as present in **Table 39**, above), does not have any potential to materially alter conclusions relating to consequences upon regional populations (i.e., cumulative impact significance levels summarised in **Table 40**, above). As such, cumulative disturbance and displacement impacts to red-throated diver associated with operation and maintenance phase activities within the OECC are assessed to be non-significant in EIA terms.

Cumulative impact 2: collision

Array site

Kittiwake

114. **Table 46** provides the predicted collision mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Designs A and B.

Table 46 Cumulative kittiwake operation and maintenance phase collision mortality for Design options A and B

Turbine configuration	Predicted annual collision mortality for Cumulative scenarios

	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	18.28	461.87	523.61	787.76
Design B	15.91	459.5	521.24	785.39

115. The minimum average regional annual mortality of kittiwake, taken as the average annual mortality rate (15.6%) multiplied by the maximum regional bio-seasonal population (933,172 individuals), is estimated to be 145,575 individuals. Proportional increases to the annual mortality rate resultant from predicted collision mortalities associated with each design option and cumulative scenario is presented in **Table 47**.

Table 47 Cumulative kittiwake operation and maintenance collision impacts as proportional increases to regional annual mortality rates

Turbine configuration	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.013%	0.317%	0.360%	0.541%
Design B	0.011%	0.316%	0.358%	0.540%

116. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10: Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 48**.

Table 48 Cumulative kittiwake operation and maintenance phase collision impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Negligible	Low	Low	Low
Design B	Negligible	Low	Low	Low

117. As described in **Offshore – operation and maintenance: impact 6 – collision**, within **Chapter 10 Ornithology**, the receptor sensitivity of kittiwake to collision impacts during the operation and maintenance phase within the array site is assessed to be Very High.

118. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10: Ornithology**, the impact significance of cumulative scenarios is provided in **Table 49**.

Table 49 Cumulative kittiwake operation and maintenance phase collision impact significance levels

Turbine configuration	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Slight	Moderate	Moderate	Moderate
Design B	Slight	Moderate	Moderate	Moderate

119. Where impact significance levels are assessed as moderate, a level which may or may not be considered significant in EIA terms, PVA to inform if levels of impact are likely to result in significant impacts to regional populations has been undertaken to support conclusions around overall significance in EIA terms. Note that, PVA are generally used to inform impact significance considerations where predicted increases to regional annual mortality rates exceed 1% and, as such, their use in this instance (where regional annual mortality rate increases are all less than 1%) is precautionary.

120. Using the online version of the Natural England and JNCC Seabird PVA tool (http://ec2-34-243-66-127.eu-west-1.compute.amazonaws.com/shiny/seabirds/PVATool_Nov2022/R/), a Density Independent PVA of cumulative impacts to the regional kittiwake population was undertaken using the parameters outlined in **Annex D**.

121. Proportional impacts to the regional population, calculated as displacement mortality divided by the maximum regional bio-seasonal population (933,172 individuals), are provided in **Table 50**:

Table 50 Proportional impacts to regional populations used in PVA for operation and maintenance phase cumulative collision impacts to kittiwake

Turbine configuration	Displacement mortality as a proportion of maximum regional bio-season population (PVA proportional mortality input)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.00002	0.00049	0.00056	0.00084
Design B	0.00002	0.00049	0.00056	0.00084

122. Counterfactual outputs from PVA models for each cumulative scenario are presented in **Table 51**. CGR values are considered the most appropriate reference values for interpretation of density independent PVA model outputs (Jitlal et al., 2017); however, CPS values (after a 25-year impact period, 2028–2053) are also presented.

Table 51 Counterfactual output values from PVA for operation and maintenance phase cumulative collision impacts to kittiwake

Turbine configuration	Density independent PVA outputs			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b

	CGR	CPS	CGR	CPS	CGR	CPS	CGR	CPS
Design A	0.99998	0.99942	0.99942	0.98512	0.99933	0.98290	0.99901	0.97451
Design B	0.99998	0.99942	0.99942	0.98512	0.99933	0.98290	0.99901	0.97451

123. The local breeding population of kittiwake has decreased from a total of 18,482 individuals breeding within Dublin and Wicklow counties during surveys for the third Irish and UK seabird census (Seabird 2000 – with surveys between 1998 and 2002), to a total of 14,718 individuals for the fourth Irish and UK seabird census (Seabirds Count, Burnell et al., 2023 – with surveys between 2015 and 2021).

124. In the context of this decreasing regional population (a 20.4% decline between 1998-2002 and 2015-2021), the CGR values presented in **Table 51** are considered to indicate no significant adverse effect to the regional kittiwake population. Consequently, where cumulative impact significance levels are assessed to be moderate, this is considered to be not significant in EIA terms.

125. Collision impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts are assessed to be moderate, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts are assessed to be moderate, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts are assessed to be moderate, which is not significant in EIA terms.

126. Therefore, in conclusion, cumulative collision impacts to kittiwake from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be moderate and not significant in EIA terms.

Great black-backed gull

127. **Table 52** provides the predicted collision mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Design options A and B.

128.

Table 52 Cumulative great black-backed gull operation and maintenance phase collision mortality for Design options A and B

	Predicted annual collision mortality for Cumulative scenarios			
Turbine configuration	**CWP**	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Design A	4.15	49.99	75.39	141.3
Design B	3.67	49.51	74.91	140.82

129. The minimum average regional annual mortality of great black-backed gull, taken as the average annual mortality rate (9.5%) multiplied by the maximum regional bio-seasonal population (53,405

individuals), is estimated to be 5,073 individuals. Proportional increases to the annual mortality rate resultant from predicted collision mortalities associated with each design option and cumulative scenario is presented in **Table 53**.

Table 53 Cumulative great black-backed gull operation and maintenance collision impacts as proportional increases to regional annual mortality rates

Turbine configuration	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.082%	0.985%	1.486%	2.785%
Design B	0.072%	0.976%	1.476%	2.776%

130. As cumulative impact magnitudes are predicted to result in a greater than 1% increase to regional mortality rates, PVA is required to support impact magnitude conclusions to inform if levels of impact are likely to result in significant impacts to regional populations.

131. Using the online version of the Natural England and JNCC Seabird PVA tool (http://ec2-34-243-66-127.eu-west-1.compute.amazonaws.com/shiny/seabirds/PVATool_Nov2022/R/), a Density Independent PVA of cumulative impacts to the regional great black-backed gull population was undertaken using the parameters outlined in **Annex D**.

132. Proportional impacts to the regional population, calculated as displacement mortality divided by the maximum regional bio-seasonal population (53,405 individuals), are provided in **Table 54**.

Table 54 Proportional impacts to regional populations used in PVA for operation and maintenance phase cumulative collision impacts to great black-backed gull

Turbine configuration	Collision mortality as a proportion of maximum regional bio-season population (PVA proportional mortality input)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.00008	0.00094	0.00141	0.00265
Design B	0.00007	0.00093	0.00140	0.00264

133. Counterfactual outputs from PVA models for each cumulative scenario are presented in **Table 55**. CGR values are considered the most appropriate reference values for interpretation of density independent PVA model outputs (Jitlal et al., 2017); however, CPS values (after a 25-year impact period, 2028-2053) are also presented.

Table 55 Counterfactual output values from PVA for operation and maintenance phase cumulative collision impacts to great black-backed gull

Turbine configuration	Density independent PVA outputs							
	CWP		CWP + 1		CWP + 1 + other 2a		CWP + 1 + other 2a + 2b	
	CGR	CPS	CGR	CPS	CGR	CPS	CGR	CPS
Design A	0.99991	0.99780	0.99899	0.97411	0.99848	0.96132	0.99715	0.92852
Design B	0.99993	0.99818	0.99900	0.97419	0.99849	0.96164	0.99717	0.92882

134. The regional breeding population of great black-backed gull has increased from a total of 786 individuals breeding within maximum foraging range of the array site during surveys for the third Irish and UK seabird census (Seabird 2000 – with surveys between 1998 and 2002), to a total of 980 individuals for the fourth Irish and UK seabird census (Seabirds Count, Burnell et al., 2023 – with surveys between 2015 and 2021).

135. In the context of an increasing regional population, CGR values exceeding 0.995 are considered to indicate no significant adverse effect to regional great black-backed gull population. As such, cumulative collision mortality impacts are assessed to be negligible or low, as described in **Table 56**.

Table 56 Cumulative great black-backed gull operation and maintenance phase collision impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Negligible	Low	Low	Low
Design B	Negligible	Low	Low	Low

136. As described in **Offshore – operation and maintenance: impact 6 – collision**, within **Chapter 10 Ornithology**, the receptor sensitivity of great black-backed gull to collision impacts during the operation and maintenance phase within the array site is assessed to be High.

137. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 57**.

Table 57 Cumulative great black-backed gull operation and maintenance phase collision impact significance levels

Turbine configuration	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Not significant	Slight	Slight	Slight
Design B	Not significant	Slight	Slight	Slight

138. Collision impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

139. Therefore, in conclusion, cumulative collision impacts to great black-backed gull from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be slight and not significant in EIA terms.

Herring gull

140. **Table 58** provides the predicted collision mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Designs A and B.

Table 58 Cumulative herring gull operation and maintenance phase collision mortality for Design options A and B

Turbine configuration	Predicted annual collision mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	27.41	134.95	228.92	322.21
Design B	23.28	130.82	224.79	318.08

141. The minimum average regional annual mortality of herring gull, taken as the average annual mortality rate (17.2%) multiplied by the maximum regional bio-seasonal population (187,090 individuals), is estimated to be 32,180 individuals. Proportional increases to the annual mortality rate resultant from predicted collision mortalities associated with each design option and cumulative scenario is presented in **Table 59**.

Table 59 Cumulative herring gull operation and maintenance collision impacts as proportional increases to regional annual mortality rates

Turbine configuration	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.085%	0.419%	0.711%	1.001%
Design B	0.072%	0.407%	0.699%	0.988%

142. As cumulative impact magnitudes are predicted to result in a greater than 1% increase to regional mortality rates, PVA is required to support impact magnitude conclusions to inform if levels of impact are likely to result in significant impacts to regional populations.

143. Using the online version of the Natural England and JNCC Seabird PVA tool (http://ec2-34-243-66-127.eu-west-1.compute.amazonaws.com/shiny/seabirds/PVATool_Nov2022/R/), a Density Independent PVA of cumulative impacts to the regional herring gull population was undertaken using the parameters outlined in **Annex D**.

144. Proportional impacts to the regional population, calculated as displacement mortality divided by the maximum regional bio-seasonal population (187,090 individuals), are provided in **Table 60**.

Table 60 Proportional impacts to regional populations used in PVA for operation and maintenance phase cumulative collision impacts to herring gull

Turbine configuration	Collision mortality as a proportion of maximum regional bio-season population (PVA proportional mortality input)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.00015	0.00072	0.00122	0.00172
Design B	0.00012	0.00070	0.00120	0.00170

145. Counterfactual outputs from PVA models for each cumulative scenario are presented in **Table 61**. CGR values are considered the most appropriate reference values for interpretation of density independent PVA model outputs (Jitlal et al., 2017); however, CPS values (after a 25-year impact period, 2028–2053) are also presented.

Table 61 Counterfactual output values from PVA for operation and maintenance phase cumulative collision impacts to herring gull

Turbine configuration	Density independent PVA outputs							
	CWP		CWP + 1		CWP + 1 + other 2a		CWP + 1 + other 2a + 2b	
	CGR	CPS	CGR	CPS	CGR	CPS	CGR	CPS

Design A	0.99981	0.99516	0.99914	0.97772	0.99852	0.96219	0.99792	0.94725
Design B	0.99985	0.99613	0.99914	0.97785	0.99854	0.96282	0.99794	0.94796

146. The regional breeding population trend of herring gull is somewhat uncertain due to a lack of information on urban breeding gull population sizes prior to the 2021 National Urban Gull Survey (the first ever such survey in Ireland). Non-urban (natural) nesting herring gull breeding populations decreased sharply from a total of 7,624 individuals breeding within maximum foraging range of the array site during surveys for the third Irish and UK seabird census (Seabird 2000 – with surveys between 1998 and 2002), to a total of 3,852 individuals for the fourth Irish and UK seabird census (Seabirds Count, Burnell et al., 2023 – with surveys between 2015 and 2021). However, urban nesting herring gull populations along the Irish east coast increased sharply during this period, such that over half of the total 'All Ireland' herring gull breeding population in the Seabirds Count census (56% - 15,198 of 27,077 Apparently Occupied Nests – Burnell et al., 2023) breed in urban colonies. As such the regional breeding herring gull is considered to be relatively stable.

147. In the context of a stable regional population, CGR values exceeding 0.995 are considered to indicate no significant adverse effect to regional herring gull population. As such, cumulative collision mortality impacts are assessed to be negligible or low, as described in **Table 62**.

Table 62 Cumulative herring gull operation and maintenance phase collision impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	**Magnitude of impact based upon consequence to regional population mortality rate**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Design A	Negligible	Low	Low	Low
Design B	Negligible	Low	Low	Low

148. As described in **Offshore – operation and maintenance: impact 6 – collision**, within **Chapter 10 Ornithology**, the receptor sensitivity of herring gull to collision impacts during the operation and maintenance phase within the array site is assessed to be High.

149. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.13** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 63**.

Table 63 Cumulative herring gull operation and maintenance phase collision impact significance levels

Turbine configuration	**Significance level of impact**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Design A	Not significant	Slight	Slight	Slight
Design B	Not significant	Slight	Slight	Slight

150. Collision impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

151. Therefore, in conclusion, cumulative collision impacts to herring gull from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be slight and not significant in EIA terms.

Common tern

152. **Table 64** provides the predicted collision mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Designs A and B.

Table 64 Cumulative common tern operation and maintenance phase collision mortality for Design options A and B

Turbine configuration	Predicted annual collision mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	2.27	11.64	15.34	23.94
Design B	2.03	11.40	15.10	23.70

153. The minimum average regional annual mortality of common tern, taken as the average annual mortality rate (19.1%) multiplied by the maximum regional bio-seasonal population (73,998 individuals), is estimated to be 14,134 individuals. Proportional increases to the annual mortality rate resultant from predicted collision mortalities associated with each design option and cumulative scenario is presented in **Table 65**.

Table 65 Cumulative common tern operation and maintenance collision impacts as proportional increases to regional annual mortality rates

Turbine configuration	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.016%	0.082%	0.109%	0.169%
Design B	0.014%	0.081%	0.107%	0.168%

154. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 66**.

Table 66 Cumulative common tern operation and maintenance phase collision impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Negligible	Negligible	Low	Low
Design B	Negligible	Negligible	Low	Low

155. As described in **Offshore – operation and maintenance: impact 6 – collision**, within **Chapter 10 Ornithology**, the receptor sensitivity of common tern to collision impacts during the operation and maintenance phase within the array site is assessed to be High.

156. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 67**.

Table 67 Cumulative common tern operation and maintenance phase collision impact significance levels

Turbine configuration	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Not significant	Not significant	Slight	Slight
Design B	Not significant	Not significant	Slight	Slight

157. Collision impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

158. Therefore, in conclusion, cumulative collision impacts to common tern from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be not significant to slight and not significant in EIA terms.

Gannet

159. **Table 68** provides the predicted collision mortality resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Designs A and B. CWP Project only collision mortalities have been corrected to account for a macro-avoidance rate of 70% (i.e., the 70% central displacement value used for assessment of displacement impacts for this receptor); however, collision mortalities from other plans and projects considered CEA have been incorporated as published / provided and, as such, for some projects (particularly data from older Tier 1 assessments) collision mortalities do not account for macro-avoidance. In this regard, cumulative collision mortality scenarios presented for gannet are therefore considered to be conservative.

Table 68 Cumulative gannet operation and maintenance phase collision mortality for Design options A and B

	Predicted annual collision mortality for Cumulative scenarios			
Turbine configuration	**CWP**	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Design A	0.27	90.17	95.00	116.72
Design B	0.23	90.13	94.96	116.68

160. The minimum average regional annual mortality of common tern, taken as the average annual mortality rate (18.1%) multiplied by the maximum regional bio-seasonal population (643,713 individuals), is estimated to be 116,512 individuals. Proportional increases to the annual mortality rate resultant from predicted collision mortalities associated with each design option and cumulative scenario is presented in **Table 69**.

Table 69 Cumulative gannet operation and maintenance collision impacts as proportional increases to regional annual mortality rates

Turbine configuration	**Predicted increase to annual regional mortality rate (%)**			
	CWP	**CWP + 1**	**CWP + 1 + other 2a**	**CWP + 1 + other 2a + 2b**
Design A	0.000%	0.077%	0.082%	0.100%
Design B	0.000%	0.077%	0.082%	0.100%

161. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted impact consequences upon regional baseline annual mortality rates are

assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown in **Table 70**.

Table 70 Cumulative gannet construction phase collision impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Negligible	Negligible	Negligible	Low
Design B	Negligible	Negligible	Negligible	Low

162. As described in **Offshore – operation and maintenance: impact 6 – collision**, within **Chapter 10 Ornithology**, the receptor sensitivity of gannet to collision impacts during the operation and maintenance phase within the array site is assessed to be High.

163. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the impact significance of cumulative scenarios is provided in **Table 71**.

Table 71 Cumulative gannet operation and maintenance phase collision impact significance levels

Turbine configuration	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Not significant	Not significant	Not significant	Slight
Design B	Not significant	Not significant	Not significant	Slight

164. Collision impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

165. Therefore, in conclusion, cumulative collision impacts to gannet from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be not significant to slight and not significant in EIA terms.

Additive effects of collision and displacement impacts

166. As gannet is predicted to potentially experience both collision and displacement impacts on association with the operational CWP Project alone and in combination with other plans and projects, the consequences of these impacts in combination are here considered.

167. **Table 72** provides the combined predicted collision and displacement mortalities (assuming the evidence-led operational phase displacement rate of 70%, with 1% resultant mortality) resulting from array site operation and maintenance phase activities at CWP Project alone and CWP Project cumulatively with projects from other tiers for turbine configuration Designs A and B.

Table 72 Cumulative gannet operation and maintenance phase collision and displacement (70%:1%) mortality for Design options A and B

Turbine configuration	Predicted annual combined collision and displacement mortality for Cumulative scenarios			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	2.13	127.18	141.57	168.91
Design B	2.09	127.14	141.53	168.87

168. Proportional increases to the annual mortality rate resultant from predicted combined collision and displacement mortalities associated with each design option and cumulative scenario is presented in **Table 73**.

Table 73 Cumulative gannet operation and maintenance combined collision and displacement impacts as proportional increases to regional annual mortality rates

Turbine configuration	Predicted increase to annual regional mortality rate (%)			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	0.002%	0.109%	0.122%	0.145%
Design B	0.002%	0.109%	0.121%	0.145%

169. In accordance with impact magnitude assessment criteria outlined in **Table 10.13** of **Chapter 10 Ornithology**, predicted combined impact consequences upon regional baseline annual mortality rates are assessed to be either Negligible (i.e., <0.1% increase to regional mortality rate) or Low (0.1–1% increase to regional mortality rate), as shown **Table 74**.

Table 74 Cumulative gannet operation and maintenance phase combined collision and displacement impact magnitudes determined from proportional increases to regional annual mortality rates

Turbine configuration	Magnitude of impact based upon consequence to regional population mortality rate			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b

Design A	Negligible	Low	Low	Low
Design B	Negligible	Low	Low	Low

170. In accordance with the matrix approach outlined to determine impact significance level in **Table 10.14** of **Chapter 10 Ornithology**, the combined impact significance of cumulative scenarios is provided in **Table 75**.

Table 75 Cumulative gannet operation and maintenance phase combined collision and displacement impact significance levels

Turbine configuration	Significance level of impact			
	CWP	CWP + 1	CWP + 1 + other 2a	CWP + 1 + other 2a + 2b
Design A	Not significant	Slight	Slight	Slight
Design B	Not significant	Slight	Slight	Slight

171. Combined collision and displacement impacts for each cumulative scenario, for turbine configuration design options A and B are as follows:

- For CWP Project alone, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects and other Tier 2a projects, impacts for turbine configuration designs A and B are assessed to be not significant, which is not significant in EIA terms.
- For CWP Project plus Tier 1 projects, other Tier 2a projects and Tier 2b projects, impacts for turbine configuration designs A and B are assessed to be slight, which is not significant in EIA terms.

172. Therefore, in conclusion, cumulative combined collision and displacement impacts to gannet from operation and maintenance phase activities within the array site for turbine configuration design options A and B are assessed to be slight and not significant in EIA terms.

1.6 CEA Impact Screening – onshore

173. The first step in the CEA for onshore ornithology is the identification of which residual impacts assessed for the CWP Project alone have the potential for a cumulative impact with other development (described as 'impact screening'). This screening exercise is set out in Table 2 below.

174. Only potential impacts assessed in Chapter 10 Ornithology as 'not significant' or above are included in the CEA (i.e., those assessed as 'imperceptible' are not taken forward as there is no potential for them to contribute to a cumulative effect).

175. In summary, **Table 76** shows that there is the potential for cumulative effects on:

- Sand martin as a result of direct effects on habitat within the onshore study area during the construction phase;

- Light-bellied brent goose as a result of disturbance and displacement within the onshore study area during the construction phase; and
- Black guillemot as a result of direct effects on habitat within the estuarine / Liffey study area during the construction phase.

176. Other potential impacts, including habitat degradation as a result of the introduction / spread of non-native invasive plant species and the presence of building and infrastructure were screened out of the CEA.

Table 76 Impact screening for cumulative effects assessment - onshore

Impact	Potential for cumulative effect	Rationale
Construction		
Onshore - Construction: Impact 1 - Direct effects on habitat	Yes	The CWP Project will result in the permanent loss of habitat within the onshore area. Following the examination of potential impacts as assessed in **Chapter 10 Ornithology**, **Sand Martin** was the one species identified as at risk to cumulative effects for habitat loss from other projects which would increase the magnitude of the effect on the species. For all other receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Onshore - Construction: Impact 2 - Disturbance and displacement	No	For all receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Onshore - Construction: Impact 3 – Introduction of invasive non-native species.	No	For all receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude). Additionally, an **Onshore Invasive Species Management Plan (ISMP)** has been prepared and is included within the Planning Application, it will ensure all invasive plant species within the CWP

		Project site are either removed or controlled. There is therefore no potential for cumulative effects with other projects.
Estuarine / Liffey Construction: Impact 1 - Direct effects on habitat	Yes	The CWP project will result in the permanent loss of habitat within the estuarine / Liffey area. Following the examination of potential impacts as assessed in **Chapter 10 Ornithology**, **Black Guillemot** was the one species identified as at risk to cumulative effects for habitat loss from other projects which would increase the magnitude of the effect on the species. For all other receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Estuarine / Liffey Construction: Impact 2 - Disturbance and displacement	No	For all receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Operation		
Estuarine / Liffey Operation and Maintenance: Impact 2 - Disturbance and displacement	No	For all receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Estuarine / Liffey Operation and Maintenance: Impact 4 - Presence of onshore buildings / infrastructure	Yes	The CWP project will result in permanent buildings / infrastructure at the onshore substation in proximity to the estuarine / Liffey area. Following the examination of potential impacts as assessed in **Chapter 10 Ornithology**, **Arctic tern and common tern** were the species identified as at risk to cumulative effects to the presence of onshore building / infrastructure from other projects which would increase the magnitude of the effect on the species, due to potential shadow cast and the creation of perching opportunities for predators such as peregrine falcon or hooded crow.

		For all other receptors, impacts are either screened out on the basis of receptor insensitivity to the impact, low receptor abundance within impacted areas, or residual impacts assessed to be of imperceptible significance level (on the basis of negligible impact magnitude).
Decommissioning		
Onshore Decommissioning: Impact 1 - Direct effects on habitat	No	The detail and scope of the decommissioning works for the CWP Project will be determined by the relevant legislation and guidance at the time of decommissioning. Project alone impacts during the decommissioning phase of the CWP Project are assessed in **Chapter 10 Ornithology.** It is anticipated that the impacts will be no greater than those identified for the construction phase, and therefore no separate assessment of cumulative impacts during the decommissioning phase is presented within this CEA.
Onshore Decommissioning: Impact 2 - Disturbance and displacement		
Onshore Decommissioning: Impact 3 - Introduction of invasive non-native species		
Estuarine / Liffey Decommissioning: Impact 1 - Direct effects on habitat		
Estuarine / Liffey Decommissioning: Impact 2 - Disturbance and displacement		

1.7 CEA 'other' development' screening – onshore

177. The second step in the CEA for Ornithology is the identification of other plans and projects that may contribute to cumulative effects considered within the CEA (described as 'project screening'). This information is set out in **Table 77** below, together with a consideration of the relevant details of each development, including the tier (see **Table 2**), proximity to the CWP Project development area and a rationale for including or excluding from the assessment.

178. The other development included in the table below are taken from the long list of other development (presented in **Appendix 5.1 Cumulative Effects Assessment Methodology**). Information gathering for the other development screened in at Stage 2 of the CEA, along with a greater understanding of the potential effects of the CWP Project, has enabled further refinement of the short list.

179. For the project screening process, a Zone of Influence (ZoI) was applied around the project area to ensure that direct and indirect cumulative effects on offshore and onshore ornithological receptors were appropriately identified and assessed.

180. For the onshore and estuarine / Liffey receptors, the ZoI was defined based on disturbance stimuli to bird species. Sources including Goodship and Furness (2022) and Cutts et al. (2013) note different types of disturbance stimuli which can be characterised by different avifaunal reactions; however, as a suitable basis for assessment, a distance of 300 m can be used to represent the maximum likely

disturbance distance for waterfowl, based on the species found to occur within or near the onshore area.

181. In summary, the following other development will be assessed for potential cumulative effects with the CWP Project in relation to onshore biodiversity:

- Dublin Port Company - MP2 Project (CEA-1323, CEA-1328);
- Electricity Supply Board (ESB) - Dublin Bay Power Station / Open Cycle Gas Turbine (OCGT), BESS and Flexible Thermal Generation (CEA-1327, CEA-1341 & CEA-1342);
- Electricity Supply Board (ESB) / EirGrid - Poolbeg Generating Station / Battery Energy Storage System (BESS), Flexible Thermal Generation, Open Cycle Gas Turbine (OCGT) (Developer: ESB) (CEA-1336, CEA-1337, & CEA-1338) and Substation (Developer: EirGrid) (CEA-1346); Hammond lane Metal Company Ltd - construction of 2-storey building and non-ferrous metals recovery facility (CEA-1340);
- Pembroke Beach DAC / Becbay Ltd & Fabrizia Developments Ltd – Redevelopment of former glass bottle site (CEA- 0333, CEA-0339, CEA-0387 and CEA-1354);
- E D & F Man Liquid Products Ireland Ltd - New Storage Tank (CEA-1344);
- Irish Water - Ringsend Wastewater Treatment Plant Upgrade Project (CEA-0331);
- Kilsaran Concrete - Continuation of use of an existing concrete batching plant (CEA-1343);
- Dublin Port Company - Bridge over existing cooling water channel (superseded by CWP project proposals) (CEA-1339);
- Ecocem Ireland Limited - Permission for the development consisting of the construction of silos, compressor rooms, cooling room, retaining walls, new fencing, new gate, revision of car park layout (CEA 3002)
- EirGrid- Dublin City Programme of Works (CEA-1371)
- Codema - Dublin's Energy Agency - Dublin District Heating System Project (DDHS) (CEA-1347); and
- 3FM Dublin Port Development; and (CEA-1348).

Table 77 Summary of other development screened into the CEA for onshore ornithology

Development	Distance from the onshore infrastructure (km)	Tier	Included in the CEA (Yes/No)	Rationale
Dublin Port Company MP2 Project CEA-1323 and CEA-1328 Planning Ref.: FS006893	0	1	No	The MP2 Project is proposed on the northern side of Poolbeg, north of the River Liffey. The EIAR produced for the project states that there are no significant residual impacts predicted on avian receptors as a result of the construction and operation of the MPS Project, including on black guillemot (RPS, 2018a). As there are no significant residual impacts predicted as a result of the MP2 Project, and considering that there will be no spatial overlap in the project construction working areas and given the distances between the projects, there is no potential for cumulative impacts with the CWP Project.
ESB Dublin Bay Power Station / OCGT, Battery Energy Storage System and Flexible Thermal Generation CEA-1327, CEA-1341 & CEA-1342 Planning Ref.: 3074/23, 3646/20 and 3647/20	0	1	Yes	• CEA-1327 - assumed to be in construction: • CEA-1341 – Assumed construction completed by 2026; • CEA-1342 - Assumed construction completed by 2026, data reviewed indicates commitment for the development to be in place by October 2024 There is potential for a temporal overlap between the construction phase of CEA 1327 and that of the CWP Project which could result in negative cumulative effects on avian receptors. Considering the proximity and potential overlap of the construction phases, the potential for cumulative impacts could not be ruled out.
Electricity Supply Board (ESB) / EirGrid - Poolbeg Generating	0	1	Yes	• CEA-1336 – Assumed construction completed by 2026;

Development	Distance from the onshore infrastructure (km)	Tier	Included in the CEA (Yes/No)	Rationale
Station / Battery Energy Storage System (BESS), Flexible Thermal Generation, Open Cycle Gas Turbine (OCGT) (Developer: ESB) (CEA-1336, CEA-1337, & CEA-1338) and Substation (Developer: EirGrid) (CEA-1346) Planning Ref: 3625/20, 3624/20, 3137/23 and 4057/23				• CEA-1337 – Assumed construction completed by 2026, data reviewed indicates commitment for the development to be in place by October 2024; • CEA-1338 – Assumed in construction by 2026; • CEA-1346 - No data, however, assumed to be in construction by 2026, for completion prior to 2029. This is the Poolbeg 220 kV substation that the CWP Project will connect into. There is potential for the construction phase of the CEA-1338 and CEA-1346 to overlap with the construction phase of the OTI and landfall which could result in negative cumulative impacts and effects on avian receptors. Considering the proximity and potential overlap of the construction phases, the potential for cumulative impacts could not be ruled out.
Hammond Lane Metal Company Ltd Construction of 2-storey building and non-ferrous metals recovery facility CEA-1340 Planning ref: 2130/18	0	1	No	The proposed development was granted planning in 2018 and is likely to already be constructed when the construction of the CWP commences. The Appropriate Assessment Screening report prepared for the project concluded that the project (construction and operational phases) will not result in likely significant effect on European sites (Doherty Environmental, 2018). Considering the construction phases of the two projects will not overlap and the lack of operational phase impacts and the small scale (40 m x 10 m) nature of the development, there is no potential for cumulative effects with the CWP project.
Pembroke Beach DAC / Becbay Ltd & Fabrizia Developments Ltd	0	1	Yes	Development of residential, office and mixed-use scheme at the former Irish Glass Bottle and Fabrizia sites at Poolbeg West.

Development	Distance from the onshore infrastructure (km)	Tier	Included in the CEA (Yes/No)	Rationale
Redevelopment of former glass bottle site CEA- 0333, CEA-0339, CEA-0387 and CEA-1354 Planning Ref.: 3406/22, 4121/21, 3270/19 and 3207/21				The EIAR produced for the development concluded that the residual impacts only remain for breeding and wintering birds arising from construction disturbance and displacement. As the CWP Project will also result in disturbance and displacement, the potential for cumulative impacts could not be ruled out.
E D & F Man Liquid Products Ireland Limited New Storage Tank CEA-1344 Planning Ref: 2804/19	0	1	No	No EIA or Environmental Report has been produced for the new Storage Tank project, so an assessment of cumulative residual effects could not be determined. However, considering the small-scale nature of the proposed storage tank (13.3m x 16.3m) there is no potential for cumulative impacts with the CWP Project.
Irish Water Ringsend Waste Water Treatment Plant Upgrade Project CEA-0331 Planning Ref: 5319/22	0.25	1	No	No EIA or Environmental Report has been produced for the project, so an assessment of cumulative residual effects could not be determined. However, considering the small-scale nature of the project (*c*. 30 m^2), there is no potential for cumulative impacts with the CWP Project.
Kilsaran Concrete Continuation of use of an existing concrete batching plant CEA-1343 Planning Ref: 3469/22	0.3	1	No	No EIA or Environmental Report has been produced for the project, so an assessment of cumulative residual effects could not be determined. The application is for the continuation of use of an existing concrete batching plant. As the plant is already in operation and will not change, the plant has therefore been considered within the baseline

Development	Distance from the onshore infrastructure (km)	Tier	Included in the CEA (Yes/No)	Rationale
				assessment. There is therefore no potential for cumulative impacts with the CWP Project.
Dublin Port Company Bridge over existing cooling water channel (superseded by CWP project proposals) CEA-1339 Planning Ref.: 3711/18	0	1	No	The installation of a bridge over the cooling water channel into the onshore substation is included as part of the OTI. The location mirrors that of this proposed bridge development. In the event that the CWP Project proceeds, this proposed bridge development would be superseded by the Project. On this basis, the proposed bridge development was not considered further in this assessment..
Dublin Port Company 3FM CEA-1348On	0	3	Yes	Due for submission in late 2023. The 3FM Project is the third and final Strategic Infrastructure Development (SID) Project needed to deliver the capacity objectives of the Dublin Port Masterplan 2040. Key components of this project will include: Southern port access road (SPAR). There is potential for a temporal overlap between the construction phase of this project and that of the CWP Project. If construction does overlap, concurrent construction activities within 50 m of the CWP Project onshore development area could cause cumulative effects.
Codema Dublin District Heating System (DDHS) CEA-1347	0	3	No	The DDHS will be a thermal energy network that uses energy from waste heat and distributes it as hot water through insulated dual (supply and return) pipelines to homes and business for space heating, hot water and industrial purposes. It is understood that this project will be located on a site within the Poolbeg peninsula, potentially in proximity to

Development	Distance from the onshore infrastructure (km)	Tier	Included in the CEA (Yes/No)	Rationale
				Construction Compound A. However, this project is not yet submitted for planning consent This project is not yet submitted. There is insufficient details available about this project to undertake a meaningful cumulative effects assessment. Therefore, the project is screened out from further assessment.
EirGrid Powering Up Dublin CEA-1371	0	3	No	Works are required to upgrade Dublin City's electricity infrastructure. This includes the installation of 50 km of cables across the city. This will include underground cable routes, some of which will link to the Poolbeg ESB Poolbeg Generating Station. Final route technologies have not yet been confirmed and this project has not yet been submitted for planning consent. There is insufficient detail available about this project to undertake a meaningful cumulative effects assessment. Therefore, the project is screened out from further assessment..
Ecocem Ireland Limited Permission for the development consisting of the construction of silos, compressor rooms, cooling room, retaining walls, new fencing, new gate, revision of car park layout Planning Ref: 3041/24	0	1	No	No Environmental Report has been produced for the project, so an assessment of cumulative residual effects could not be determined. The application is for minor developments within an existing operational site. As the plant is already in operation and proposed works are considered localised within an existing site boundary, It was concluded that there is no potential for significant cumulative impacts with the CWP Project.

1.8 CEA Assessment of cumulative effects – onshore

1.8.1 Construction phase

Cumulative impact 1: direct effects on habitats

Onshore

182. The CWP Project will result in the loss of habitat within the onshore area, which in turn, will result in the loss of a breeding colony of sand martin recorded within a harbour wall adjacent to the proposed onshore substation. Approximately four sand martin nests will be permanently lost to facilitate this proposed infrastructure.

183. The permanent loss of habitat at the CWP Project was considered a moderate negative effect in the absence of mitigation and has been determined as significant in EIA terms. Additional mitigation measures in the form of the provision of an artificial sand martin wall will mitigate against the loss of habitat and four sand martin nests (as well as increasing the number of nesting opportunities for the species i.e., the sand martin will with contain a minimum of 27 nesting cavities), thus reducing the impact significance to a slight negative effect making it not significant in EIA terms and removing the potential for cumulative impacts.

184. The accumulative effect of habitat losses with nearby projects (listed in **Table 77** above) will not increase the magnitude of this impact on this sand martin colony. None of the projects screened through for further assessment noted impacts on sand martin or identified suitable habitats for the species, at risk of being lost.

185. Furthermore, the policies and objectives listed in the Dublin City Council Development Plan (2022-2028) and the Dublin City Biodiversity Action Plan (2021-2025) will moderate the impacts on onshore habitats and flora from future proposed projects.

Estuarine / Liffey

186. The CWP Project will result in the loss of habitat within the estuarine / Liffey area, which in turn, will result in the loss of a confirmed breeding sites and potential breeding sites for black guillemot recorded within a harbour wall adjacent to the onshore substation. At least two active and three potential nest sites will be permanently lost to facilitate this proposed infrastructure.

187. The permanent loss of habitat at the CWP Project was considered to have a moderate negative effect in the absence of mitigation and has been determined as significant in EIA terms. Additional mitigation measures in the form of the provision of artificial nest boxes will mitigate against the loss of habitat and active nesting areas (as well as increasing the number of nesting opportunities for the species i.e., a minimum of four nest boxes will be erected), thus reducing the impact significance to a slight negative effect making it not significant in EIA terms and removing the potential for cumulative effects.

188. The cumulative effect of habitat losses with nearby projects (listed in **Table 77** above) will not increase the magnitude of this impact on the black guillemot population. None of the screened in project listed above noted impacts on black guillemot or identified suitable habitats at risk of being lost.

1.8.2 Operation and maintenance

Cumulative impact 4: presence of buildings / infrastructure

Estuarine / Liffey

189. The CWP project will result in permanent buildings / infrastructure at the onshore substation in proximity to the estuarine / Liffey area, which would increase the magnitude of the effect on Arctic tern and common tern (which are breeding in close proximity to the onshore substation), due to potential shadow cast and the creation of perching opportunities for predators such as peregrine falcon or hooded crow.

190. The presence of buildings / infrastructure from the CWP Project was considered to have a slight negative effect for Arctic tern and not significant negative effect for common tern, in the absence of mitigation. Both of which has been determined as not significant in EIA terms. Therefore, additional mitigation is not required.

191. The accumulative effect of the presence of buildings / infrastructure with nearby projects (listed in **Table 77** above) will not increase the magnitude of this impact on the Arctic tern and common tern colonies. None of the projects screened through for further assessment noted impacts on Arctic or common terns or have buildings / structure or infrastructure within the vicinity of the estuarine / Liffey area.

1.9 CEA summary

192. This CEA, which supports **Chapter 10 Ornithology** has assessed the potential cumulative effects on Ornithology from the construction and operation and maintenance phases of the CWP Project alongside other developments.

193. In summary, the CEA for ornithology does not identify any significant cumulative effects resulting from the CWP Project alongside other development.

1.10 References

194. Awel Y Môr Offshore Wind Fram (2022). Preliminary Environmental Information Report. Volume 2, Chapter 4: Offshore Ornithology. Revision: A.

195. Burnell, D., Perkins, A.J., Newton, S.F., Bolton, M., Tierney, T.D. and Dunn, T.E. (2023). Seabirds Count. A census of breeding seabird seabirds in Britain and Ireland (2015-2021). Lynx Nature Books.

196. Butler, A., Searle, K., Mobbs, D.C. and Daunt, F. 2020. A Population Viability Analysis Modelling Tool for Seabird Species – Tool Testing: Report for methodology and results for testing of tool. JNCC Report No. 657, JNCC, Peterborough, ISSN 0963-8091.

197. Cutts, N., Hemingway, K. and Spencer, J. (2013). Waterbird Disturbance Mitigation Toolkit informing estuarine planning and construction projects. Produced by the Institute of Estuarine and Coastal Studies (IECS), University of Hull, 2013.

198. Doherty Environmental (2018). Hammond Lane, Pigeon House Road Upgrade Works, Habitat Directives Assessment Screening Statement in Support of Appropriate Assessment. (Unpublished Report).

199. European Commission (1999). Guidelines for the Assessment of Indirect and Cumulative Effects as well as Impact Interactions (Ref NE80328/D1/3).

200. EPA (2022). Guidelines on the information to be contained in Environmental Impact Assessment Reports. ISBN 978-1-80009-005-7.

201. Goodship, N.M. and Furness, R.W. (MacArthur Green) (2022). Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species. NatureScot Research Report 1283.

202. Jitlal, M., Burthe, S. Freeman, S. and Daunt, F. (2017). Testing and validating metrics of change produced by Population Viability Analysis (PVA) (Ref CR/2014/16). Draft report to The Scottish Government.

203. Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird Populations of Britain and Ireland, JNCC, Peterborough, ISBN 0 7136 6901 2.

204. PINS (2019). Advice Note Seventeen; Cumulative effects assessment relevant to nationally significant infrastructure projects (Version 2). Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-17/ [Last accessed 02/02/2024].

205. RPS (2018a). MP2 Project, Environmental Impact Assessment Report Main Document (Part 1). IBE1429/EIAR. (Unpublished Report).

206. RPS (2018b). Dublin Port Company. Berth 47A Access Bridge & Storage Area. Environmental Report. (Unpublished Report).

207. Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report No. 724. The British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU.

ANNEX A - ABUNDANCE OF RECEPTORS AT PROJECTS CONSIDERED IN CEA IN RELATION TO DISTURBANCE AND DISPLACEMENT

1.11 Guillemot

Table 78 Guillemot abundance values for other screened in plans and projects

Project	Tier	Abundance	Source
Awel-y-Mor	1	4,488	Awel-y-Mor. ES, Volume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	3,448	Burbo Bank Extension. Boat-based survey data maximum estimated population within site plus 4 km buffer
North Hoyle	1		No data
Walney Extension 3 + 4	1	6,093	Morgan. PEIR, Volume 2, Chapter 10
West of Duddon Sands	1	833	Morgan. PEIR, Volume 2, Chapter 10
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1	238	Morgan. PEIR, Volume 2, Chapter 10
Barrow	1		No data
Robin Rigg	1	28	Morgan. PEIR, Volume 2, Chapter 10
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1	35,339	Erebus. Updated numbers presented in ORML2170 Project Erebus Supplementary Environmental Information Addendum
Morgan	1	8,994	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	11,697	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	11,912	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	16,964	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	52,328	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow Bank Phase 2)	2b	11,602	Phase 1 project consultation shared figure

Project	Tier	Abundance	Source
West Anglesey Demonstration Zone	1		No data
Fair Head Phase 2	1		
Swansea Bay Tidal Lagoon	1		
Cardiff Bay Tidal Lagoon	1		
West Somerset Tidal Lagoon	1		
Mares Connect	1		
Celtix Connect - Sea Fibre	1		
Greenlink Interconnector	1		
North Wall Emergency Power Generation Plant	1		
Dublin Port Company MP2	1		
Arklow Waste Water Treatment	1		
Maintenance dredging River Boyne, Drogheda	1		

1.12 Razorbill

Table 79 Razorbill abundance values for other screened in plans and projects

Project	Tier	Abundance	Source
Awel-y-Mor	1	692	Awel-y-Mor. ES, Voume 2, Chapter 4
Gwynt y Mor	1	455	Morgan. PEIR, Volume 2, Chapter 10
Rhyl Flats	1		No data
Burbo Bank Extension	1	360	Burbo Bank Extension. Boat-based survey data maximum estimated population within site plus 4 km buffer
North Hoyle	1	2,354	Morgan. PEIR, Volume 2, Chapter 10
Walney Extension 3 + 4	1	9,933	Walney Extension.
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1	360	Morgan. PEIR, Volume 2, Chapter 10

Project	Tier	Abundance	Source
Ormonde	1		No data
Barrow	1		No data
Robin Rigg	1	7	Morgan. PEIR, Volume 2, Chapter 10
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1	3,867	Erebus. Updated numbers presented in ORML2170 Project Erebus Supplementary Environmental Information Addendum
Morgan	1	622	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	1,881	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	2,883	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	6,084	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	9,998	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow Bank Phase 2)	2b	10,999	Phase 1 project consultation shared figure
West Anglesey Demonstration Zone	1		No data
Fair Head Phase 2	1		
Swansea Bay Tidal Lagoon	1		
Cardiff Bay Tidal Lagoon	1		
West Somerset Tidal Lagoon	1		
Mares Connect	1		
Celtix Connect - Sea Fibre	1		
Greenlink Interconnector	1		
North Wall Emergency Power Generation Plant	1		
Dublin Port Company MP2	1		
Arklow Waste Water Treatment	1		
Maintenance dredging River Boyne, Drogheda	1		

1.13 Puffin

Table 80 Puffin abundance values for other screened in plans and projects

Project	Tier	Abundance	Source
Awel-y-Mor	1	16	Awel-y-Mor. ES, Voume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	493	Burbo Bank Extension. Boat-based survey data maximum estimated population within site plus 4 km buffer
North Hoyle	1		No data
Walney Extension 3 + 4	1	561	Walney Extension.
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1		No data
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1	1,576	Erebus. Updated numbers presented in ORML2170 Project Erebus Supplementary Environmental Information Addendum
Morgan	1	18	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	28	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	30	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	200	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	22	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow Bank Phase 2)	2b	30	Phase 1 project consultation shared figure
West Anglesey Demonstration Zone	1		No data
Fair Head Phase 2	1		

Project	Tier	Abundance	Source
Swansea Bay Tidal Lagoon	1		
Cardiff Bay Tidal Lagoon	1		
West Somerset Tidal Lagoon	1		
Mares Connect	1		
Celtix Connect - Sea Fibre	1		
Greenlink Interconnector	1		
North Wall Emergency Power Generation Plant	1		
Dublin Port Company MP2	1		
Arklow Waste Water Treatment	1		
Maintenance dredging River Boyne, Drogheda	1		

1.14 Red-throated diver

Table 81 Red-throated diver abundance values for other screened in plans and projects

Project	Tier	Abundance	Source
Awel-y-Mor	1	55	Awel-y-Mor. ES, Volume 2, Chapter 4 [Note – Taken from **Table 14** - Sum of seasonal abundances within site and 5 km buffer area]
Gwynt y Mor	1	35	Awel-y-Mor. ES, Volume 2, Chapter 4 [Note – Taken from **Table 55** – Predicted displacement during migration free winter bio-season within site and 8 km buffer area – Considered most appropriate available metric in the absence of abundance values for other bio-seasons and suitably conservative as displacement estimates calculated from an 8 km buffer cover a far larger area than abundance estimates generated for within 4 km buffer areas]
Rhyl Flats	1	24	
Burbo Bank Extension	1	30	
North Hoyle	1	0	
Walney Extension 3 + 4	1	0	
West of Duddon Sands	1	0	
Walney 1 + 2	1	0	
Burbo Bank	1	11	
Ormonde	1	0	
Barrow	1	0	
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1	0	Erebus.
Morgan	1	0	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	28	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	0	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	458	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	10	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow Bank Phase 2)	2b	375	Phase 1 project consultation shared figure
West Anglesey Demonstration Zone	1		No data
Fair Head Phase 2	1		
Swansea Bay Tidal Lagoon	1		
Cardiff Bay Tidal Lagoon	1		

Project	Tier	Abundance	Source
West Somerset Tidal Lagoon	1		
Mares Connect	1		
Celtix Connect - Sea Fibre	1		
Greenlink Interconnector	1		
North Wall Emergency Power Generation Plant	1		
Dublin Port Company MP2	1		
Arklow Waste Water Treatment	1		
Maintenance dredging River Boyne, Drogheda	1		

1.15 Gannet

Table 0-82 Gannet abundance values for other screened in plans and projects

Project	Tier	Abundance	Source / Justification
Awel-y-Mor	1	528	Awel-y-Mor. ES, Voume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	429	Burbo Bank Extension. Boat-based survey data maximum estimated population within site plus 4 km buffer
North Hoyle	1		No data
Walney Extension 3 + 4	1	1,348	Walney Extension.
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1		No data
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1	658	Morgan. PEIR, Volume 2, Chapter 10

Project	Tier	Abundance	Source / Justification
Morgan	1	454	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	912	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	693	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	265	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	1,366	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	803	Phase 1 project consultation shared figure
West Anglesey Demonstration Zone	1		No data
Fair Head Phase 2	1		
Swansea Bay Tidal Lagoon	1		
Cardiff Bay Tidal Lagoon	1		
West Somerset Tidal Lagoon	1		
Mares Connect	1		
Celtix Connect - Sea Fibre	1		
Greenlink Interconnector	1		
North Wall Emergency Power Generation Plant	1		
Dublin Port Company MP2	1		
Arklow Waste Water Treatment	1		
Maintenance dredging River Boyne, Drogheda	1		

ANNEX B - CUMULATIVE DISPLACEMENT MATRICES

1.15.1 Construction

Guillemot

Table 83 Displacement matrices – construction phase for guillemot (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)		**CWP**															
	0.5	0.42	0.85	1.70	2.54	3.39	4.24	8.48	16.96	25.45	33.93	42.41	50.89	59.37	67.86	76.34	84.82
	5	4.24	8.48	16.96	25.45	33.93	42.41	84.82	169.64	254.46	339.28	424.10	508.92	593.74	678.56	763.38	848.20
	10	8.48	16.96	33.93	50.89	67.86	84.82	169.64	339.28	508.92	678.56	848.20	1017.84	1187.48	1357.12	1526.76	1696.40
	15	12.72	25.45	50.89	76.34	101.78	127.23	254.46	508.92	763.38	1017.84	1272.30	1526.76	1781.22	2035.68	2290.14	2544.60
	20	16.96	33.93	67.86	101.78	135.71	169.64	339.28	678.56	1017.84	1357.12	1696.40	2035.68	2374.96	2714.24	3053.52	3392.80
	25	21.21	**42.41**	84.82	127.23	169.64	212.05	424.10	848.20	1272.30	1696.40	2120.50	2544.60	2968.70	3392.80	3816.90	4241.00
	30	25.45	50.89	101.78	152.68	203.57	254.46	508.92	1017.84	1526.76	2035.68	2544.60	3053.52	3562.44	4071.36	4580.28	5089.20
	35	29.69	59.37	118.75	178.12	237.50	296.87	593.74	1187.48	1781.22	2374.96	2968.70	3562.44	4156.18	4749.92	5343.66	5937.40
	40	33.93	67.86	135.71	203.57	271.42	339.28	678.56	1357.12	2035.68	2714.24	3392.80	4071.36	4749.92	5428.48	6107.04	6785.60
	45	38.17	76.34	152.68	229.01	305.35	381.69	763.38	1526.76	2290.14	3053.52	3816.90	4580.28	5343.66	6107.04	6870.42	7633.80
	50	42.41	84.82	169.64	254.46	339.28	424.10	848.20	1696.40	2544.60	3392.80	4241.00	5089.20	5937.40	6785.60	7633.80	8482.00
		CWP + Tier 1															
	0.5/1	4.58	9.16	18.31	27.47	36.62	45.78	91.55	183.10	274.66	366.21	457.76	549.31	640.86	732.42	823.97	915.52
	5/10	45.78	91.55	183.10	274.66	366.21	457.76	915.52	1831.04	2746.56	3662.08	4577.60	5493.12	6408.64	7324.16	8239.68	9155.20
	10/20	91.55	183.10	366.21	549.31	732.42	915.52	1831.04	3662.08	5493.12	7324.16	9155.20	10986.24	12817.28	14648.32	16479.36	18310.40
	15/30	137.33	274.66	549.31	823.97	1098.62	1373.28	2746.56	5493.12	8239.68	10986.24	13732.80	16479.36	19225.92	21972.48	24719.04	27465.60
	20/40	183.10	366.21	732.42	1098.62	1464.83	1831.04	3662.08	7324.16	10986.24	14648.32	18310.40	21972.48	25634.56	29296.64	32958.72	36620.80
	25/50	228.88	**457.76**	915.52	1373.28	1831.04	2288.80	4577.60	9155.20	13732.80	18310.40	22888.00	27465.60	32043.20	36620.80	41198.40	45776.00
	30/60	274.66	549.31	1098.62	1647.94	2197.25	2746.56	5493.12	10986.24	16479.36	21972.48	27465.60	32958.72	38451.84	43944.96	49438.08	54931.20
	35/70	320.43	640.86	1281.73	1922.59	2563.46	3204.32	6408.64	12817.28	19225.92	25634.56	32043.20	38451.84	44860.48	51269.12	57677.76	64086.40
	40/80	366.21	732.42	1464.83	2197.25	2929.66	3662.08	7324.16	14648.32	21972.48	29296.64	36620.80	43944.96	51269.12	58593.28	65917.44	73241.60
	45/90	411.98	823.97	1647.94	2471.90	3295.87	4119.84	8239.68	16479.36	24719.04	32958.72	41198.40	49438.08	57677.76	65917.44	74157.12	82396.80
	50/100	457.76	915.52	1831.04	2746.56	3662.08	4577.60	9155.20	18310.40	27465.60	36620.80	45776.00	54931.20	64086.40	73241.60	82396.80	91552.00
		CWP + Tier 1 +Tier 2a															
	0.5/1	5.89	11.77	23.54	35.31	47.09	58.86	117.72	235.43	353.15	470.86	588.58	706.30	824.01	941.73	1059.44	1177.16

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	5/10	58.86	117.72	235.43	353.15	470.86	588.58	1177.16	2354.32	3531.48	4708.64	5885.80	7062.96	8240.12	9417.28	10594.44	11771.60
	10/20	117.72	235.43	470.86	706.30	941.73	1177.16	2354.32	4708.64	7062.96	9417.28	11771.60	14125.92	16480.24	18834.56	21188.88	23543.20
	15/30	176.57	353.15	706.30	1059.44	1412.59	1765.74	3531.48	7062.96	10594.44	14125.92	17657.40	21188.88	24720.36	28251.84	31783.32	35314.80
	20/40	235.43	470.86	941.73	1412.59	1883.46	2354.32	4708.64	9417.28	14125.92	18834.56	23543.20	28251.84	32960.48	37669.12	42377.76	47086.40
	25/50	294.29	**588.58**	1177.16	1765.74	2354.32	2942.90	5885.80	11771.60	17657.40	23543.20	29429.00	35314.80	41200.60	47086.40	52972.20	58858.00
	30/60	353.15	706.30	1412.59	2118.89	2825.18	3531.48	7062.96	14125.92	21188.88	28251.84	35314.80	42377.76	49440.72	56503.68	63566.64	70629.60
	35/70	412.01	824.01	1648.02	2472.04	3296.05	4120.06	8240.12	16480.24	24720.36	32960.48	41200.60	49440.72	57680.84	65920.96	74161.08	82401.20
	40/80	470.86	941.73	1883.46	2825.18	3766.91	4708.64	9417.28	18834.56	28251.84	37669.12	47086.40	56503.68	65920.96	75338.24	84755.52	94172.80
	45/90	529.72	1059.44	2118.89	3178.33	4237.78	5297.22	10594.44	21188.88	31783.32	42377.76	52972.20	63566.64	74161.08	84755.52	95349.96	105944.40
	50/100	588.58	1177.16	2354.32	3531.48	4708.64	5885.80	11771.60	23543.20	35314.80	47086.40	58858.00	70629.60	82401.20	94172.80	105944.40	117716.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	0.5/1	6.18	12.35	24.70	37.06	49.41	61.76	123.52	247.03	370.55	494.07	617.59	741.10	864.62	988.14	1111.65	1235.17
	5/10	61.76	123.52	247.03	370.55	494.07	617.59	1235.17	2470.34	3705.51	4940.68	6175.85	7411.02	8646.19	9881.36	11116.53	12351.70
	10/20	123.52	247.03	494.07	741.10	988.14	1235.17	2470.34	4940.68	7411.02	9881.36	12351.70	14822.04	17292.38	19762.72	22233.06	24703.40
	15/30	185.28	370.55	741.10	1111.65	1482.20	1852.76	3705.51	7411.02	11116.53	14822.04	18527.55	22233.06	25938.57	29644.08	33349.59	37055.10
	20/40	247.03	494.07	988.14	1482.20	1976.27	2470.34	4940.68	9881.36	14822.04	19762.72	24703.40	29644.08	34584.76	39525.44	44466.12	49406.80
	25/50	308.79	**617.59**	1235.17	1852.76	2470.34	3087.93	6175.85	12351.70	18527.55	24703.40	30879.25	37055.10	43230.95	49406.80	55582.65	61758.50
	30/60	370.55	741.10	1482.20	2223.31	2964.41	3705.51	7411.02	14822.04	22233.06	29644.08	37055.10	44466.12	51877.14	59288.16	66699.18	74110.20
	35/70	432.31	864.62	1729.24	2593.86	3458.48	4323.10	8646.19	17292.38	25938.57	34584.76	43230.95	51877.14	60523.33	69169.52	77815.71	86461.90
	40/80	494.07	988.14	1976.27	2964.41	3952.54	4940.68	9881.36	19762.72	29644.08	39525.44	49406.80	59288.16	69169.52	79050.88	88932.24	98813.60
	45/90	555.83	1111.65	2223.31	3334.96	4446.61	5558.27	11116.53	22233.06	33349.59	44466.12	55582.65	66699.18	77815.71	88932.24	100048.77	111165.30
	50/100	617.59	1235.17	2470.34	3705.51	4940.68	6175.85	12351.70	24703.40	37055.10	49406.80	61758.50	74110.20	86461.90	98813.60	111165.30	123517.00

Table 84 Displacement matrices – construction phase for razorbill (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement (%)		CWP															
	0.5	0.15	0.30	0.61	0.91	1.22	1.52	3.04	6.08	9.13	12.17	15.21	18.25	21.29	24.34	27.38	30.42
	5	1.52	3.04	6.08	9.13	12.17	15.21	30.42	60.84	91.26	121.68	152.10	182.52	212.94	243.36	273.78	304.20
	10	3.04	6.08	12.17	18.25	24.34	30.42	60.84	121.68	182.52	243.36	304.20	365.04	425.88	486.72	547.56	608.40
	15	4.56	9.13	18.25	27.38	36.50	45.63	91.26	182.52	273.78	365.04	456.30	547.56	638.82	730.08	821.34	912.60
	20	6.08	12.17	24.34	36.50	48.67	60.84	121.68	243.36	365.04	486.72	608.40	730.08	851.76	973.44	1095.12	1216.80
	25	7.61	**15.21**	30.42	45.63	60.84	76.05	152.10	304.20	456.30	608.40	760.50	912.60	1064.70	1216.80	1368.90	1521.00
	30	9.13	18.25	36.50	54.76	73.01	91.26	182.52	365.04	547.56	730.08	912.60	1095.12	1277.64	1460.16	1642.68	1825.20
	35	10.65	21.29	42.59	63.88	85.18	106.47	212.94	425.88	638.82	851.76	1064.70	1277.64	1490.58	1703.52	1916.46	2129.40
	40	12.17	24.34	48.67	73.01	97.34	121.68	243.36	486.72	730.08	973.44	1216.80	1460.16	1703.52	1946.88	2190.24	2433.60
	45	13.69	27.38	54.76	82.13	109.51	136.89	273.78	547.56	821.34	1095.12	1368.90	1642.68	1916.46	2190.24	2464.02	2737.80
	50	15.21	30.42	60.84	91.26	121.68	152.10	304.20	608.40	912.60	1216.80	1521.00	1825.20	2129.40	2433.60	2737.80	3042.00
		CWP + Tier 1															
	0.5/1	1.31	2.62	5.24	7.86	10.48	13.09	26.19	52.38	78.57	104.76	130.95	157.13	183.32	209.51	235.70	261.89
	5/10	13.09	26.19	52.38	78.57	104.76	130.95	261.89	523.78	785.67	1047.56	1309.45	1571.34	1833.23	2095.12	2357.01	2618.90
	10/20	26.19	52.38	104.76	157.13	209.51	261.89	523.78	1047.56	1571.34	2095.12	2618.90	3142.68	3666.46	4190.24	4714.02	5237.80
	15/30	39.28	78.57	157.13	235.70	314.27	392.84	785.67	1571.34	2357.01	3142.68	3928.35	4714.02	5499.69	6285.36	7071.03	7856.70
	20/40	52.38	104.76	209.51	314.27	419.02	523.78	1047.56	2095.12	3142.68	4190.24	5237.80	6285.36	7332.92	8380.48	9428.04	10475.60
	25/50	65.47	**130.95**	261.89	392.84	523.78	654.73	1309.45	2618.90	3928.35	5237.80	6547.25	7856.70	9166.15	10475.60	11785.05	13094.50
	30/60	78.57	157.13	314.27	471.40	628.54	785.67	1571.34	3142.68	4714.02	6285.36	7856.70	9428.04	10999.38	12570.72	14142.06	15713.40
	35/70	91.66	183.32	366.65	549.97	733.29	916.62	1833.23	3666.46	5499.69	7332.92	9166.15	10999.38	12832.61	14665.84	16499.07	18332.30
	40/80	104.76	209.51	419.02	628.54	838.05	1047.56	2095.12	4190.24	6285.36	8380.48	10475.60	12570.72	14665.84	16760.96	18856.08	20951.20
	45/90	117.85	235.70	471.40	707.10	942.80	1178.51	2357.01	4714.02	7071.03	9428.04	11785.05	14142.06	16499.07	18856.08	21213.09	23570.10
	50/100	130.95	261.89	523.78	785.67	1047.56	1309.45	2618.90	5237.80	7856.70	10475.60	13094.50	15713.40	18332.30	20951.20	23570.10	26189.00
		CWP + Tier 1 +Tier 2a															
	0.5/1	1.56	3.12	6.24	9.36	12.48	15.59	31.19	62.38	93.56	124.75	155.94	187.13	218.32	249.50	280.69	311.88
	5/10	15.59	31.19	62.38	93.56	124.75	155.94	311.88	623.76	935.64	1247.52	1559.40	1871.28	2183.16	2495.04	2806.92	3118.80
	10/20	31.19	62.38	124.75	187.13	249.50	311.88	623.76	1247.52	1871.28	2495.04	3118.80	3742.56	4366.32	4990.08	5613.84	6237.60
	15/30	46.78	93.56	187.13	280.69	374.26	467.82	935.64	1871.28	2806.92	3742.56	4678.20	5613.84	6549.48	7485.12	8420.76	9356.40
	20/40	62.38	124.75	249.50	374.26	499.01	623.76	1247.52	2495.04	3742.56	4990.08	6237.60	7485.12	8732.64	9980.16	11227.68	12475.20
	25/50	77.97	**155.94**	311.88	467.82	623.76	779.70	1559.40	3118.80	4678.20	6237.60	7797.00	9356.40	10915.80	12475.20	14034.60	15594.00

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	30/60	93.56	187.13	374.26	561.38	748.51	935.64	1871.28	3742.56	5613.84	7485.12	9356.40	11227.68	13098.96	14970.24	16841.52	18712.80
	35/70	109.16	218.32	436.63	654.95	873.26	1091.58	2183.16	4366.32	6549.48	8732.64	10915.80	13098.96	15282.12	17465.28	19648.44	21831.60
	40/80	124.75	249.50	499.01	748.51	998.02	1247.52	2495.04	4990.08	7485.12	9980.16	12475.20	14970.24	17465.28	19960.32	22455.36	24950.40
	45/90	140.35	280.69	561.38	842.08	1122.77	1403.46	2806.92	5613.84	8420.76	11227.68	14034.60	16841.52	19648.44	22455.36	25262.28	28069.20
	50/100	155.94	311.88	623.76	935.64	1247.52	1559.40	3118.80	6237.60	9356.40	12475.20	15594.00	18712.80	21831.60	24950.40	28069.20	31188.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	0.5/1	1.83	3.67	7.34	11.01	14.68	18.34	36.69	73.38	110.06	146.75	183.44	220.13	256.81	293.50	330.19	366.88
	5/10	18.34	36.69	73.38	110.06	146.75	183.44	366.88	733.75	1100.63	1467.50	1834.38	2201.25	2568.13	2935.00	3301.88	3668.75
	10/20	36.69	73.38	146.75	220.13	293.50	366.88	733.75	1467.50	2201.25	2935.00	3668.75	4402.50	5136.25	5870.00	6603.75	7337.50
	15/30	55.03	110.06	220.13	330.19	440.25	550.31	1100.63	2201.25	3301.88	4402.50	5503.13	6603.75	7704.38	8805.00	9905.63	11006.25
	20/40	73.38	146.75	293.50	440.25	587.00	733.75	1467.50	2935.00	4402.50	5870.00	7337.50	8805.00	10272.50	11740.00	13207.50	14675.00
	25/50	91.72	**183.44**	366.88	550.31	733.75	917.19	1834.38	3668.75	5503.13	7337.50	9171.88	11006.25	12840.63	14675.00	16509.38	18343.75
	30/60	110.06	220.13	440.25	660.38	880.50	1100.63	2201.25	4402.50	6603.75	8805.00	11006.25	13207.50	15408.75	17610.00	19811.25	22012.50
	35/70	128.41	256.81	513.63	770.44	1027.25	1284.06	2568.13	5136.25	7704.38	10272.50	12840.63	15408.75	17976.88	20545.00	23113.13	25681.25
	40/80	146.75	293.50	587.00	880.50	1174.00	1467.50	2935.00	5870.00	8805.00	11740.00	14675.00	17610.00	20545.00	23480.00	26415.00	29350.00
	45/90	165.09	330.19	660.38	990.56	1320.75	1650.94	3301.88	6603.75	9905.63	13207.50	16509.38	19811.25	23113.13	26415.00	29716.88	33018.75
	50/100	183.44	366.88	733.75	1100.63	1467.50	1834.38	3668.75	7337.50	11006.25	14675.00	18343.75	22012.50	25681.25	29350.00	33018.75	36687.50

Puffin

Table 85 Displacement matrices – construction phase for puffin (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)		**CWP**															
	0.5	0.01	0.01	0.02	0.03	0.04	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
	5	0.05	0.10	0.20	0.30	0.40	0.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
	10	0.10	0.20	0.40	0.60	0.80	1.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00
	15	0.15	0.30	0.60	0.90	1.20	1.50	3.00	6.00	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00
	20	0.20	0.40	0.80	1.20	1.60	2.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00
	25	0.25	**0.50**	1.00	1.50	2.00	2.50	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
	30	0.30	0.60	1.20	1.80	2.40	3.00	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00
	35	0.35	0.70	1.40	2.10	2.80	3.50	7.00	14.00	21.00	28.00	35.00	42.00	49.00	56.00	63.00	70.00
	40	0.40	0.80	1.60	2.40	3.20	4.00	8.00	16.00	24.00	32.00	40.00	48.00	56.00	64.00	72.00	80.00
	45	0.45	0.90	1.80	2.70	3.60	4.50	9.00	18.00	27.00	36.00	45.00	54.00	63.00	72.00	81.00	90.00
	50	0.50	1.00	2.00	3.00	4.00	5.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
		CWP + Tier 1															
	0.5/1	0.14	0.28	0.56	0.85	1.13	1.41	2.82	5.64	8.47	11.29	14.11	16.93	19.75	22.58	25.40	28.22
	5/10	1.41	2.82	5.64	8.47	11.29	14.11	28.22	56.44	84.66	112.88	141.10	169.32	197.54	225.76	253.98	282.20
	10/20	2.82	5.64	11.29	16.93	22.58	28.22	56.44	112.88	169.32	225.76	282.20	338.64	395.08	451.52	507.96	564.40
	15/30	4.23	8.47	16.93	25.40	33.86	42.33	84.66	169.32	253.98	338.64	423.30	507.96	592.62	677.28	761.94	846.60
	20/40	5.64	11.29	22.58	33.86	45.15	56.44	112.88	225.76	338.64	451.52	564.40	677.28	790.16	903.04	1015.92	1128.80
	25/50	7.06	**14.11**	28.22	42.33	56.44	70.55	141.10	282.20	423.30	564.40	705.50	846.60	987.70	1128.80	1269.90	1411.00
	30/60	8.47	16.93	33.86	50.80	67.73	84.66	169.32	338.64	507.96	677.28	846.60	1015.92	1185.24	1354.56	1523.88	1693.20
	35/70	9.88	19.75	39.51	59.26	79.02	98.77	197.54	395.08	592.62	790.16	987.70	1185.24	1382.78	1580.32	1777.86	1975.40
	40/80	11.29	22.58	45.15	67.73	90.30	112.88	225.76	451.52	677.28	903.04	1128.80	1354.56	1580.32	1806.08	2031.84	2257.60
	45/90	12.70	25.40	50.80	76.19	101.59	126.99	253.98	507.96	761.94	1015.92	1269.90	1523.88	1777.86	2031.84	2285.82	2539.80
	50/100	14.11	28.22	56.44	84.66	112.88	141.10	282.20	564.40	846.60	1128.80	1411.00	1693.20	1975.40	2257.60	2539.80	2822.00
		CWP + Tier 1 +Tier 2a															
	0.5/1	0.14	0.28	0.57	0.85	1.13	1.42	2.83	5.67	8.50	11.33	14.17	17.00	19.83	22.66	25.50	28.33
	5/10	1.42	2.83	5.67	8.50	11.33	14.17	28.33	56.66	84.99	113.32	141.65	169.98	198.31	226.64	254.97	283.30
	10/20	2.83	5.67	11.33	17.00	22.66	28.33	56.66	113.32	169.98	226.64	283.30	339.96	396.62	453.28	509.94	566.60
	15/30	4.25	8.50	17.00	25.50	34.00	42.50	84.99	169.98	254.97	339.96	424.95	509.94	594.93	679.92	764.91	849.90
	20/40	5.67	11.33	22.66	34.00	45.33	56.66	113.32	226.64	339.96	453.28	566.60	679.92	793.24	906.56	1019.88	1133.20
	25/50	7.08	**14.17**	28.33	42.50	56.66	70.83	141.65	283.30	424.95	566.60	708.25	849.90	991.55	1133.20	1274.85	1416.50

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	30/60	8.50	17.00	34.00	50.99	67.99	84.99	169.98	339.96	509.94	679.92	849.90	1019.88	1189.86	1359.84	1529.82	1699.80
	35/70	9.92	19.83	39.66	59.49	79.32	99.16	198.31	396.62	594.93	793.24	991.55	1189.86	1388.17	1586.48	1784.79	1983.10
	40/80	11.33	22.66	45.33	67.99	90.66	113.32	226.64	453.28	679.92	906.56	1133.20	1359.84	1586.48	1813.12	2039.76	2266.40
	45/90	12.75	25.50	50.99	76.49	101.99	127.49	254.97	509.94	764.91	1019.88	1274.85	1529.82	1784.79	2039.76	2294.73	2549.70
	50/100	14.17	28.33	56.66	84.99	113.32	141.65	283.30	566.60	849.90	1133.20	1416.50	1699.80	1983.10	2266.40	2549.70	2833.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	0.5/1	0.14	0.28	0.57	0.85	1.14	1.42	2.85	5.70	8.54	11.39	14.24	17.09	19.94	22.78	25.63	28.48
	5/10	1.42	2.85	5.70	8.54	11.39	14.24	28.48	56.96	85.44	113.92	142.40	170.88	199.36	227.84	256.32	284.80
	10/20	2.85	5.70	11.39	17.09	22.78	28.48	56.96	113.92	170.88	227.84	284.80	341.76	398.72	455.68	512.64	569.60
	15/30	4.27	8.54	17.09	25.63	34.18	42.72	85.44	170.88	256.32	341.76	427.20	512.64	598.08	683.52	768.96	854.40
	20/40	5.70	11.39	22.78	34.18	45.57	56.96	113.92	227.84	341.76	455.68	569.60	683.52	797.44	911.36	1025.28	1139.20
	25/50	7.12	**14.24**	28.48	42.72	56.96	71.20	142.40	284.80	427.20	569.60	712.00	854.40	996.80	1139.20	1281.60	1424.00
	30/60	8.54	17.09	34.18	51.26	68.35	85.44	170.88	341.76	512.64	683.52	854.40	1025.28	1196.16	1367.04	1537.92	1708.80
	35/70	9.97	19.94	39.87	59.81	79.74	99.68	199.36	398.72	598.08	797.44	996.80	1196.16	1395.52	1594.88	1794.24	1993.60
	40/80	11.39	22.78	45.57	68.35	91.14	113.92	227.84	455.68	683.52	911.36	1139.20	1367.04	1594.88	1822.72	2050.56	2278.40
	45/90	12.82	25.63	51.26	76.90	102.53	128.16	256.32	512.64	768.96	1025.28	1281.60	1537.92	1794.24	2050.56	2306.88	2563.20
	50/100	14.24	28.48	56.96	85.44	113.92	142.40	284.80	569.60	854.40	1139.20	1424.00	1708.80	1993.60	2278.40	2563.20	2848.00

Red-throated diver

Table 86 Displacement matrices – construction phase for red-throated diver (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)	**CWP**																
	0.5	0.01	0.02	0.05	0.07	0.09	0.11	0.23	0.46	0.69	0.92	1.15	1.37	1.60	1.83	2.06	2.29
	5	0.11	0.23	0.46	0.69	0.92	1.15	2.29	4.58	6.87	9.16	11.45	13.74	16.03	18.32	20.61	22.90
	10	0.23	0.46	0.92	1.37	1.83	2.29	4.58	9.16	13.74	18.32	22.90	27.48	32.06	36.64	41.22	45.80
	15	0.34	0.69	1.37	2.06	2.75	3.44	6.87	13.74	20.61	27.48	34.35	41.22	48.09	54.96	61.83	68.70
	20	0.46	0.92	1.83	2.75	3.66	4.58	9.16	18.32	27.48	36.64	45.80	54.96	64.12	73.28	82.44	91.60
	25	0.57	1.15	2.29	3.44	4.58	5.73	11.45	22.90	34.35	45.80	57.25	68.70	80.15	91.60	103.05	114.50
	30	0.69	1.37	2.75	4.12	5.50	6.87	13.74	27.48	41.22	54.96	68.70	82.44	96.18	109.92	123.66	137.40
	35	0.80	1.60	3.21	4.81	6.41	8.02	16.03	32.06	48.09	64.12	80.15	96.18	112.21	128.24	144.27	160.30
	40	0.92	1.83	3.66	5.50	7.33	9.16	18.32	36.64	54.96	73.28	91.60	109.92	128.24	146.56	164.88	183.20
	45	1.03	2.06	4.12	6.18	8.24	10.31	20.61	41.22	61.83	82.44	103.05	123.66	144.27	164.88	185.49	206.10
	50	1.15	**2.29**	4.58	6.87	9.16	11.45	22.90	45.80	68.70	91.60	114.50	137.40	160.30	183.20	206.10	229.00
	CWP + Tier 1																
	0.5/1	0.02	0.04	0.08	0.12	0.16	0.21	0.41	0.82	1.24	1.65	2.06	2.47	2.88	3.30	3.71	4.12
	5/10	0.21	0.41	0.82	1.24	1.65	2.06	4.12	8.24	12.36	16.48	20.60	24.72	28.84	32.96	37.08	41.20
	10/20	0.41	0.82	1.65	2.47	3.30	4.12	8.24	16.48	24.72	32.96	41.20	49.44	57.68	65.92	74.16	82.40
	15/30	0.62	1.24	2.47	3.71	4.94	6.18	12.36	24.72	37.08	49.44	61.80	74.16	86.52	98.88	111.24	123.60
	20/40	0.82	1.65	3.30	4.94	6.59	8.24	16.48	32.96	49.44	65.92	82.40	98.88	115.36	131.84	148.32	164.80
	25/50	1.03	2.06	4.12	6.18	8.24	10.30	20.60	41.20	61.80	82.40	103.00	123.60	144.20	164.80	185.40	206.00
	30/60	1.24	2.47	4.94	7.42	9.89	12.36	24.72	49.44	74.16	98.88	123.60	148.32	173.04	197.76	222.48	247.20
	35/70	1.44	2.88	5.77	8.65	11.54	14.42	28.84	57.68	86.52	115.36	144.20	173.04	201.88	230.72	259.56	288.40
	40/80	1.65	3.30	6.59	9.89	13.18	16.48	32.96	65.92	98.88	131.84	164.80	197.76	230.72	263.68	296.64	329.60
	45/90	1.85	3.71	7.42	11.12	14.83	18.54	37.08	74.16	111.24	148.32	185.40	222.48	259.56	296.64	333.72	370.80
	50/100	2.06	**4.12**	8.24	12.36	16.48	20.60	41.20	82.40	123.60	164.80	206.00	247.20	288.40	329.60	370.80	412.00
	CWP + Tier 1 +Tier 2a																
	0.5/1	0.02	0.04	0.08	0.13	0.17	0.21	0.42	0.83	1.25	1.67	2.09	2.50	2.92	3.34	3.75	4.17
	5/10	0.21	0.42	0.83	1.25	1.67	2.09	4.17	8.34	12.51	16.68	20.85	25.02	29.19	33.36	37.53	41.70
	10/20	0.42	0.83	1.67	2.50	3.34	4.17	8.34	16.68	25.02	33.36	41.70	50.04	58.38	66.72	75.06	83.40
	15/30	0.63	1.25	2.50	3.75	5.00	6.26	12.51	25.02	37.53	50.04	62.55	75.06	87.57	100.08	112.59	125.10
	20/40	0.83	1.67	3.34	5.00	6.67	8.34	16.68	33.36	50.04	66.72	83.40	100.08	116.76	133.44	150.12	166.80
	25/50	1.04	2.09	4.17	6.26	8.34	10.43	20.85	41.70	62.55	83.40	104.25	125.10	145.95	166.80	187.65	208.50

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	30/60	1.25	2.50	5.00	7.51	10.01	12.51	25.02	50.04	75.06	100.08	125.10	150.12	175.14	200.16	225.18	250.20
	35/70	1.46	2.92	5.84	8.76	11.68	14.60	29.19	58.38	87.57	116.76	145.95	175.14	204.33	233.52	262.71	291.90
	40/80	1.67	3.34	6.67	10.01	13.34	16.68	33.36	66.72	100.08	133.44	166.80	200.16	233.52	266.88	300.24	333.60
	45/90	1.88	3.75	7.51	11.26	15.01	18.77	37.53	75.06	112.59	150.12	187.65	225.18	262.71	300.24	337.77	375.30
	50/100	2.09	**4.17**	8.34	12.51	16.68	20.85	41.70	83.40	125.10	166.80	208.50	250.20	291.90	333.60	375.30	417.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	0.5/1	0.03	0.06	0.12	0.18	0.24	0.30	0.60	1.21	1.81	2.42	3.02	3.63	4.23	4.84	5.44	6.05
	5/10	0.30	0.60	1.21	1.81	2.42	3.02	6.05	12.09	18.14	24.18	30.23	36.27	42.32	48.36	54.41	60.45
	10/20	0.60	1.21	2.42	3.63	4.84	6.05	12.09	24.18	36.27	48.36	60.45	72.54	84.63	96.72	108.81	120.90
	15/30	0.91	1.81	3.63	5.44	7.25	9.07	18.14	36.27	54.41	72.54	90.68	108.81	126.95	145.08	163.22	181.35
	20/40	1.21	2.42	4.84	7.25	9.67	12.09	24.18	48.36	72.54	96.72	120.90	145.08	169.26	193.44	217.62	241.80
	25/50	1.51	3.02	6.05	9.07	12.09	15.11	30.23	60.45	90.68	120.90	151.13	181.35	211.58	241.80	272.03	302.25
	30/60	1.81	3.63	7.25	10.88	14.51	18.14	36.27	72.54	108.81	145.08	181.35	217.62	253.89	290.16	326.43	362.70
	35/70	2.12	4.23	8.46	12.69	16.93	21.16	42.32	84.63	126.95	169.26	211.58	253.89	296.21	338.52	380.84	423.15
	40/80	2.42	4.84	9.67	14.51	19.34	24.18	48.36	96.72	145.08	193.44	241.80	290.16	338.52	386.88	435.24	483.60
	45/90	2.72	5.44	10.88	16.32	21.76	27.20	54.41	108.81	163.22	217.62	272.03	326.43	380.84	435.24	489.65	544.05
	50/100	3.02	**6.05**	12.09	18.14	24.18	30.23	60.45	120.90	181.35	241.80	302.25	362.70	423.15	483.60	544.05	604.50

Table 87 Displacement matrices – construction phase for gannet (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement (%)		CWP															
	0.5	0.01	0.01	0.03	0.04	0.05	0.07	0.13	0.27	0.40	0.53	0.66	0.80	0.93	1.06	1.19	1.33
	5	0.07	0.13	0.27	0.40	0.53	0.66	1.33	2.65	3.98	5.30	6.63	7.95	9.28	10.60	11.93	13.25
	10	0.13	0.27	0.53	0.80	1.06	1.33	2.65	5.30	7.95	10.60	13.25	15.90	18.55	21.20	23.85	26.50
	15	0.20	0.40	0.80	1.19	1.59	1.99	3.98	7.95	11.93	15.90	19.88	23.85	27.83	31.80	35.78	39.75
	20	0.27	0.53	1.06	1.59	2.12	2.65	5.30	10.60	15.90	21.20	26.50	31.80	37.10	42.40	47.70	53.00
	25	0.33	0.66	1.33	1.99	2.65	3.31	6.63	13.25	19.88	26.50	33.13	39.75	46.38	53.00	59.63	66.25
	30	0.40	0.80	1.59	2.39	3.18	3.98	7.95	15.90	23.85	31.80	39.75	47.70	55.65	63.60	71.55	79.50
	35	0.46	**0.93**	1.86	2.78	3.71	4.64	9.28	18.55	27.83	37.10	46.38	55.65	64.93	74.20	83.48	92.75
	40	0.53	1.06	2.12	3.18	4.24	5.30	10.60	21.20	31.80	42.40	53.00	63.60	74.20	84.80	95.40	106.00
	45	0.60	1.19	2.39	3.58	4.77	5.96	11.93	23.85	35.78	47.70	59.63	71.55	83.48	95.40	107.33	119.25
	50	0.66	1.33	2.65	3.98	5.30	6.63	13.25	26.50	39.75	53.00	66.25	79.50	92.75	106.00	119.25	132.50
		CWP + Tier 1															
	0.5/1	0.26	0.52	1.03	1.55	2.06	2.58	5.15	10.31	15.46	20.62	25.77	30.93	36.08	41.24	46.39	51.55
	5/10	2.58	5.15	10.31	15.46	20.62	25.77	51.55	103.09	154.64	206.18	257.73	309.27	360.82	412.36	463.91	515.45
	10/20	5.15	10.31	20.62	30.93	41.24	51.55	103.09	206.18	309.27	412.36	515.45	618.54	721.63	824.72	927.81	1030.90
	15/30	7.73	15.46	30.93	46.39	61.85	77.32	154.64	309.27	463.91	618.54	773.18	927.81	1082.45	1237.08	1391.72	1546.35
	20/40	10.31	20.62	41.24	61.85	82.47	103.09	206.18	412.36	618.54	824.72	1030.90	1237.08	1443.26	1649.44	1855.62	2061.80
	25/50	12.89	25.77	51.55	77.32	103.09	128.86	257.73	515.45	773.18	1030.90	1288.63	1546.35	1804.08	2061.80	2319.53	2577.25
	30/60	15.46	30.93	61.85	92.78	123.71	154.64	309.27	618.54	927.81	1237.08	1546.35	1855.62	2164.89	2474.16	2783.43	3092.70
	35/70	18.04	**36.08**	72.16	108.24	144.33	180.41	360.82	721.63	1082.45	1443.26	1804.08	2164.89	2525.71	2886.52	3247.34	3608.15
	40/80	20.62	41.24	82.47	123.71	164.94	206.18	412.36	824.72	1237.08	1649.44	2061.80	2474.16	2886.52	3298.88	3711.24	4123.60
	45/90	23.20	46.39	92.78	139.17	185.56	231.95	463.91	927.81	1391.72	1855.62	2319.53	2783.43	3247.34	3711.24	4175.15	4639.05
	50/100	25.77	51.55	103.09	154.64	206.18	257.73	515.45	1030.90	1546.35	2061.80	2577.25	3092.70	3608.15	4123.60	4639.05	5154.50
		CWP + Tier 1 +Tier 2a															
	0.5/1	0.29	0.58	1.17	1.75	2.34	2.92	5.84	11.68	17.51	23.35	29.19	35.03	40.86	46.70	52.54	58.38
	5/10	2.92	5.84	11.68	17.51	23.35	29.19	58.38	116.75	175.13	233.50	291.88	350.25	408.63	467.00	525.38	583.75
	10/20	5.84	11.68	23.35	35.03	46.70	58.38	116.75	233.50	350.25	467.00	583.75	700.50	817.25	934.00	1050.75	1167.50
	15/30	8.76	17.51	35.03	52.54	70.05	87.56	175.13	350.25	525.38	700.50	875.63	1050.75	1225.88	1401.00	1576.13	1751.25
	20/40	11.68	23.35	46.70	70.05	93.40	116.75	233.50	467.00	700.50	934.00	1167.50	1401.00	1634.50	1868.00	2101.50	2335.00
	25/50	14.59	29.19	58.38	87.56	116.75	145.94	291.88	583.75	875.63	1167.50	1459.38	1751.25	2043.13	2335.00	2626.88	2918.75

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	30/60	17.51	35.03	70.05	105.08	140.10	175.13	350.25	700.50	1050.75	1401.00	1751.25	2101.50	2451.75	2802.00	3152.25	3502.50
	35/70	20.43	**40.86**	81.73	122.59	163.45	204.31	408.63	817.25	1225.88	1634.50	2043.13	2451.75	2860.38	3269.00	3677.63	4086.25
	40/80	23.35	46.70	93.40	140.10	186.80	233.50	467.00	934.00	1401.00	1868.00	2335.00	2802.00	3269.00	3736.00	4203.00	4670.00
	45/90	26.27	52.54	105.08	157.61	210.15	262.69	525.38	1050.75	1576.13	2101.50	2626.88	3152.25	3677.63	4203.00	4728.38	5253.75
	50/100	29.19	58.38	116.75	175.13	233.50	291.88	583.75	1167.50	1751.25	2335.00	2918.75	3502.50	4086.25	4670.00	5253.75	5837.50
		CWP + Tier 1 +Tier 2a + Tier 2b															
	0.5/1	0.31	0.62	1.25	1.87	2.50	3.12	6.24	12.48	18.72	24.96	31.20	37.43	43.67	49.91	56.15	62.39
	5/10	3.12	6.24	12.48	18.72	24.96	31.20	62.39	124.78	187.17	249.56	311.95	374.34	436.73	499.12	561.51	623.90
	10/20	6.24	12.48	24.96	37.43	49.91	62.39	124.78	249.56	374.34	499.12	623.90	748.68	873.46	998.24	1123.02	1247.80
	15/30	9.36	18.72	37.43	56.15	74.87	93.59	187.17	374.34	561.51	748.68	935.85	1123.02	1310.19	1497.36	1684.53	1871.70
	20/40	12.48	24.96	49.91	74.87	99.82	124.78	249.56	499.12	748.68	998.24	1247.80	1497.36	1746.92	1996.48	2246.04	2495.60
	25/50	15.60	31.20	62.39	93.59	124.78	155.98	311.95	623.90	935.85	1247.80	1559.75	1871.70	2183.65	2495.60	2807.55	3119.50
	30/60	18.72	37.43	74.87	112.30	149.74	187.17	374.34	748.68	1123.02	1497.36	1871.70	2246.04	2620.38	2994.72	3369.06	3743.40
	35/70	21.84	**43.67**	87.35	131.02	174.69	218.37	436.73	873.46	1310.19	1746.92	2183.65	2620.38	3057.11	3493.84	3930.57	4367.30
	40/80	24.96	49.91	99.82	149.74	199.65	249.56	499.12	998.24	1497.36	1996.48	2495.60	2994.72	3493.84	3992.96	4492.08	4991.20
	45/90	28.08	56.15	112.30	168.45	224.60	280.76	561.51	1123.02	1684.53	2246.04	2807.55	3369.06	3930.57	4492.08	5053.59	5615.10
	50/100	31.20	62.39	124.78	187.17	249.56	311.95	623.90	1247.80	1871.70	2495.60	3119.50	3743.40	4367.30	4991.20	5615.10	6239.00

1.15.2 Operation and maintenance

Guillemot

Table 88 Displacement matrices – operation and maintenance phase for guillemot (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)	**CWP**																
	1	0.8482	1.6964	3.3928	5.0892	6.7856	8.482	16.964	33.928	50.892	67.856	84.82	101.784	118.748	135.712	152.676	169.64
	10	8.482	16.964	33.928	50.892	67.856	84.82	169.64	339.28	508.92	678.56	848.2	1017.84	1187.48	1357.12	1526.76	1696.4
	20	16.964	33.928	67.856	101.784	135.712	169.64	339.28	678.56	1017.84	1357.12	1696.4	2035.68	2374.96	2714.24	3053.52	3392.8
	30	25.446	50.892	101.784	152.676	203.568	254.46	508.92	1017.84	1526.76	2035.68	2544.6	3053.52	3562.44	4071.36	4580.28	5089.2
	40	33.928	67.856	135.712	203.568	271.424	339.28	678.56	1357.12	2035.68	2714.24	3392.8	4071.36	4749.92	5428.48	6107.04	6785.6
	50	42.41	**84.82**	169.64	254.46	339.28	424.1	848.2	1696.4	2544.6	3392.8	4241	5089.2	5937.4	6785.6	7633.8	8482
	60	50.892	101.784	203.568	305.352	407.136	508.92	1017.84	2035.68	3053.52	4071.36	5089.2	6107.04	7124.88	8142.72	9160.56	10178.4
	70	59.374	118.748	237.496	356.244	474.992	593.74	1187.48	2374.96	3562.44	4749.92	5937.4	7124.88	8312.36	9499.84	10687.32	11874.8
	80	67.856	135.712	271.424	407.136	542.848	678.56	1357.12	2714.24	4071.36	5428.48	6785.6	8142.72	9499.84	10856.96	12214.08	13571.2
	90	76.338	152.676	305.352	458.028	610.704	763.38	1526.76	3053.52	4580.28	6107.04	7633.8	9160.56	10687.32	12214.08	13740.84	15267.6
	100	84.82	169.64	339.28	508.92	678.56	848.2	1696.4	3392.8	5089.2	6785.6	8482	10178.4	11874.8	13571.2	15267.6	16964
	CWP + Tier 1																
	1	5.0017	10.0034	20.0068	30.0102	40.0136	50.017	100.034	200.068	300.102	400.136	500.17	600.204	700.238	800.272	900.306	1000.34
	10	50.017	100.034	200.068	300.102	400.136	500.17	1000.34	2000.68	3001.02	4001.36	5001.7	6002.04	7002.38	8002.72	9003.06	10003.4
	20	100.034	200.068	400.136	600.204	800.272	1000.34	2000.68	4001.36	6002.04	8002.72	10003.4	12004.08	14004.76	16005.44	18006.12	20006.8
	30	150.051	300.102	600.204	900.306	1200.408	1500.51	3001.02	6002.04	9003.06	12004.08	15005.1	18006.12	21007.14	24008.16	27009.18	30010.2
	40	200.068	400.136	800.272	1200.408	1600.544	2000.68	4001.36	8002.72	12004.08	16005.44	20006.8	24008.16	28009.52	32010.88	36012.24	40013.6
	50	250.085	**500.17**	1000.34	1500.51	2000.68	2500.85	5001.7	10003.4	15005.1	20006.8	25008.5	30010.2	35011.9	40013.6	45015.3	50017
	60	300.102	600.204	1200.408	1800.612	2400.816	3001.02	6002.04	12004.08	18006.12	24008.16	30010.2	36012.24	42014.28	48016.32	54018.36	60020.4
	70	350.119	700.238	1400.476	2100.714	2800.952	3501.19	7002.38	14004.76	21007.14	28009.52	35011.9	42014.28	49016.66	56019.04	63021.42	70023.8
	80	400.136	800.272	1600.544	2400.816	3201.088	4001.36	8002.72	16005.44	24008.16	32010.88	40013.6	48016.32	56019.04	64021.76	72024.48	80027.2
	90	450.153	900.306	1800.612	2700.918	3601.224	4501.53	9003.06	18006.12	27009.18	36012.24	45015.3	54018.36	63021.42	72024.48	81027.54	90030.6
	100	500.17	1000.34	2000.68	3001.02	4001.36	5001.7	10003.4	20006.8	30010.2	40013.6	50017	60020.4	70023.8	80027.2	90030.6	100034
	CWP + Tier 1 + Tier 2a																
	1	7.6181	15.2362	30.4724	45.7086	60.9448	76.181	152.362	304.724	457.086	609.448	761.81	914.172	1066.534	1218.896	1371.258	1523.62
	10	76.181	152.362	304.724	457.086	609.448	761.81	1523.62	3047.24	4570.86	6094.48	7618.1	9141.72	10665.34	12188.96	13712.58	15236.2
	20	152.362	304.724	609.448	914.172	1218.896	1523.62	3047.24	6094.48	9141.72	12188.96	15236.2	18283.44	21330.68	24377.92	27425.16	30472.4
	30	228.543	457.086	914.172	1371.258	1828.344	2285.43	4570.86	9141.72	13712.58	18283.44	22854.3	27425.16	31996.02	36566.88	41137.74	45708.6

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	40	304.724	609.448	1218.896	1828.344	2437.792	3047.24	6094.48	12188.96	18283.44	24377.92	30472.4	36566.88	42661.36	48755.84	54850.32	60944.8
	50	380.905	**761.81**	1523.62	2285.43	3047.24	3809.05	7618.1	15236.2	22854.3	30472.4	38090.5	45708.6	53326.7	60944.8	68562.9	76181
	60	457.086	914.172	1828.344	2742.516	3656.688	4570.86	9141.72	18283.44	27425.16	36566.88	45708.6	54850.32	63992.04	73133.76	82275.48	91417.2
	70	533.267	1066.534	2133.068	3199.602	4266.136	5332.67	10665.34	21330.68	31996.02	42661.36	53326.7	63992.04	74657.38	85322.72	95988.06	106653.4
	80	609.448	1218.896	2437.792	3656.688	4875.584	6094.48	12188.96	24377.92	36566.88	48755.84	60944.8	73133.76	85322.72	97511.68	109700.6	121889.6
	90	685.629	1371.258	2742.516	4113.774	5485.032	6856.29	13712.58	27425.16	41137.74	54850.32	68562.9	82275.48	95988.06	109700.6	123413.2	137125.8
	100	761.81	1523.62	3047.24	4570.86	6094.48	7618.1	15236.2	30472.4	45708.6	60944.8	76181	91417.2	106653.4	121889.6	137125.8	152362
		CWP + Tier 1 + Tier 2a + Tier 2b															
	1	8.1982	16.3964	32.7928	49.1892	65.5856	81.982	163.964	327.928	491.892	655.856	819.82	983.784	1147.748	1311.712	1475.676	1639.64
	10	81.982	163.964	327.928	491.892	655.856	819.82	1639.64	3279.28	4918.92	6558.56	8198.2	9837.84	11477.48	13117.12	14756.76	16396.4
	20	163.964	327.928	655.856	983.784	1311.712	1639.64	3279.28	6558.56	9837.84	13117.12	16396.4	19675.68	22954.96	26234.24	29513.52	32792.8
	30	245.946	491.892	983.784	1475.676	1967.568	2459.46	4918.92	9837.84	14756.76	19675.68	24594.6	29513.52	34432.44	39351.36	44270.28	49189.2
	40	327.928	655.856	1311.712	1967.568	2623.424	3279.28	6558.56	13117.12	19675.68	26234.24	32792.8	39351.36	45909.92	52468.48	59027.04	65585.6
	50	409.91	**819.82**	1639.64	2459.46	3279.28	4099.1	8198.2	16396.4	24594.6	32792.8	40991	49189.2	57387.4	65585.6	73783.8	81982
	60	491.892	983.784	1967.568	2951.352	3935.136	4918.92	9837.84	19675.68	29513.52	39351.36	49189.2	59027.04	68864.88	78702.72	88540.56	98378.4
	70	573.874	1147.748	2295.496	3443.244	4590.992	5738.74	11477.48	22954.96	34432.44	45909.92	57387.4	68864.88	80342.36	91819.84	103297.3	114774.8
	80	655.856	1311.712	2623.424	3935.136	5246.848	6558.56	13117.12	26234.24	39351.36	52468.48	65585.6	78702.72	91819.84	104937	118054.1	131171.2
	90	737.838	1475.676	2951.352	4427.028	5902.704	7378.38	14756.76	29513.52	44270.28	59027.04	73783.8	88540.56	103297.3	118054.1	132810.8	147567.6
	100	819.82	1639.64	3279.28	4918.92	6558.56	8198.2	16396.4	32792.8	49189.2	65585.6	81982	98378.4	114774.8	131171.2	147567.6	163964

Table 89 Displacement matrices – operation and maintenance phase for razorbill (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement (%)		CWP															
	1	0.30	0.61	1.22	1.83	2.43	3.04	6.08	12.17	18.25	24.34	30.42	36.50	42.59	48.67	54.76	60.84
	10	3.04	6.08	12.17	18.25	24.34	30.42	60.84	121.68	182.52	243.36	304.20	365.04	425.88	486.72	547.56	608.40
	20	6.08	12.17	24.34	36.50	48.67	60.84	121.68	243.36	365.04	486.72	608.40	730.08	851.76	973.44	1095.12	1216.80
	30	9.13	18.25	36.50	54.76	73.01	91.26	182.52	365.04	547.56	730.08	912.60	1095.12	1277.64	1460.16	1642.68	1825.20
	40	12.17	24.34	48.67	73.01	97.34	121.68	243.36	486.72	730.08	973.44	1216.80	1460.16	1703.52	1946.88	2190.24	2433.60
	50	15.21	**30.42**	60.84	91.26	121.68	152.10	304.20	608.40	912.60	1216.80	1521.00	1825.20	2129.40	2433.60	2737.80	3042.00
	60	18.25	36.50	73.01	109.51	146.02	182.52	365.04	730.08	1095.12	1460.16	1825.20	2190.24	2555.28	2920.32	3285.36	3650.40
	70	21.29	42.59	85.18	127.76	170.35	212.94	425.88	851.76	1277.64	1703.52	2129.40	2555.28	2981.16	3407.04	3832.92	4258.80
	80	24.34	48.67	97.34	146.02	194.69	243.36	486.72	973.44	1460.16	1946.88	2433.60	2920.32	3407.04	3893.76	4380.48	4867.20
	90	27.38	54.76	109.51	164.27	219.02	273.78	547.56	1095.12	1642.68	2190.24	2737.80	3285.36	3832.92	4380.48	4928.04	5475.60
	100	30.42	60.84	121.68	182.52	243.36	304.20	608.40	1216.80	1825.20	2433.60	3042.00	3650.40	4258.80	4867.20	5475.60	6084.00
		CWP + Tier 1															
	1	1.46	2.92	5.85	8.77	11.69	14.62	29.23	58.46	87.69	116.92	146.16	175.39	204.62	233.85	263.08	292.31
	10	14.62	29.23	58.46	87.69	116.92	146.16	292.31	584.62	876.93	1169.24	1461.55	1753.86	2046.17	2338.48	2630.79	2923.10
	20	29.23	58.46	116.92	175.39	233.85	292.31	584.62	1169.24	1753.86	2338.48	2923.10	3507.72	4092.34	4676.96	5261.58	5846.20
	30	43.85	87.69	175.39	263.08	350.77	438.47	876.93	1753.86	2630.79	3507.72	4384.65	5261.58	6138.51	7015.44	7892.37	8769.30
	40	58.46	116.92	233.85	350.77	467.70	584.62	1169.24	2338.48	3507.72	4676.96	5846.20	7015.44	8184.68	9353.92	10523.16	11692.40
	50	73.08	**146.16**	292.31	438.47	584.62	730.78	1461.55	2923.10	4384.65	5846.20	7307.75	8769.30	10230.85	11692.40	13153.95	14615.50
	60	87.69	175.39	350.77	526.16	701.54	876.93	1753.86	3507.72	5261.58	7015.44	8769.30	10523.16	12277.02	14030.88	15784.74	17538.60
	70	102.31	204.62	409.23	613.85	818.47	1023.09	2046.17	4092.34	6138.51	8184.68	10230.85	12277.02	14323.19	16369.36	18415.53	20461.70
	80	116.92	233.85	467.70	701.54	935.39	1169.24	2338.48	4676.96	7015.44	9353.92	11692.40	14030.88	16369.36	18707.84	21046.32	23384.80
	90	131.54	263.08	526.16	789.24	1052.32	1315.40	2630.79	5261.58	7892.37	10523.16	13153.95	15784.74	18415.53	21046.32	23677.11	26307.90
	100	146.16	292.31	584.62	876.93	1169.24	1461.55	2923.10	5846.20	8769.30	11692.40	14615.50	17538.60	20461.70	23384.80	26307.90	29231.00
		CWP + Tier 1 +Tier 2a															
	1	1.96	3.92	7.85	11.77	15.69	19.61	39.23	78.46	117.69	156.92	196.15	235.37	274.60	313.83	353.06	392.29
	10	19.61	39.23	78.46	117.69	156.92	196.15	392.29	784.58	1176.87	1569.16	1961.45	2353.74	2746.03	3138.32	3530.61	3922.90
	20	39.23	78.46	156.92	235.37	313.83	392.29	784.58	1569.16	2353.74	3138.32	3922.90	4707.48	5492.06	6276.64	7061.22	7845.80
	30	58.84	117.69	235.37	353.06	470.75	588.44	1176.87	2353.74	3530.61	4707.48	5884.35	7061.22	8238.09	9414.96	10591.83	11768.70
	40	78.46	156.92	313.83	470.75	627.66	784.58	1569.16	3138.32	4707.48	6276.64	7845.80	9414.96	10984.12	12553.28	14122.44	15691.60
	50	98.07	**196.15**	392.29	588.44	784.58	980.73	1961.45	3922.90	5884.35	7845.80	9807.25	11768.70	13730.15	15691.60	17653.05	19614.50

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	60	117.69	235.37	470.75	706.12	941.50	1176.87	2353.74	4707.48	7061.22	9414.96	11768.70	14122.44	16476.18	18829.92	21183.66	23537.40
	70	137.30	274.60	549.21	823.81	1098.41	1373.02	2746.03	5492.06	8238.09	10984.12	13730.15	16476.18	19222.21	21968.24	24714.27	27460.30
	80	156.92	313.83	627.66	941.50	1255.33	1569.16	3138.32	6276.64	9414.96	12553.28	15691.60	18829.92	21968.24	25106.56	28244.88	31383.20
	90	176.53	353.06	706.12	1059.18	1412.24	1765.31	3530.61	7061.22	10591.83	14122.44	17653.05	21183.66	24714.27	28244.88	31775.49	35306.10
	100	196.15	392.29	784.58	1176.87	1569.16	1961.45	3922.90	7845.80	11768.70	15691.60	19614.50	23537.40	27460.30	31383.20	35306.10	39229.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	1	2.51	5.02	10.05	15.07	20.09	25.11	50.23	100.46	150.68	200.91	251.14	301.37	351.60	401.82	452.05	502.28
	10	25.11	50.23	100.46	150.68	200.91	251.14	502.28	1004.56	1506.84	2009.12	2511.40	3013.68	3515.96	4018.24	4520.52	5022.80
	20	50.23	100.46	200.91	301.37	401.82	502.28	1004.56	2009.12	3013.68	4018.24	5022.80	6027.36	7031.92	8036.48	9041.04	10045.60
	30	75.34	150.68	301.37	452.05	602.74	753.42	1506.84	3013.68	4520.52	6027.36	7534.20	9041.04	10547.88	12054.72	13561.56	15068.40
	40	100.46	200.91	401.82	602.74	803.65	1004.56	2009.12	4018.24	6027.36	8036.48	10045.60	12054.72	14063.84	16072.96	18082.08	20091.20
	50	125.57	**251.14**	502.28	753.42	1004.56	1255.70	2511.40	5022.80	7534.20	10045.60	12557.00	15068.40	17579.80	20091.20	22602.60	25114.00
	60	150.68	301.37	602.74	904.10	1205.47	1506.84	3013.68	6027.36	9041.04	12054.72	15068.40	18082.08	21095.76	24109.44	27123.12	30136.80
	70	175.80	351.60	703.19	1054.79	1406.38	1757.98	3515.96	7031.92	10547.88	14063.84	17579.80	21095.76	24611.72	28127.68	31643.64	35159.60
	80	200.91	401.82	803.65	1205.47	1607.30	2009.12	4018.24	8036.48	12054.72	16072.96	20091.20	24109.44	28127.68	32145.92	36164.16	40182.40
	90	226.03	452.05	904.10	1356.16	1808.21	2260.26	4520.52	9041.04	13561.56	18082.08	22602.60	27123.12	31643.64	36164.16	40684.68	45205.20
	100	251.14	502.28	1004.56	1506.84	2009.12	2511.40	5022.80	10045.60	15068.40	20091.20	25114.00	30136.80	35159.60	40182.40	45205.20	50228.00

Puffin

Table 90 Displacement matrices – operation and maintenance phase for puffin (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)		**CWP**															
	1	0.01	0.02	0.04	0.06	0.08	0.10	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
	10	0.10	0.20	0.40	0.60	0.80	1.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00
	20	0.20	0.40	0.80	1.20	1.60	2.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00
	30	0.30	0.60	1.20	1.80	2.40	3.00	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00
	40	0.40	0.80	1.60	2.40	3.20	4.00	8.00	16.00	24.00	32.00	40.00	48.00	56.00	64.00	72.00	80.00
	50	0.50	**1.00**	2.00	3.00	4.00	5.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
	60	0.60	1.20	2.40	3.60	4.80	6.00	12.00	24.00	36.00	48.00	60.00	72.00	84.00	96.00	108.00	120.00
	70	0.70	1.40	2.80	4.20	5.60	7.00	14.00	28.00	42.00	56.00	70.00	84.00	98.00	112.00	126.00	140.00
	80	0.80	1.60	3.20	4.80	6.40	8.00	16.00	32.00	48.00	64.00	80.00	96.00	112.00	128.00	144.00	160.00
	90	0.90	1.80	3.60	5.40	7.20	9.00	18.00	36.00	54.00	72.00	90.00	108.00	126.00	144.00	162.00	180.00
	100	1.00	2.00	4.00	6.00	8.00	10.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00
		CWP + Tier 1															
	1	0.15	0.29	0.58	0.88	1.17	1.46	2.92	5.84	8.77	11.69	14.61	17.53	20.45	23.38	26.30	29.22
	10	1.46	2.92	5.84	8.77	11.69	14.61	29.22	58.44	87.66	116.88	146.10	175.32	204.54	233.76	262.98	292.20
	20	2.92	5.84	11.69	17.53	23.38	29.22	58.44	116.88	175.32	233.76	292.20	350.64	409.08	467.52	525.96	584.40
	30	4.38	8.77	17.53	26.30	35.06	43.83	87.66	175.32	262.98	350.64	438.30	525.96	613.62	701.28	788.94	876.60
	40	5.84	11.69	23.38	35.06	46.75	58.44	116.88	233.76	350.64	467.52	584.40	701.28	818.16	935.04	1051.92	1168.80
	50	7.31	**14.61**	29.22	43.83	58.44	73.05	146.10	292.20	438.30	584.40	730.50	876.60	1022.70	1168.80	1314.90	1461.00
	60	8.77	17.53	35.06	52.60	70.13	87.66	175.32	350.64	525.96	701.28	876.60	1051.92	1227.24	1402.56	1577.88	1753.20
	70	10.23	20.45	40.91	61.36	81.82	102.27	204.54	409.08	613.62	818.16	1022.70	1227.24	1431.78	1636.32	1840.86	2045.40
	80	11.69	23.38	46.75	70.13	93.50	116.88	233.76	467.52	701.28	935.04	1168.80	1402.56	1636.32	1870.08	2103.84	2337.60
	90	13.15	26.30	52.60	78.89	105.19	131.49	262.98	525.96	788.94	1051.92	1314.90	1577.88	1840.86	2103.84	2366.82	2629.80
	100	14.61	29.22	58.44	87.66	116.88	146.10	292.20	584.40	876.60	1168.80	1461.00	1753.20	2045.40	2337.60	2629.80	2922.00
		CWP + Tier 1 +Tier 2a															
	1	0.15	0.29	0.59	0.88	1.18	1.47	2.94	5.89	8.83	11.78	14.72	17.66	20.61	23.55	26.50	29.44
	10	1.47	2.94	5.89	8.83	11.78	14.72	29.44	58.88	88.32	117.76	147.20	176.64	206.08	235.52	264.96	294.40
	20	2.94	5.89	11.78	17.66	23.55	29.44	58.88	117.76	176.64	235.52	294.40	353.28	412.16	471.04	529.92	588.80
	30	4.42	8.83	17.66	26.50	35.33	44.16	88.32	176.64	264.96	353.28	441.60	529.92	618.24	706.56	794.88	883.20
	40	5.89	11.78	23.55	35.33	47.10	58.88	117.76	235.52	353.28	471.04	588.80	706.56	824.32	942.08	1059.84	1177.60
	50	7.36	**14.72**	29.44	44.16	58.88	73.60	147.20	294.40	441.60	588.80	736.00	883.20	1030.40	1177.60	1324.80	1472.00

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	60	8.83	17.66	35.33	52.99	70.66	88.32	176.64	353.28	529.92	706.56	883.20	1059.84	1236.48	1413.12	1589.76	1766.40
	70	10.30	20.61	41.22	61.82	82.43	103.04	206.08	412.16	618.24	824.32	1030.40	1236.48	1442.56	1648.64	1854.72	2060.80
	80	11.78	23.55	47.10	70.66	94.21	117.76	235.52	471.04	706.56	942.08	1177.60	1413.12	1648.64	1884.16	2119.68	2355.20
	90	13.25	26.50	52.99	79.49	105.98	132.48	264.96	529.92	794.88	1059.84	1324.80	1589.76	1854.72	2119.68	2384.64	2649.60
	100	14.72	29.44	58.88	88.32	117.76	147.20	294.40	588.80	883.20	1177.60	1472.00	1766.40	2060.80	2355.20	2649.60	2944.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	1	0.15	0.30	0.59	0.89	1.19	1.49	2.97	5.95	8.92	11.90	14.87	17.84	20.82	23.79	26.77	29.74
	10	1.49	2.97	5.95	8.92	11.90	14.87	29.74	59.48	89.22	118.96	148.70	178.44	208.18	237.92	267.66	297.40
	20	2.97	5.95	11.90	17.84	23.79	29.74	59.48	118.96	178.44	237.92	297.40	356.88	416.36	475.84	535.32	594.80
	30	4.46	8.92	17.84	26.77	35.69	44.61	89.22	178.44	267.66	356.88	446.10	535.32	624.54	713.76	802.98	892.20
	40	5.95	11.90	23.79	35.69	47.58	59.48	118.96	237.92	356.88	475.84	594.80	713.76	832.72	951.68	1070.64	1189.60
	50	7.44	**14.87**	29.74	44.61	59.48	74.35	148.70	297.40	446.10	594.80	743.50	892.20	1040.90	1189.60	1338.30	1487.00
	60	8.92	17.84	35.69	53.53	71.38	89.22	178.44	356.88	535.32	713.76	892.20	1070.64	1249.08	1427.52	1605.96	1784.40
	70	10.41	20.82	41.64	62.45	83.27	104.09	208.18	416.36	624.54	832.72	1040.90	1249.08	1457.26	1665.44	1873.62	2081.80
	80	11.90	23.79	47.58	71.38	95.17	118.96	237.92	475.84	713.76	951.68	1189.60	1427.52	1665.44	1903.36	2141.28	2379.20
	90	13.38	26.77	53.53	80.30	107.06	133.83	267.66	535.32	802.98	1070.64	1338.30	1605.96	1873.62	2141.28	2408.94	2676.60
	100	14.87	29.74	59.48	89.22	118.96	148.70	297.40	594.80	892.20	1189.60	1487.00	1784.40	2081.80	2379.20	2676.60	2974.00

Red-throated diver

Table 91 Displacement matrices – operation and maintenance phase for red-throated diver (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
Displacement (%)	CWP																
	1	0.02	0.05	0.09	0.14	0.18	0.23	0.46	0.92	1.37	1.83	2.29	2.75	3.21	3.66	4.12	4.58
	10	0.23	0.46	0.92	1.37	1.83	2.29	4.58	9.16	13.74	18.32	22.90	27.48	32.06	36.64	41.22	45.80
	20	0.46	0.92	1.83	2.75	3.66	4.58	9.16	18.32	27.48	36.64	45.80	54.96	64.12	73.28	82.44	91.60
	30	0.69	1.37	2.75	4.12	5.50	6.87	13.74	27.48	41.22	54.96	68.70	82.44	96.18	109.92	123.66	137.40
	40	0.92	1.83	3.66	5.50	7.33	9.16	18.32	36.64	54.96	73.28	91.60	109.92	128.24	146.56	164.88	183.20
	50	1.15	2.29	4.58	6.87	9.16	11.45	22.90	45.80	68.70	91.60	114.50	137.40	160.30	183.20	206.10	229.00
	60	1.37	2.75	5.50	8.24	10.99	13.74	27.48	54.96	82.44	109.92	137.40	164.88	192.36	219.84	247.32	274.80
	70	1.60	3.21	6.41	9.62	12.82	16.03	32.06	64.12	96.18	128.24	160.30	192.36	224.42	256.48	288.54	320.60
	80	1.83	3.66	7.33	10.99	14.66	18.32	36.64	73.28	109.92	146.56	183.20	219.84	256.48	293.12	329.76	366.40
	90	2.06	4.12	8.24	12.37	16.49	20.61	41.22	82.44	123.66	164.88	206.10	247.32	288.54	329.76	370.98	412.20
	100	2.29	**4.58**	9.16	13.74	18.32	22.90	45.80	91.60	137.40	183.20	229.00	274.80	320.60	366.40	412.20	458.00
	CWP + Tier 1																
	1	0.03	0.06	0.13	0.19	0.26	0.32	0.64	1.28	1.92	2.56	3.21	3.85	4.49	5.13	5.77	6.41
	10	0.32	0.64	1.28	1.92	2.56	3.21	6.41	12.82	19.23	25.64	32.05	38.46	44.87	51.28	57.69	64.10
	20	0.64	1.28	2.56	3.85	5.13	6.41	12.82	25.64	38.46	51.28	64.10	76.92	89.74	102.56	115.38	128.20
	30	0.96	1.92	3.85	5.77	7.69	9.62	19.23	38.46	57.69	76.92	96.15	115.38	134.61	153.84	173.07	192.30
	40	1.28	2.56	5.13	7.69	10.26	12.82	25.64	51.28	76.92	102.56	128.20	153.84	179.48	205.12	230.76	256.40
	50	1.60	3.21	6.41	9.62	12.82	16.03	32.05	64.10	96.15	128.20	160.25	192.30	224.35	256.40	288.45	320.50
	60	1.92	3.85	7.69	11.54	15.38	19.23	38.46	76.92	115.38	153.84	192.30	230.76	269.22	307.68	346.14	384.60
	70	2.24	4.49	8.97	13.46	17.95	22.44	44.87	89.74	134.61	179.48	224.35	269.22	314.09	358.96	403.83	448.70
	80	2.56	5.13	10.26	15.38	20.51	25.64	51.28	102.56	153.84	205.12	256.40	307.68	358.96	410.24	461.52	512.80
	90	2.88	5.77	11.54	17.31	23.08	28.85	57.69	115.38	173.07	230.76	288.45	346.14	403.83	461.52	519.21	576.90
	100	3.21	**6.41**	12.82	19.23	25.64	32.05	64.10	128.20	192.30	256.40	320.50	384.60	448.70	512.80	576.90	641.00
	CWP + Tier 1 +Tier 2a																
	1	0.03	0.07	0.13	0.20	0.26	0.33	0.65	1.30	1.95	2.60	3.26	3.91	4.56	5.21	5.86	6.51
	10	0.33	0.65	1.30	1.95	2.60	3.26	6.51	13.02	19.53	26.04	32.55	39.06	45.57	52.08	58.59	65.10
	20	0.65	1.30	2.60	3.91	5.21	6.51	13.02	26.04	39.06	52.08	65.10	78.12	91.14	104.16	117.18	130.20
	30	0.98	1.95	3.91	5.86	7.81	9.77	19.53	39.06	58.59	78.12	97.65	117.18	136.71	156.24	175.77	195.30
	40	1.30	2.60	5.21	7.81	10.42	13.02	26.04	52.08	78.12	104.16	130.20	156.24	182.28	208.32	234.36	260.40
	50	1.63	3.26	6.51	9.77	13.02	16.28	32.55	65.10	97.65	130.20	162.75	195.30	227.85	260.40	292.95	325.50

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	60	1.95	3.91	7.81	11.72	15.62	19.53	39.06	78.12	117.18	156.24	195.30	234.36	273.42	312.48	351.54	390.60
	70	2.28	4.56	9.11	13.67	18.23	22.79	45.57	91.14	136.71	182.28	227.85	273.42	318.99	364.56	410.13	455.70
	80	2.60	5.21	10.42	15.62	20.83	26.04	52.08	104.16	156.24	208.32	260.40	312.48	364.56	416.64	468.72	520.80
	90	2.93	5.86	11.72	17.58	23.44	29.30	58.59	117.18	175.77	234.36	292.95	351.54	410.13	468.72	527.31	585.90
	100	3.26	**6.51**	13.02	19.53	26.04	32.55	65.10	130.20	195.30	260.40	325.50	390.60	455.70	520.80	585.90	651.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	1	0.05	0.10	0.21	0.31	0.41	0.51	1.03	2.05	3.08	4.10	5.13	6.16	7.18	8.21	9.23	10.26
	10	0.51	1.03	2.05	3.08	4.10	5.13	10.26	20.52	30.78	41.04	51.30	61.56	71.82	82.08	92.34	102.60
	20	1.03	2.05	4.10	6.16	8.21	10.26	20.52	41.04	61.56	82.08	102.60	123.12	143.64	164.16	184.68	205.20
	30	1.54	3.08	6.16	9.23	12.31	15.39	30.78	61.56	92.34	123.12	153.90	184.68	215.46	246.24	277.02	307.80
	40	2.05	4.10	8.21	12.31	16.42	20.52	41.04	82.08	123.12	164.16	205.20	246.24	287.28	328.32	369.36	410.40
	50	2.57	5.13	10.26	15.39	20.52	25.65	51.30	102.60	153.90	205.20	256.50	307.80	359.10	410.40	461.70	513.00
	60	3.08	6.16	12.31	18.47	24.62	30.78	61.56	123.12	184.68	246.24	307.80	369.36	430.92	492.48	554.04	615.60
	70	3.59	7.18	14.36	21.55	28.73	35.91	71.82	143.64	215.46	287.28	359.10	430.92	502.74	574.56	646.38	718.20
	80	4.10	8.21	16.42	24.62	32.83	41.04	82.08	164.16	246.24	328.32	410.40	492.48	574.56	656.64	738.72	820.80
	90	4.62	9.23	18.47	27.70	36.94	46.17	92.34	184.68	277.02	369.36	461.70	554.04	646.38	738.72	831.06	923.40
	100	5.13	**10.26**	20.52	30.78	41.04	51.30	102.60	205.20	307.80	410.40	513.00	615.60	718.20	820.80	923.40	1026.00

Table 92 Displacement matrices – operation and maintenance phase for gannet (value shown in bold represents central value used in impact assessment)

		Mortality (%)															
		0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Displacement (%)	**CWP**																
	1	0.01	0.03	0.05	0.08	0.11	0.13	0.27	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65
	10	0.13	0.27	0.53	0.80	1.06	1.33	2.65	5.30	7.95	10.60	13.25	15.90	18.55	21.20	23.85	26.50
	20	0.27	0.53	1.06	1.59	2.12	2.65	5.30	10.60	15.90	21.20	26.50	31.80	37.10	42.40	47.70	53.00
	30	0.40	0.80	1.59	2.39	3.18	3.98	7.95	15.90	23.85	31.80	39.75	47.70	55.65	63.60	71.55	79.50
	40	0.53	1.06	2.12	3.18	4.24	5.30	10.60	21.20	31.80	42.40	53.00	63.60	74.20	84.80	95.40	106.00
	50	0.66	1.33	2.65	3.98	5.30	6.63	13.25	26.50	39.75	53.00	66.25	79.50	92.75	106.00	119.25	132.50
	60	0.80	1.59	3.18	4.77	6.36	7.95	15.90	31.80	47.70	63.60	79.50	95.40	111.30	127.20	143.10	159.00
	70	0.93	**1.86**	3.71	5.57	7.42	9.28	18.55	37.10	55.65	74.20	92.75	111.30	129.85	148.40	166.95	185.50
	80	1.06	2.12	4.24	6.36	8.48	10.60	21.20	42.40	63.60	84.80	106.00	127.20	148.40	169.60	190.80	212.00
	90	1.19	2.39	4.77	7.16	9.54	11.93	23.85	47.70	71.55	95.40	119.25	143.10	166.95	190.80	214.65	238.50
	100	1.33	2.65	5.30	7.95	10.60	13.25	26.50	53.00	79.50	106.00	132.50	159.00	185.50	212.00	238.50	265.00
	CWP + Tier 1																
	1	0.26	0.53	1.06	1.59	2.11	2.64	5.29	10.57	15.86	21.15	26.44	31.72	37.01	42.30	47.58	52.87
	10	2.64	5.29	10.57	15.86	21.15	26.44	52.87	105.74	158.61	211.48	264.35	317.22	370.09	422.96	475.83	528.70
	20	5.29	10.57	21.15	31.72	42.30	52.87	105.74	211.48	317.22	422.96	528.70	634.44	740.18	845.92	951.66	1057.40
	30	7.93	15.86	31.72	47.58	63.44	79.31	158.61	317.22	475.83	634.44	793.05	951.66	1110.27	1268.88	1427.49	1586.10
	40	10.57	21.15	42.30	63.44	84.59	105.74	211.48	422.96	634.44	845.92	1057.40	1268.88	1480.36	1691.84	1903.32	2114.80
	50	13.22	26.44	52.87	79.31	105.74	132.18	264.35	528.70	793.05	1057.40	1321.75	1586.10	1850.45	2114.80	2379.15	2643.50
	60	15.86	31.72	63.44	95.17	126.89	158.61	317.22	634.44	951.66	1268.88	1586.10	1903.32	2220.54	2537.76	2854.98	3172.20
	70	18.50	**37.01**	74.02	111.03	148.04	185.05	370.09	740.18	1110.27	1480.36	1850.45	2220.54	2590.63	2960.72	3330.81	3700.90
	80	21.15	42.30	84.59	126.89	169.18	211.48	422.96	845.92	1268.88	1691.84	2114.80	2537.76	2960.72	3383.68	3806.64	4229.60
	90	23.79	47.58	95.17	142.75	190.33	237.92	475.83	951.66	1427.49	1903.32	2379.15	2854.98	3330.81	3806.64	4282.47	4758.30
	100	26.44	52.87	105.74	158.61	211.48	264.35	528.70	1057.40	1586.10	2114.80	2643.50	3172.20	3700.90	4229.60	4758.30	5287.00
	CWP + Tier 1 +Tier 2a																
	1	0.33	0.67	1.33	2.00	2.66	3.33	6.65	13.31	19.96	26.61	33.27	39.92	46.57	53.22	59.88	66.53
	10	3.33	6.65	13.31	19.96	26.61	33.27	66.53	133.06	199.59	266.12	332.65	399.18	465.71	532.24	598.77	665.30
	20	6.65	13.31	26.61	39.92	53.22	66.53	133.06	266.12	399.18	532.24	665.30	798.36	931.42	1064.48	1197.54	1330.60
	30	9.98	19.96	39.92	59.88	79.84	99.80	199.59	399.18	598.77	798.36	997.95	1197.54	1397.13	1596.72	1796.31	1995.90
	40	13.31	26.61	53.22	79.84	106.45	133.06	266.12	532.24	798.36	1064.48	1330.60	1596.72	1862.84	2128.96	2395.08	2661.20
	50	16.63	33.27	66.53	99.80	133.06	166.33	332.65	665.30	997.95	1330.60	1663.25	1995.90	2328.55	2661.20	2993.85	3326.50

		Mortality (%)															
		0.5	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
	60	19.96	39.92	79.84	119.75	159.67	199.59	399.18	798.36	1197.54	1596.72	1995.90	2395.08	2794.26	3193.44	3592.62	3991.80
	70	23.29	**46.57**	93.14	139.71	186.28	232.86	465.71	931.42	1397.13	1862.84	2328.55	2794.26	3259.97	3725.68	4191.39	4657.10
	80	26.61	53.22	106.45	159.67	212.90	266.12	532.24	1064.48	1596.72	2128.96	2661.20	3193.44	3725.68	4257.92	4790.16	5322.40
	90	29.94	59.88	119.75	179.63	239.51	299.39	598.77	1197.54	1796.31	2395.08	2993.85	3592.62	4191.39	4790.16	5388.93	5987.70
	100	33.27	66.53	133.06	199.59	266.12	332.65	665.30	1330.60	1995.90	2661.20	3326.50	3991.80	4657.10	5322.40	5987.70	6653.00
		CWP + Tier 1 +Tier 2a + Tier 2b															
	1	0.37	0.75	1.49	2.24	2.98	3.73	7.46	14.91	22.37	29.82	37.28	44.74	52.19	59.65	67.10	74.56
	10	3.73	7.46	14.91	22.37	29.82	37.28	74.56	149.12	223.68	298.24	372.80	447.36	521.92	596.48	671.04	745.60
	20	7.46	14.91	29.82	44.74	59.65	74.56	149.12	298.24	447.36	596.48	745.60	894.72	1043.84	1192.96	1342.08	1491.20
	30	11.18	22.37	44.74	67.10	89.47	111.84	223.68	447.36	671.04	894.72	1118.40	1342.08	1565.76	1789.44	2013.12	2236.80
	40	14.91	29.82	59.65	89.47	119.30	149.12	298.24	596.48	894.72	1192.96	1491.20	1789.44	2087.68	2385.92	2684.16	2982.40
	50	18.64	37.28	74.56	111.84	149.12	186.40	372.80	745.60	1118.40	1491.20	1864.00	2236.80	2609.60	2982.40	3355.20	3728.00
	60	22.37	44.74	89.47	134.21	178.94	223.68	447.36	894.72	1342.08	1789.44	2236.80	2684.16	3131.52	3578.88	4026.24	4473.60
	70	26.10	**52.19**	104.38	156.58	208.77	260.96	521.92	1043.84	1565.76	2087.68	2609.60	3131.52	3653.44	4175.36	4697.28	5219.20
	80	29.82	59.65	119.30	178.94	238.59	298.24	596.48	1192.96	1789.44	2385.92	2982.40	3578.88	4175.36	4771.84	5368.32	5964.80
	90	33.55	67.10	134.21	201.31	268.42	335.52	671.04	1342.08	2013.12	2684.16	3355.20	4026.24	4697.28	5368.32	6039.36	6710.40
	100	37.28	74.56	149.12	223.68	298.24	372.80	745.60	1491.20	2236.80	2982.40	3728.00	4473.60	5219.20	5964.80	6710.40	7456.00

ANNEX C - COLLISION MORTALITY OF RECEPTORS AT PROJECTS CONSIDERED IN CEA IN RELATION TO COLLISION

1.16 Kittiwake

Table 93 Kittiwake collision mortality values for other screened in plans and projects

Project	Tier	Predicted mortality	Source / Justification
Awel-y-Mor	1	53.86	Awel-y-Mor. ES, Volume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	22.26	Morecambe. PEIR, Volume 1, Chapter 12
North Hoyle	1		No data
Walney Extension 3 + 4	1	187.60	Morecambe. PEIR, Volume 1, Chapter 12
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1	2.16	Morecambe. PEIR, Volume 1, Chapter 12
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1	10.80	Morecambe. PEIR, Volume 1, Chapter 12
Erebus	1	58	Morgan. PEIR, Volume 2, Chapter 10
Morgan	1	39.81	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	32.00	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	37.10	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	18.28	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	61.74	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	264.15	Phase 1 project consultation shared figure
Other screened in projects	NA - no potential impact-receptor-pathway		

1.17 Great black-backed gull

Table 94 Great black-backed gull collision mortality values for other screened in plans and projects

Project	Tier	Predicted mortality	Source / Justification
Awel-y-Mor	1	4.87	Morecambe. PEIR, Volume 1, Chapter 12
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1		No data
North Hoyle	1		No data
Walney Extension 3 + 4	1	16.20	Walney Extension 4 EIAR – amended reflect updated 0.994 avoidance rate from 0.99 used in project
West of Duddon Sands	1		No data
Walney 1 + 2	1	12.30	Morecambe. PEIR, Volume 1, Chapter 12
Burbo Bank	1		No data
Ormonde	1	0.28	Morecambe. PEIR, Volume 1, Chapter 12
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1		Phase 1 project consultation shared figure
Erebus	1	1.00	Morgan. PEIR, Volume 2, Chapter 10
Morgan	1	2.81	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	0.98	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	7.40	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	4.15	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	25.40	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	65.91	Phase 1 project consultation shared figure
Other screened in projects	NA - no potential impact-receptor-pathway		

1.18 Herring gull

Table 95 Herring gull collision mortality values for other screened in plans and projects

Project	Tier	Predicted mortality	Source / Justification
Awel-y-Mor	1	2.96	Morecambe. PEIR, Volume 1, Chapter 12
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	28.32	Morecambe. PEIR, Volume 1, Chapter 12
North Hoyle	1		No data
Walney Extension 3 + 4	1	32.70	Walney Extension 4 EIAR – amended reflect updated 0.994 avoidance rate from 0.99 used in project
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1	0.44	Morecambe. PEIR, Volume 1, Chapter 12
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1	22.90	Morecambe. PEIR, Volume 1, Chapter 12
Erebus	1	3.00	Morgan. PEIR, Volume 2, Chapter 10
Morgan	1	11.80	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	3.42	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	2.00	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	27.41	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	93.97	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	93.29	Phase 1 project consultation shared figure
Other screened in projects	NA - no potential impact-receptor-pathway		

1.19 Common tern

Table 96 Common tern collision mortality values for other screened in plans and projects

Project	Tier	Predicted mortality	Source / Justification
Awel-y-Mor	1	0.2	Awel-y-Mor. ES, Volume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	9	Burbo Bank Extension ES
North Hoyle	1		No data
Walney Extension 3 + 4	1		No data
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1		No data
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1		No data
Erebus	1		No data
Morgan	1		No data
Morecambe	1	0.17	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1		No data
White Cross	1		No data
Codling	2a	2.27	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	3.70	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	8.60	Phase 1 project consultation shared figure
Other screened in projects	NA - no potential impact-receptor-pathway		

1.20 Gannet

Table 97 Gannet collision mortality values for other screened in plans and projects

Project	Tier	Predicted mortality	Source / Justification
Awel-y-Mor	1	20.49	Awel-y-Mor. ES, Volume 2, Chapter 4
Gwynt y Mor	1		No data
Rhyl Flats	1		No data
Burbo Bank Extension	1	3.57	Morecambe. PEIR, Volume 1, Chapter 12
North Hoyle	1		No data
Walney Extension 3 + 4	1	37.40	Morecambe. PEIR, Volume 1, Chapter 12
West of Duddon Sands	1		No data
Walney 1 + 2	1		No data
Burbo Bank	1		No data
Ormonde	1	2.00	Morecambe. PEIR, Volume 1, Chapter 12
Barrow	1		No data
Robin Rigg	1		No data
Arklow Bank Phase 1	1		No data
Twin Hub	1	11.97	Morecambe. PEIR, Volume 1, Chapter 12
Erebus	1	7.01	Morecambe. PEIR, Volume 1, Chapter 12
Morgan	1	2.15	Morgan. PEIR, Volume 2, Chapter 10
Morecambe	1	1.81	Morecambe. PEIR, Volume 1, Chapter 12
Mona	1	2.50	Morgan. PEIR, Volume 2, Chapter 10
White Cross	1		No data
Codling	2a	0.27	Phase 1 project consultation shared figure
Other Tier 2a projects (Dublin Array and NISA)	2a	4.83	Phase 1 project consultation shared figure
Tier 2b projects (Oriel and Arklow)	2b	21.72	Phase 1 project consultation shared figure
Other screened in projects	NA - no potential impact-receptor-pathway		

ANNEX D - CUMULATIVE PVA PARAMETERS

1.21 Guillemot – displacement

1.21.1 Set up

Log file was created on: 2023-12-22 14:09:19 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7). Software package versions shown in **Table D.1**

Package	Version
popbio	2.4.4
shiny	1.1.0
shinyjs	1.0
shinydashboard	0.7.1
shinyWidgets	0.4.5
DT	0.5
plotly	4.8.0
rmarkdown	1.10
dplyr	0.7.6
tidyr	0.8.1

1.21.2 Basic information

This run had reference name “”.

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 2744.

Years for burn-in: 0.

Case study selected: None.

1.21.3 Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 1332663 in 2023

Productivity rate per pair: mean: 0.5826832 , sd: 0.1894517

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

1.21.4 Impacts

Number of impact scenarios: 4.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on demographic rates

Scenario A - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00018 , se: NA

Scenario B - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00105 , se: NA

Scenario C - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0016 , se: NA

Scenario D - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00172 , se: NA

1.21.5 Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

How should outputs be produced, in terms of ages?: breeding.pairs

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

1.22 Kittiwake – collision

1.22.1 Set up

Log file was created on: 2023-12-20 15:37:05 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7). Software package versions shown in **Table D.1**

Package	Version
popbio	2.4.4
shiny	1.1.0
shinyjs	1.0
shinydashboard	0.7.1
shinyWidgets	0.4.5
DT	0.5
plotly	4.8.0
rmarkdown	1.10
dplyr	0.7.6
tidyr	0.8.1

1.22.2 Basic information

This run had reference name "".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 2744.

Years for burn-in: 0.

Case study selected: None.

1.22.3 Baseline demographic rates

Species chosen to set initial values: Black-Legged Kittiwake.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 4.

Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 933172 in 2023

Productivity rate per pair: mean: 0.6036278 , sd: 0.325783

Adult survival rate: mean: 0.854 , sd: 0.077

Immatures survival rates:

Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA

Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA

Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA

Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

1.22.4 Impacts

Number of impact scenarios: 4.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on demographic rates

Scenario A - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2e-05 , se: NA

Scenario B - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00049 , se: NA

Scenario C - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00056 , se: NA

Scenario D - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00084 , se: NA

1.22.5 Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

How should outputs be produced, in terms of ages?: breeding.pairs

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

1.23 Great-black-backed gull – collision

1.23.1 Set up

Log file was created on: 2023-12-20 15:37:05 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7). Software package versions shown in **Table D.1**

Package	Version
popbio	2.4.4
shiny	1.1.0
shinyjs	1.0
shinydashboard	0.7.1
shinyWidgets	0.4.5
DT	0.5
plotly	4.8.0
rmarkdown	1.10
dplyr	0.7.6
tidyr	0.8.1

1.23.2 Basic information

This run had reference name "".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 2744.

Years for burn-in: 0. [Model would not run with burn-in included]

Case study selected: None.

1.23.3 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 53405 in 2023

Productivity rate per pair: mean: 0.9707373 , sd: 0.435337

Adult survival rate: mean: 0.93 , sd: 0.001

Immatures survival rates:

Age class 0 to 1 - mean: 0.93 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.93 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 0.001 , DD: NA

1.23.4 Impacts

Number of impact scenarios: 8.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on demographic rates

Scenario A - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-05 , se: NA

Scenario B - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00094 , se: NA

Scenario C - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00141 , se: NA

Scenario D - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00265 , se: NA

Scenario E - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-05 , se: NA

Scenario F - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00093 , se: NA

Scenario G - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0014 , se: NA

Scenario H - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00264 , se: NA

1.23.5 Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

How should outputs be produced, in terms of ages?: breeding.pairs

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

1.24 Herring gull – collision

1.24.1 Set up

Log file was created on: 2023-12-19 22:18:28 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7). Software package versions shown in **Table D.1**

Package	Version
popbio	2.4.4
shiny	1.1.0
shinyjs	1.0
shinydashboard	0.7.1
shinyWidgets	0.4.5
DT	0.5
plotly	4.8.0
rmarkdown	1.10
dplyr	0.7.6
tidyr	0.8.1

1.24.2 Basic information

This run had reference name "".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 2744.

Years for burn-in: 0. [Model would not run with burn-in included]

Case study selected: None.

1.24.3 Baseline demographic rates

Species chosen to set initial values: Herring Gull.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 53405 in 187090

Productivity rate per pair: mean: 0.6146853 , sd: 0.4759263

Adult survival rate: mean: 0.834 , sd: 0.079

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 0.079 , DD: NA

Age class 1 to 2 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.079 , DD: NA

1.24.4 Impacts

Number of impact scenarios: 8.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on demographic rates

Scenario A - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00015 , se: NA

Scenario B - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00072 , se: NA

Scenario C - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00122 , se: NA

Scenario D - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00172 , se: NA

Scenario E - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00012 , se: NA

Scenario F - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-04 , se: NA

Scenario G - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0012 , se: NA

Scenario H - Name:

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0017 , se: NA

1.24.5 Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

How should outputs be produced, in terms of ages?: breeding.pairs

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA