Morecambe Offshore Windfarm: Generation Assets

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Glossary of Acronyms

AR	Avoidance Rate
BDMPS	Biologically Defined Minimum Population Scales
CEA	Cumulative Effect Assessment
CPGR	Counterfactual of Population Growth Rate
CPS	Counterfactual of Population Size
CRM	Collision Risk Model
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
ExA	Examining Authority
HAT	Highest Astronomical Tide
LCL	Lower Confidence Limit
MERP	Marine Ecosystems Research Programme
NRW	Natural Resources Wales
OSP	Offshore substation platform
OWF	Offshore windfarm
PVA	Population Viability Analysis
RR	Relevant Representation
sCRM	Stochastic Collision Risk Model
SD	Standard deviation
SNCB	Statutory Nature Conservation Body
TCE	The Crown Estate
UCL	Upper Confidence Limit
UK	United Kingdom
WTG	Wind turbine generators

Glossary of Unit Terms

km	kilometre
km^2	square kilometre
m	metre
MW	Megawatt

Glossary of Terminology

Applicant	Morecambe Offshore Windfarm Ltd
Biologically defined minimum population scale (BDMPS)	The estimated population size of a species within a defined biogeographic area during a biologically relevant season, as defined by Furness (2015). For many seabird species present in United Kingdom (UK) waters there are two defined biogeographic areas; UK Western waters and UK North Sea and Channel. However, some species have different defined BDMPS areas, dependent on the distribution and movements of the species population through the year. Furness (2015) defines the BDMPS for non-breeding seasons; the breeding season BDMPS is defined as the breeding population within foraging range from the project, plus non-breeders and immatures.
Generation Assets (the Project)	Generation Assets associated with the Morecambe Offshore Windfarm. This is infrastructure in connection with electricity production, namely the fixed foundation wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s).
Inter-array cables	Cables which link the WTGs to each other and the OSP(s).
Offshore substation platform(s) (OSP(s))	A fixed structure located within the windfarm site, containing electrical equipment to aggregate the power from the WTGs and convert it into a more suitable form for export to shore.
Platform link cable	An electrical cable which links one or more offshore substation platform.
Stochastic Collision Risk Model (sCRM)	A programme used to assess the collision risk (estimated mortality) of seabirds to operational turbines of offshore windfarms. A sCRM is used to account for uncertainty around input variables.
Wind turbine generator (WTG)	A fixed structure located within the windfarm site that converts the kinetic energy of wind into electrical energy.
Windfarm site	The area within which the WTGs, inter-array cables, OSP(s) and platform link cables would be present.

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1 Introduction

1. This document presents an update to the assessment of effects on offshore ornithology receptors presented in Chapter 12 Offshore Ornithology of the Environmental Statement (ES) (REP1-032) submitted as part of the assessment of the Morecambe Offshore Windfarm Generation Assets (the Project) by Morecambe Offshore Windfarm Ltd (the Applicant).

2. The Applicant's response to Relevant Representations (RRs) was provided at Procedural Deadline A (PD1-011). The review and information provided in this note has been undertaken to provide information on outstanding issues from the Natural England Relevant Representations (RR-061) and at the request of the Examining Authority (ExA) in its Rule 9 Letter (PD-006). In addition, updates have been provided to address specific comments from Natural Resources Wales (NRW) in its written representations at Deadline 1 (REP1-099). A summary of the relevant comments received and the Applicant's response, including where specific items are addressed within this document, are provided in **Table 1.1** (Natural England) and **Table 1.2** (NRW). It also provides commentary in **Section 2.1.1** on the August 2024 collision risk guidance as noted in the Rule 8 letter (PD-010).

1.1 Updates at Deadline 3

3. The following updates to this document (Rev 02) have been included at Deadline 3:

- Updated operation and maintenance phase displacement assessment for Manx shearwater to reflect updated seasonal periods for this species, as advised by NRW in its written representations (REP1-099), including updated cumulative assessment incorporating 'gap-filling' of historic projects.
- Updated quantitative assessment of effects on Pen y Gogarth / Great Orme's Head Site of Special Scientific Interest (SSSI) as advised by NRW in its written representations (REP1-099).
- Updates to Examination document references, as appropriate.

Table 1.1 Summary of Natural England relevant representations addressed in this document

Natural England Comment summary	Natural England Reference (RR-061)	Applicant Reference (PD1-011)	Applicant response	Document location
Cumulative assessment methodology. Natural England has requested that historic projects with 'zero' values are 'gap-filled' using a common approach with the Mona and Morgan projects. Natural England requested that this was addressed for the following species: ▪ Guillemot ▪ Little gull ▪ Herring gull ▪ Lesser black-backed gull ▪ Great black-backed gull	B1 B8 B14 B16 B18 B19 B21 (Item 1 of the Rule 9 letter)	RR-061-63 RR-061-70 RR-061-77 RR-061-79 RR-061-80 RR-061-81 RR-061-83	The cumulative assessment has been updated for these species, including 'gap-filled' data for historic projects, following the approach used for the Mona and Morgan Generation projects. The updated cumulative assessments have not resulted in any changes to the conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).	**Section 3**
Average mortality values used in the assessment do not align with Natural England's most recently issued advice.	B9 (Item 3 of the Rule 9 letter)	RR-061-71	The Project alone increase in background mortality estimates have been updated for all species assessed in ES Chapter 12 Offshore Ornithology (REP1-032). The cumulative assessment update has also used the updated mortality rates for applicable species. These updates have not resulted in any changes to the conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).	**Section 2** **Section 3**
There is inconsistency between applied mean peak seasonal values for gannet used in the displacement assessment.	B10	RR-061-72	An update to the assessment for gannet was documented separately in Section 4 of the Applicant's Response to the Rule 9	n/a

Natural England Comment summary	Natural England Reference (RR-061)	Applicant Reference (PD1-011)	Applicant response	Document location
	(Item 4 of the Rule 9 letter)		Letter submitted at Procedural Deadline A (PD1-010) and is not, therefore, included in this document. This update did not result in any changes to the conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).	
Natural England advised that an updated non-breeding season reference population should be used for the great black-backed gull assessment.	B20	RR-061-82	Both the Project alone and cumulative assessment for great black-backed gull have been updated using the revised non-breeding season reference population advised by Natural England. This update has not resulted in any changes to the conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).	**Section 2.2.2** **Section 3.2.2.3**
Natural England advised that the Applicant should consider increase in air gap to further mitigate Project contribution to cumulative effects on great black-backed gull.	B21	RR-061-83	The Applicant has presented a review of the effects of increasing air gap on the assessment conclusions. This has confirmed that increasing air gap from 25m to 28m or 30m above Highest Astronomical Tide (HAT) would make no measurable difference to the cumulative effects on great black-backed gull, and therefore further increase in air gap would not be effective mitigation for the cumulative effects on this species.	**Section 4**

Table 1.2 Summary of Natural Resources Wales written representations addressed in this document

Natural Resources Wales Comment summary (REP1-099)	Applicant Reference (REP2-027)	Applicant response	Document location
The Applicant has applied inconsistent months to the estimation of seasonal mean peak abundances for gannet and Manx shearwater, and advised that these should be updated at the EIA scale and at the HRA scale for applicable Welsh SPAs.	WR-099-11 to WR-099-15	As noted by NRW, corrected values for gannet at the EIA scale were presented in the Applicant's response to the Rule 9 letter (PD1-010). Updates for Manx shearwater at the EIA scale are presented in this document. The updated assessment has not affected the EIA conclusions; i.e. there would be no significant effect on this species. HRA updates for Welsh sites have been provided in Rev 02 of the Offshore Ornithology Technical Note 2 (HRA) (Offshore Ornithology Technical Note 2 (HRA)_Rev 02 Clean).	**Sections 2.2.1.4 and 3.2.1.2**
The Applicant has not 'gap filled' historic projects for the cumulative assessment for projects where mortality data was not available.	WR-099-19 to WR-099-25	The cumulative assessment has been updated for Manx shearwater and other species identified by Natural England (Table 1.1), including 'gap-filled' data for historic projects, following the approach used for the Mona and Morgan Generation projects. The updated cumulative assessments have not resulted in any changes to the conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).	**Section 3**
NRW advise that the Applicant should undertake full quantitative assessments of predicted impacts of displacement of the guillemot and razorbill and collision of the kittiwake features of the Pen-y-Gogarth / Great Orme's Head SSSI.	WR-099-36 to WR-099-41	A full quantitative project alone and cumulative assessment of the effects of the Project on the guillemot, razorbill and kittiwake features of the Pen-y-Gogarth / Great Orme's Head SSSI is presented in this document.	**Section 5**

2 Project-alone effects assessment update

2.1 Approach

4. In accordance with Natural England's RRs (RR-061), the Project-alone Environmental Impact Assessment (EIA) has been updated to reflect amended average annual mortality rates for some species (as previously presented in Table 12.17 of ES Chapter 12 (REP1-032)). These rates affect the background mortality rate for those species, against which changes in background mortality are calculated. The updated rates are as presented in Table 3 of Annex B3 of Natural England's RRs (RR-061) for the following species:

- Red-throated diver
- Common scoter
- Gannet
- Guillemot
- Razorbill
- Kittiwake
- Herring gull
- Lesser black-backed gull
- Great black-backed gull

5. In addition, Natural England also identified changes to the breeding season reference populations (Biologically Defined Minimum Population Scales; BDMPS) for two species (great black-backed gull and Manx shearwater). The updated background mortality rates and reference populations are set out in **Table 2.1**.

*Table 2.1 Changes in average annual mortality rates for species assessed as recommended by Natural England. **Bold** represents a change.*

Species	Initial calculated average mortality rate (REP1-032)	Updated average mortality rate	Initial BDMPS reference population (REP1-032)	Updated BDMPS reference population
Common scoter	0.238	**0.2283**	N/A	N/A
Great black-backed gull	0.093	**0.0969**	44,573 (breeding)	**13,324** (breeding)
Guillemot	0.143	**0.1405**	N/A	N/A
Herring gull	0.172	**0.1724**	N/A	N/A

Species	Initial calculated average mortality rate (REP1-032)	Updated average mortality rate	Initial BDMPS reference population (REP1-032)	Updated BDMPS reference population
Kittiwake	0.157	**0.1577**	N/A	N/A
Lesser black-backed gull	0.124	**0.1237**	N/A	N/A
Manx shearwater	0.130	0.1300	1,821,544 (breeding)	**1,821,518** (breeding)
Razorbill	0.178	**0.1302**	N/A	N/A
Red-throated diver	0.233	**0.2277**	N/A	N/A

6. For each species identified above, the resultant change in background mortality has been recalculated using the updated background mortality and reference populations, as appropriate. No changes to predicted mortality as a result of Project have been identified, therefore these values are the same as those presented in ES Chapter 12 Offshore Ornithology (REP1-032).

7. Following written representation by Natural Resources Wales (NRW) (REP1-098), the Project-alone assessment for Manx shearwater has been updated to amend inconsistencies, highlighted by NRW, in the seasonal mean peak values presented in Table 12.21 of ES Chapter 12 Offshore Ornithology (REP1-032) and the monthly density and abundance values shown in Table 5.148 of Appendix 12.1 Offshore Ornithology Technical Report (APP-070). NRW recommended that the breeding season for Manx shearwater (Furness 2015) should be used in analyses to its full definition and where the breeding season overlaps with either spring or autumn migration, those months are considered part of the breeding season, with the non-breeding periods adjusted accordingly. These changes and the updated seasonal mean peaks are shown in **Table 2.2** below:

*Table 2.2 Seasonal mean peak updates following changes to the assignment of months to the breeding season for Manx shearwater. **Bold** text represents a change.*

Seasonal period	Seasonal mean peaks in ES	Updated seasonal mean peaks
Breeding season	4705 (June – July)	**5161 (April – August)**
Autumn migration	2650 (August - October	**376 (September – October)**
Winter	-	-
Spring migration	1617 (March – May)	**0 (March)**

8. With these changes, the Project-alone displacement assessment for Manx shearwater has been updated to account for the above changes to seasonal mean peaks and seasonal periods, as well as the changes to reference populations shown in **Table 2.1**.

9. It should be noted that an update to the assessment for **gannet** was documented separately in Section 4 of The Applicant's Response to the Rule 9 Letter (PD1-010) and is not, therefore, included in this document.

2.1.1 Collision risk guidance update

10. It is noted that since submission of the application, updated guidance has been issued by the Statutory Nature Conservation Bodies (SNCBs) regarding collision risk modelling (August 2024). However, Natural England provided the Applicant with an advanced draft of this guidance, which was used in the relevant assessment and submission documents. In its Rule 8 letter, (PD-010) the ExA requested that any updates to the assessment arising from this guidance should be presented by the Applicant at Deadline 1. The Applicant can confirm that, as the draft guidance was used in the submitted assessment in Chapter 12 Offshore Ornithology (REP1-032), there are no changes within the final SNCB guidance that would affect the assessment outcomes. No other changes to parameters used in the assessment have been identified.

2.2 Results

11. The updated assessment for the species considered for displacement and barrier effects is presented in **Section 2.2.1** below. For species assessed for collision risk, the updated assessment is presented in **Section 2.2.2**. For all species assessed, very small or no measurable change in the estimated change in background mortality has been predicted. Therefore, no change in the Project-alone assessment conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032) have been identified.

2.2.1 Updates to operation and maintenance phase displacement and barrier effects assessments

2.2.1.1 Common Scoter

Non-breeding / year-round

12. The estimated number of common scoter subject to operational disturbance/displacement during the non-breeding season (and year-round since this was the only season in which the species was detected) is **unchanged** from the EIA and would be 43 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially

suffer mortality due to displacement is **unchanged** from the EIA, estimated as between zero and four individuals (displacement/mortality range of 90%/1% to 100%/10%; see cells highlighted in Table 12.22 of ES Chapter 12 (REP1-032)).

13. Using the updated average baseline mortality rate for common scoter of 0.2283 (see **Table 2.1**), the number of individuals subject to mortality from the non-breeding population (see paragraph 12.174 in ES Chapter 12 (REP1-032) for detail on population size) would be 32,749 (141,801 x 0.2283), this is **changed** from 33,749 in the EIA (paragraph 12.181 in ES Chapter 12 (REP1-032)). The addition of a maximum of four individuals (i.e. the maximum potential mortality, as per **Paragraph 12** above) would increase the background mortality by 0.01% and is **unchanged** from the EIA (paragraph 12.174 in ES Chapter 12 (REP1-032)). Therefore, the assessment conclusion is **unchanged** from the EIA, being **minor adverse** for common scoter in the non-breeding season / year-round (paragraph 12.183 in ES Chapter 12 (REP1-032)).

14. The range of percentage change in background mortality across the confidence interval (LCL to UCL) is **unchanged** from the EIA (see cells highlighted in Table 3.33 in Appendix 12.1 Offshore Ornithology Technical Report (APP-070)).

2.2.1.2 Guillemot

Breeding season

15. The estimated number of guillemots subject to operational disturbance/displacement during the breeding season is **unchanged** from the EIA and would be 6,374 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as 19 to 446 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.27 of ES Chapter 12 (REP1-032)).

16. The breeding season BDMPS for guillemot is 1,145,528 (Furness, 2015). Using the updated average baseline mortality rate for guillemot of **0.1405** (**Table 2.1**), the number of individuals subject to mortality in the breeding season would be 160,947 (1,145,528 x 0.1405), this is **changed** from 163,811 in the EIA (paragraph 12.208 in ES Chapter 12 (REP1-032)). The addition of a maximum of 446 individuals (i.e. the maximum potential mortality, as per **Paragraph 15** above) would increase the background mortality by 0.28%, this is **changed** from 0.27% in the EIA (paragraph 12.208 in ES Chapter 12 (REP1-032)). However, it remains that this value is considered precautionary and considering the background mortality rate (i.e. c.14%), it seems implausible that a rate of 10% would be caused from this single source. Based

on a more realistic background rate (i.e. 1%) the addition of a maximum of 45 individuals would increase the background mortality rate by 0.03%, this is **unchanged** from the EIA (paragraph 12.208 in ES Chapter 12 (REP1-032)). Therefore, the assessment conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.209 in ES Chapter 12 (REP1-032)).

17. The change to background mortality across the confidence interval (LCL to UCL) is also **unchanged** from the EIA (see cells highlighted in Table 3.47 in ES Appendix 12.1 (APP-070)).

Non-breeding season

18. The estimated number of guillemots subject to operational disturbance/displacement during the non-breeding season is **unchanged** from the EIA and would be 8,315 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as 25 to 582 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in **Table 12.28** of ES Chapter 12 (REP1-032)).

19. Using the updated average baseline mortality rate for guillemot of 0.1405 (**Table 2.1**), the number of individuals subject to mortality in the non-breeding season population would be 160,060 (1,139,220 x 0.1405), this is **changed** from 162,908 in the EIA (paragraph 12.211 in ES Chapter 12 (REP1-032)). The addition of a maximum of 582 individuals (i.e. the maximum potential mortality, as per **Paragraph 18** above) would increase the background mortality by 0.36%, this is **unchanged** from the EIA (paragraph 12.211 in ES Chapter 12 (REP1-032)). Following the same rationale on displacement/mortality rates as for the breeding season, a more realistic background rate (i.e. 1%) would result in the addition of a maximum of 58 individuals, which would increase the background mortality rate by 0.04%. This is **unchanged** from the EIA (paragraph 12.211 in ES Chapter 12 (REP1-032)) Therefore the assessment conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.212 in ES Chapter 12 (REP1-032)).

20. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from **0.01% – 0.53%** (LCL-UCL), compared to 0.01% – 0.52% (LCL-UCL) in the EIA (see cells highlighted in Table 3.49 in ES Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Year-round

21. The estimated number of guillemots subject to operational disturbance/displacement year-round is **unchanged** from the EIA and would be 14,689 (summing the above seasonal totals). Of these, the number of birds that could potentially suffer mortality due to displacement year-round is

unchanged from the EIA, estimated as 44 to 1,028 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.29 of ES Chapter 12 (REP1-032)).

22. Using the updated average baseline mortality rate for guillemot of 0.1405 (see **Table 2.1**), the number of individuals subject to mortality from the largest BDMPS population (Furness, 2015) throughout the year (breeding season: 1,145,528) would be 160,947 (1,145,528 x 0.1405) which is **changed** from 163,811 in the EIA (paragraph 12.214 in ES Chapter 12 (REP1-032)). The addition of a maximum of 1,028 individuals (i.e. the maximum potential mortality, as per **Paragraph 21** above) would increase background mortality by 0.64%, this is **changed** from 0.63% in the EIA (paragraph 12.214 in ES Chapter 12 (REP1-032)). Following the same rationale on displacement/mortality rates as for the breeding season, numbers based on a more realistic background rate (i.e. 1%), leads to the addition of a maximum of 103 individuals and would increase the background mortality rate by 0.06%, this is **unchanged** from the EIA (paragraph 12.215 in ES Chapter 12 (REP1-032)). The assessment conclusion for year-round based on a 70%/1% scenario is **unchanged** from the EIA as **minor adverse** (paragraph 12.216 in ES Chapter 12 (REP1-032)).

23. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from **0.02% – 0.94%** (LCL-UCL), compared to 0.02% – 0.93% (LCL-UCL) in the EIA, but would not affect the assessment conclusions.

2.2.1.3 Razorbill

Breeding season

24. The estimated number of razorbills subject to operational disturbance/displacement during the breeding season is **unchanged** from the EIA and would be 252 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as one to 18 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.30 of ES Chapter 12 (REP1-032)).

25. The BDMPS population for razorbill in the breeding season is 198,969 (Furness, 2015). Using the updated average baseline mortality rate for razorbill of 0.1302 (**Table 2.1**), the number of individuals subject to mortality in the breeding season population would be 25,906 (198,969 x 0.1302), this is **changed** from 35,416 in the EIA (paragraph 12.218 in ES Chapter 12 (REP1-032)). The addition of a maximum of 18 individuals (i.e. the maximum potential mortality, as per **Paragraph 24** above) would increase background mortality by 0.07%, this is **changed** from 0.05% in the EIA (paragraph 12.218 in ES

Chapter 12 (REP1-032)). However, following the same rationale as for guillemots, numbers based on a more realistic background rate (i.e. 1%), leads to the addition of a maximum of two individuals and would increase the background mortality rate by 0.01%, this is **changed** from <0.01% in the EIA (paragraph 12.218 in ES Chapter 12 (REP1-032)). However, these changes are immaterial and leave the conclusion of the assessment of razorbill in the breeding season as **unchanged** from the EIA being **minor adverse** (paragraph 12.219 in ES Chapter 12 (REP1-032)).

26. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from **0.00% – 0.16%** (LCL-UCL), compared to 0.00% – 0.12% (LCL-UCL) in the EIA (see cells highlighted in Table 3-51 in Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Autumn migration period

27. The estimated number of razorbills subject to operational disturbance/displacement during the autumn migration period is **unchanged** from the EIA and would be 694 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as two to 49 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.31 of ES Chapter 12 (REP1-032)).

28. The BDMPS population for razorbills in the autumn migration period is 606,914 (Furness, 2015). Using the updated average baseline mortality rate for razorbill of 0.1302 (**Table 2.1**), the number of individuals subject to mortality in the autumn migration period would be 79,020 (606,914 x 0.1302), this is **changed** from 108,031 in the EIA (paragraph 12.221 in ES Chapter 12 (REP1-032)). The addition of a maximum of 49 individuals (i.e. the maximum potential mortality, as per **Paragraph 27** above) would increase background mortality by 0.06%, this is **changed** from 0.05% in the EIA (paragraph 12.221 in ES Chapter 12 (REP1-032)). Following the same rationale as for guillemot, numbers based on a more realistic background rate (i.e. 1%), would result in an addition of a maximum of five individuals, and would increase the background mortality rate by 0.01%. This is **changed** from <0.01% in the EIA (paragraph 12.221 in ES Chapter 12 (REP1-032)). However, these changes leave the conclusion of the assessment of razorbill in the autumn migration period as **unchanged** from the EIA being **minor adverse** (paragraph 12.222 in ES Chapter 12 (REP1-032)).

29. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from **0.00% – 0.09%** (LCL-UCL), compared to 0.00% – 0.07% (LCL-UCL) in the EIA (see cells highlighted in

Table 3-53 in Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Winter

30. The estimated number of razorbills subject to operational disturbance/displacement during the winter season is **unchanged** from the EIA and would be 651 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as two to 46 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.32 of ES Chapter 12 (REP1-032)).

31. The BDMPS population for razorbill in the winter season is 341,422 (Furness, 2015). Using the updated average baseline mortality rate for razorbill of 0.1302 (**Table 2.1**), the number of individuals subject to mortality in the winter season population would be 44,453 (341,422 x 0.1302), this is **changed** from 60,773 in the EIA (paragraph 12.224 in ES Chapter 12 (REP1-032)). The addition of a maximum of 46 individuals (i.e. the maximum potential mortality, as per paragraph 30 above) would increase background mortality by 0.10%, this is **changed** from 0.08% the EIA (paragraph 12.224 in ES Chapter 12 (REP1-032)). Following the same rationale as for guillemot, numbers based on a more realistic background rate (i.e. 1%), would result in the addition of a maximum of five individuals and would increase the background mortality rate by 0.01%, this is **changed** from <0.01% in the EIA (paragraph 12.224 in ES Chapter 12 (REP1-032)). However, these changes are immaterial and leave the conclusion of the assessment for razorbill in the winter season as **unchanged** from the EIA, being **minor adverse** (paragraph 12.225 in ES Chapter 12 (REP1-032)).

32. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from 0.00% – 0.20% (LCL-UCL), compared to 0.00% – 0.15% (LCL-UCL) in the EIA (see cells highlighted in Table 3-55 in Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Spring migration period

33. The estimated number of razorbills subject to operational disturbance/displacement during the spring migration period is **unchanged** from the EIA and would be 382 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as one to 27 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.33 of ES Chapter 12 (REP1-032)).

34. The BDMPS population for razorbill in the spring migration period is 606,914 (Furness, 2015). Using the updated average baseline mortality rate for razorbill of 0.1302 (**Table 2.1**), the number of individuals subject to mortality in the spring migration period would be 79,020 (606,914 x 0.1302), this is **changed** from 108,031 in the EIA (paragraph 12.227 in ES Chapter 12 (REP1-032)). The addition of a maximum of 27 individuals (i.e. the maximum potential mortality, as per **Paragraph 33** above) would increase background mortality by 0.03%, this is **changed** from 0.02% in the EIA (paragraph 12.227 in ES Chapter 12 (REP1-032)). Following the same rationale as for guillemot, a more realistic background rate (i.e. 1%) would equate to the addition of a maximum of three individuals, and would increase the background mortality rate by <0.01%. This is **unchanged** from the EIA (paragraph 12.227 in ES Chapter 12 (REP1-032)). The assessment conclusion for the spring migration period based on a 70%/1% scenario is **unchanged** from that of the EIA, remaining as **minor adverse** (paragraph 12.228 in ES Chapter 12 (REP1-032)).

35. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from 0.00% – 0.05% (LCL-UCL), compared to 0.00% – 0.04% (LCL-UCL) in the EIA (see cells highlighted in Table 3-57 in Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Year-round

36. The estimated number of razorbills subject to operational disturbance/displacement year-round is **unchanged** from the EIA and would be 1,979 (summing the above seasonal totals). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as six to 139 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in Table 12.34 of ES Chapter 12 (REP1-032)).

37. Using the updated average baseline mortality rate for razorbill of 0.1302 (**Table 2.1**), the number of individuals subject to mortality from the largest BDMPS population throughout the year (autumn / spring migration periods) would be 79,020 (606,914 x 0.1302), this is changed from 108,031 in the EIA (paragraph 12.229 in ES Chapter 12 (REP1-032)). The addition of a maximum of 139 (i.e. the maximum potential mortality, as per **Paragraph 36** above) individuals would increase background mortality by 0.18%, this is changed from 0.13% in the EIA (paragraph 12.229 in ES Chapter 12 (REP1-032)). Following the same rationale as for guillemots, a more realistic background rate (i.e. 1%) would equate to the addition of a maximum of 14 individuals and would increase the background mortality rate by 0.02%. This is **changed** from 0.01% in the EIA (paragraph 12.230 in ES Chapter 12 (REP1-032)). However, these changes are immaterial and leave the conclusion of the assessment of

razorbill year-round as **unchanged** from the EIA being **minor adverse** (paragraph 12.231 in ES Chapter 12 (REP1-032)).

38. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from 0.00% – 0.31% (LCL-UCL), compared to 0.00% – 0.23% (LCL-UCL) in the EIA, but would not affect the assessment conclusions.

2.2.1.4 Manx shearwater

39. The written representation provided by NRW (REP1-099) highlighted some inconsistencies in the calculation of seasonal mean peaks of Manx shearwater, namely in the allocation of months to seasonal periods, previously presented in Table 12.21 of ES Chapter 12 (REP1-032). The applicant has addressed these inconsistencies and updated the operation and maintenance phase displacement assessment, based on the seasonal mean peaks calculated from Table 5.148 in Appendix 12.1 (APP-070) with the updated seasonal period definitions.

Breeding season

40. In the breeding season, the estimated number of Manx shearwaters subject to operational disturbance/displacement is 5,161 individuals, this is changed from 4,705 in the EIA (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the estimated number of birds subject to mortality would be between 15 and 361 individuals (from 30%/1% to 70%/10%; see **Table 2.3**), this is changed from 14 and 329 in the EIA (Table 12.35 in ES Chapter 12 (REP1-032)).

41. The reference population for the breeding season was updated to account for the allocation of 26 individuals to the North Sea BDMPS from the UK Western waters & Channel BDMPS, as advised by Natural England in its relevant representations (Table 6 – RR-061 Annex B3). This changes the reference population for both the breeding season and annual assessments, from 1,821,544 to 1,821,518. The background mortality rate for this species is unchanged (0.1300; **Table 2.1**).

42. At an average baseline mortality rate for Manx shearwater of 0.1300, the number of individuals subject to mortality in the breeding season would be 236,797 (1,821,518 x 0.13), which is changed from 236,801 in the EIA (paragraph 12.236 in ES Chapter 12 (REP1-032)). The addition of a maximum of 361, increases the mortality rate by 0.15%. It remains that this value is considered precautionary and, taking into account the background mortality rate (c. 13%), it is implausible that a rate of 10% would be caused by this single source. Based on a more realistic background rate (i.e. 1%; see paragraphs 12.232 to 12.234 in ES Chapter 12 (REP1-032)) the addition of 36 individuals would increase the mortality rate by 0.02%; this is changed from

the estimated increase in background mortality of 0.01% in the EIA (paragraph 12.236 ES Chapter 12 (REP1-032)).

43. This change is deemed immaterial and leaves the conclusion of the assessment of Manx shearwater in the breeding season as **unchanged** from the EIA being **negligible adverse and not significant in EIA terms** (paragraph 12.237 in ES Chapter 12 (REP1-032)).

44. The range of percentage change in background mortality is changed from the EIA across the confidence interval, ranging from 0.00% – 0.23% (LCL-UCL), compared to 0.00% – 0.30% (LCL-UCL) in the EIA, but would not affect the assessment conclusions.

Autumn migration period

45. In the autumn migration period, the estimated number of Manx shearwaters subject to operational disturbance/displacement is 376 individuals, this is changed from 2,650 in the EIA (paragraph 12.238 in ES Chapter 12 (REP1-032)). Of these, the estimated number of birds subject to mortality would be between one and 26 individuals (from 30%/1% to 70%/10%; see **Table 2.4**), this is changed from eight and 186 individuals in the EIA (paragraph 12.238 in ES Chapter 12 (REP1-032)).

46. The BDMPS population for Manx shearwater in the Autumn migration period is 1,582,895 (Furness, 2015). At the average baseline mortality rate for Manx shearwater of 0.1300, the number of individuals subject to mortality in the autumn migration period is 205,516 (1,580,895 x 0.13) and is unchanged from the EIA (paragraph 12.239 in ES Chapter 12 (REP1-032)). The addition of a maximum of 26 to this increases the mortality rate by 0.01%. However, for the reasons presented in **Paragraph 42** above, a more realistic addition of three (1% mortality) would increase the mortality rate by <0.01%.

47. Overall, the estimated effect on Manx shearwater during the autumn migration period has decreased, however the assessment conclusion remains **unchanged** from the EIA, as **negligible adverse and not significant in EIA terms** (paragraph 12.240 in ES Chapter 12 (REP1-032)).

48. The range of percentage change in background mortality is changed from the EIA across the confidence interval, ranging from 0.00% – 0.03% (LCL-UCL), compared to 0.00% – 0.13% (LCL-UCL) in the EIA, but would not affect the assessment conclusions.

Spring migration period

49. It is estimated that there are zero Manx shearwaters subject to operational displacement/disturbance in the spring migration period (Table 2.5), this is changed from 1,617 in the EIA (paragraph 12.241 in ES Chapter 12 (REP1-032)). Therefore, the assessment conclusion for the spring migration period is

changed from the EIA (negligible adverse; paragraph 12.243 in ES Chapter 12 (REP1-032)) and is now deemed **no effect**.

Year-round

50. The estimated number of Manx shearwaters subject to operational disturbance/displacement throughout the year is 5,537 individuals, this is changed from 8,972 in the EIA (paragraph 12.244 in ES Chapter 12 (REP1-032)). Of these, the estimated number of birds subject to mortality would be between 17 and 388 individuals (from 30%/1% to 70%/10%; see **Table 2.6**), this is changed from between 27 and 628 in the EIA (paragraph 12.244 in ES Chapter 12 (REP1-032)).

51. At the average baseline mortality rate for Manx shearwater of 0.1300, the number of individuals subject to mortality from the largest BDMPS population (1,821,518 in the breeding season) throughout the year would be 236,797 (1,821,518 x 0.13), which is changed from 236,801 in the EIA (paragraph 12.245 in ES Chapter 12 (REP1-032)). The addition of a maximum of 388 individuals would increase the mortality rate by 0.16%. However, for the reasons presented in **Paragraph 42** above, a more realistic addition of 39 birds (1% mortality) would increase the mortality rate by 0.02%. This change in background mortality has changed from 0.03% in the EIA (paragraph 12.245 in ES Chapter 12 (REP1-032)).

52. The assessment conclusion for year-round is **unchanged** from the EIA as **negligible adverse and not significant in EIA terms** (paragraph 12.246 in ES Chapter 12 (REP1-032)).

53. The range of percentage change in background mortality is changed from the EIA across the confidence interval, ranging from 0.00% – 0.26% (LCL-UCL), compared to 0.00% – 0.57% (LCL-UCL) in the EIA, but would not affect the assessment conclusions.

Table 2.3 Updated breeding season displacement matrix for Manx shearwater (windfarm site plus 2km buffer)

Breeding season	Mortality										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	5	10	15	21	26	52	103	155	258	413	516
20%	10	21	31	41	52	103	206	310	516	826	1032
30%	15	31	46	62	77	155	310	464	774	1239	1548
40%	21	41	62	83	103	206	413	619	1032	1652	2064
50%	26	52	77	103	129	258	516	774	1290	2064	2581
60%	31	62	93	124	155	310	619	929	1548	2477	3097
70%	36	72	108	145	181	361	723	1084	1806	2890	3613
80%	41	83	124	165	206	413	826	1239	2064	3303	4129
90%	46	93	139	186	232	464	929	1393	2322	3716	4645
100%	52	103	155	206	258	516	1032	1548	2581	4129	5161

Note: The cells show the number of birds predicted to be subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to be the most realistic scenario, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

Table 2.4 Updated autumn migration displacement matrix for Manx shearwater (windfarm site plus 2km buffer)

Breeding season	Mortality									
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0	1	1	2	2	4	8	11	19	30	38
20%	1	2	2	3	4	8	15	23	38	60	75
30%	1	2	3	5	6	11	23	34	56	90	113
40%	2	3	5	6	8	15	30	45	75	120	150
50%	2	4	6	8	9	19	38	56	94	150	188
60%	2	5	7	9	11	23	45	68	113	180	226
70%	3	5	8	11	13	26	53	79	132	211	263
80%	3	6	9	12	15	30	60	90	150	241	301
90%	3	7	10	14	17	34	68	102	169	271	338
100%	4	8	11	15	19	38	75	113	188	301	376

Note: The cells show the number of birds predicted to be subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to be the most realistic scenario, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

Table 2.5 Updated spring migration displacement matrix for Manx shearwater (windfarm site plus 2km buffer)

Breeding season	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	0	0	0	0	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0	0	0	0	0
100%	0	0	0	0	0	0	0	0	0	0	0

Note: The cells show the number of birds predicted to be subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to be the most realistic scenario, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

Table 2.6 Updated year-round displacement matrix for Manx shearwater (windfarm site plus 2km buffer)

Breeding season	**Mortality**										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	6	11	17	22	28	55	111	166	277	443	554
20%	11	22	33	44	55	111	221	332	554	886	1107
30%	17	33	50	66	83	166	332	498	831	1329	1661
40%	22	44	66	89	111	221	443	664	1107	1772	2215
50%	28	55	83	111	138	277	554	831	1384	2215	2769
60%	33	66	100	133	166	332	664	997	1661	2658	3322
70%	39	78	116	155	194	388	775	1163	1938	3101	3876
80%	44	89	133	177	221	443	886	1329	2215	3544	4430
90%	50	100	149	199	249	498	997	1495	2492	3987	4983
100%	55	111	166	221	277	554	1107	1661	2769	4430	5537

Note: The cells show the number of birds predicted to be subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to be the most realistic scenario, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

2.2.1.5 Red-throated diver

Autumn migration period

54. The estimated number of red-throated divers subject to operational disturbance/displacement during the autumn migration period is **unchanged** from the EIA and would be two individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA and is estimated as zero individuals (displacement/mortality range 100%/1% to 100%/10%; see cells highlighted in Table 12.40 of ES Chapter 12 (REP1-032)).

55. The BDMPS for red-throated diver in autumn is 4,373. Using the updated baseline mortality rate for red-throated diver of 0.2277 (**Table 2.1**), the number of individuals subject to mortality in the autumn migration period would be 996 (4,373 x 0.2277), this is changed from 1,019 in the EIA (paragraph 12.267 in ES Chapter 12 (REP1-032)). Since zero individuals are predicted to suffer from displacement/disturbance related mortality, the assessment conclusion is **unchanged** from the EIA as **no change** (paragraph 12.267 in ES Chapter 12 (REP1-032)).

56. The range of percentage change in background mortality is **unchanged** from the EIA across the confidence interval (see cells highlighted in Table 3-27 in ES Appendix 12.1 (APP-070)).

Winter

57. The estimated number of red-throated divers subject to operational disturbance/displacement during the winter season is **unchanged** from the EIA and would be 12 individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as zero to one individual (displacement/mortality range of 100%/1% to 100%/10%; see cells highlighted in Table 12.41 in ES Chapter 12 (REP1-032)).

58. The BDMPS for red-throated diver in the winter is 1,657 (Furness, 2015). Using the updated baseline mortality rate for red-throated diver of 0.2277 (see Table 2.1), the number of individuals subject to mortality in the winter season would be 377 (1,657 x 0.2277), this is **changed** from 386 in the EIA (paragraph 12.269 in ES Chapter 12 (REP1-032)). The addition of a maximum of one individual to this would increase the background mortality rate by 0.31%; this is **changed** from 0.26% the EIA (paragraph 12.269 in ES Chapter 12 (REP1-032)). However, it remains that this value is considered precautionary as an upper range of 10% mortality of displaced birds due to displacement seems very unlikely (see paragraph 12.261 in ES Chapter 12 (REP1-032)). Therefore, based on a more realistic background mortality rate (i.e. 1%) there would be a 0.03% increase to the background mortality rate, this is **changed**

from no increase in mortality the EIA (paragraph 12.269 in ES Chapter 12 (REP1-032)). The assessment conclusion for red-throated diver in the winter season is **unchanged** from the EIA, remaining as **minor adverse** (paragraph 12.270 in ES Chapter 12 (REP1-032)).

59. The range of percentage change in background mortality is **changed** from the EIA across the confidence interval, ranging from 0.00% – 0.73% (LCL-UCL), compared to 0.00% – 0.71% (LCL-UCL) in the EIA (see cells highlighted in Table 3-29 in ES Appendix 12.1 (APP-070)), but would not affect the assessment conclusions.

Spring migration period

60. The estimated number of red-throated divers subject to operational disturbance/displacement during the spring migration period is **unchanged** from the EIA and would be six individuals (Table 12.21 in ES Chapter 12 (REP1-032)). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as zero to one individual (displacement/mortality range of 100%/1% to 100%/10%; see cells highlighted in Table 12.42 in ES Chapter 12 (REP1-032)).

61. The BDMPS for red-throated diver in the spring migration period is 4,373 (Furness, 2015). Using the updated baseline mortality rate for red-throated diver of 0.2277 (see **Table 2.1**), the number of individuals subject to mortality in the spring migration period would be 996 (4,373 x 0.2277), this is **changed** from 1,019 in the EIA (paragraph 12.272 in ES Chapter 12 (REP1-032)). The addition of a maximum of one individual (i.e. the maximum potential mortality, as per **Paragraph 60** above) to this would increase the background mortality rate by 0.1%, this is **unchanged** from the EIA (paragraph 12.272 in ES Chapter 12 (REP1-032)). It remains that this value is considered precautionary as during this period birds would be passing through the windfarm site during migration, and the upper range of 10% mortality of displaced birds due to displacement seemed very unlikely (see paragraph 12.261 in ES Chapter 12 (REP1-032)). Based on a more realistic background mortality rate (i.e. 1%) there would be a 0.01% increase, this is **changed** from no increase in the EIA (paragraph 12.272 in ES Chapter 12 (REP1-032)). The assessment conclusion for red-throated diver in the winter season is **unchanged** from the EIA and remains as **minor adverse** (paragraph 12.273 in ES Chapter 12 (REP1-032)).

62. The range of percentage change in background mortality is **unchanged** from the EIA across the confidence interval (see cells highlighted in Table 3-31 in ES Appendix 12.1 (APP-070]).

Year-round (non-breeding)

63. The estimated number of red-throated divers subject to operational disturbance/displacement year-round would be 20 individuals (summing the above seasonal totals). Of these, the number of birds that could potentially suffer mortality due to displacement is **unchanged** from the EIA, estimated as zero to two individuals (displacement/mortality range of 100%/1% to 100%/10%; see cells highlighted in Table 12.43 in ES Chapter 12 [REP1-032]).

64. The largest BDMPS for red-throated diver is 4,373 during the spring and autumn migration periods, and the largest population with connectivity to UK waters is 27,000 (Furness, 2015). Using the updated baseline mortality rate for red-throated diver of 0.2277 (**Table 2.1**), the number of individuals subject to mortality in the spring migration period would be 996 (4,373 x 0.2277), this is **changed** from 1,019 in the EIA (paragraph 12.275 in ES Chapter 12 [REP1-032]). The addition of a maximum of two individuals (i.e. the maximum potential mortality, as per **Paragraph 63** above) to this would increase the background mortality rate by 0.20%, this is **changed** from 0.19% in the EIA (paragraph 12.275 in ES Chapter 12 (REP1-032)). In relation to the biogeographic population, the number of individuals subject to mortality over one year would be 6,148 (27,000 x 0.2277), this is **changed** from 6,291 in the EIA (paragraph 12.275 in ES Chapter 12 (REP1-032)). The addition of a maximum of two birds (i.e. the maximum potential mortality, as per **Paragraph 63** above) would increase the background mortality rate by 0.03%, this is **unchanged** from the EIA (paragraph 12.275 in ES Chapter 12 (REP1-032)).

65. However, it remains that this upper mortality value (10%) is considered precautionary, with such a high level of mortality very unlikely (see paragraph 12.261 in ES Chapter 12 (REP1-032)). Based on a more realistic background mortality rate (i.e. 1%) there would be a 0.02% increase in background mortality on the BDMPS, this is **changed** from no increase in the EIA (paragraph 12.272 in ES Chapter 12 (REP1-032)). In relation to the biogeographic population, there would be no increase in background mortality, this is **unchanged** from the EIA (paragraph 12.275 in ES Chapter 12 (REP1-032)). The assessment conclusion for red-throated diver year-round is **unchanged** from the EIA and remains as **minor adverse** (paragraph 12.276 in ES Chapter 12 (REP1-032)).

66. The range of percentage change to background mortality across the confidence interval is 0.00% – 0.55% (LCL – UCL), this is **changed** from 0.00% – 0.54% in the EIA, but would not affect the assessment conclusions. In relation to the biogeographic population the range across the confidence interval is **unchanged** from 0.00% – 0.09% (LCL – UCL).

2.2.1.6 Summary of displacement assessment updates

67. A summary to the operation and maintenance phase displacement assessment update is presented in **Table 2.7**. Very small changes in increase in background mortality (i.e. no more than 0.01% change) have been identified for guillemot and red-throated diver, while a small decrease (no more than 0.07%) has been identified for razorbill. No change in increase in background mortality has been identified for common scoter and Manx shearwater. Overall, **no changes** to the assessment conclusions, as presented in ES Chapter 12 Offshore Ornithology (REP1-032), have been identified for any species as a result of these small changes.

Table 2.7 Summary of operation and maintenance phase displacement effect update

Species	Predicted mortalities	BDMPS population	Updated background mortality rate	Background mortality	Original % increase in background mortality (REP1-032)	Updated % increase in background mortality
Gannet[1]	3 – 4	661,888	**0.1866**	**123,508**	0.00% – 0.01%	0.00% – **0.00%**
Common scoter	0 – 4	141,801	**0.2283**	**32,373**	0.00% – 0.01%	0.00% – 0.01%
Guillemot	44 – 1,028	1,145,528	**0.1405**	**160,947**	0.03% – 0.63%	0.03% – **0.64%**
Razorbill	6 – 139	606,914	**0.1302**	**79,020**	0.01% – 0.13%	**0.00% – 0.06%**
Manx shearwater	27 – 628	**1,821,518**	No change – 0.1300	236,801	0.01% – 0.27%	0.01% – 0.27%
Red-throated diver	0 – 2	4,373	**0.2277**	**996**	0.02% – 0.19%	0.02% – **0.20%**
[1] Taken from Section 4 of the Applicant's Response to the Rule 9 Letter (PD1-010) **Bold** indicates a change from ES Chapter 12 Offshore Ornithology (REP1-032)						

2.2.2 Updates to collision risk assessments

68. The changes in background mortality rates (**Table 2.1**) led to changes in baseline seasonal mortality and increases in background mortality (%) displayed in the EIA (Table 12.48 in ES Chapter 12 (REP1-032)). **Table 2.8** below replaces that table and highlights the material changes to the assessment outputs. **Table 2.9** summarises the changes with comparison against the values from the EIA.

*Table 2.8 Update of estimates of percentage increases in the background mortality rate for seasonal and annual populations due to predicted collisions. Figures **bold** show a change from the EIA*

Species		Little gull	Kittiwake	Common gull	Herring gull	Lesser black-backed gull	Great black-backed gull
Baseline average mortality rate		0.2000	**0.1577**	0.2590	**0.1724**	**0.1237**	**0.0969**
Breeding Season	Reference population	n/a	245,234	n/a	217,167	240,750	**13,424**
	Baseline seasonal mortality	n/a	**38,673**	n/a	**37,440**	**29,781**	**1,301**
	Mean seasonal mortality from collision	n/a	16.33	n/a	1.78	2.02	0.66
	Increase in background mortality (%)	n/a	0.04%	n/a	<0.01%	<0.01%	**0.05%**
Autumn migration	Reference population	n/a	911,586	n/a	n/a	163,304	n/a
	Baseline seasonal mortality	n/a	**143,757**	n/a	n/a	**20,201**	n/a
	Mean seasonal mortality from collision	n/a	8.50	n/a	n/a	1.25	n/a
	Increase in background mortality (%)	n/a	<0.01%	n/a	n/a	<0.01%	n/a
Non-breeding / winter	Reference population	5,700	n/a	13,036	173,299	41,159	17,742
	Baseline seasonal mortality	1,140	n/a	3,376	**29,877**	**5,091**	**1,719**
	Mean seasonal mortality from collision	2.92	n/a	2.39	2.38	0.15	1.10

Species		Little gull	Kittiwake	Common gull	Herring gull	Lesser black-backed gull	Great black-backed gull
	Increase in background mortality (%)	0.26%	n/a	0.07%	**<0.01%**	<0.01%	**0.06%**
Spring migration	Reference population	n/a	691,526	n/a	n/a	163,304	n/a
	Baseline seasonal mortality	n/a	**109,054**	n/a	n/a	**20,201**	n/a
	Mean seasonal mortality from collision	n/a	0.62	n/a	n/a	0.15	n/a
	Increase in background mortality (%)	n/a	<0.01%	n/a	n/a	<0.01%	n/a
Annual (largest BDMPS)	Reference population	n/a	911,586	13,036	217,167	240,750	**17,742**
	Baseline annual mortality	n/a	**143,757**	3,376	**37,440**	**29,781**	**1,719**
	Mean annual mortality from collision	2.92	25.45	2.39	4.15	3.57	1.75
	Increase in background mortality (%)	n/a	0.02%	0.07%	0.01%	0.01%	**0.10%**
Annual (bio-geographic population)	Reference population	5,700	5,100,000	1,600,000	1,098,000	864,000	235,000
	Baseline annual mortality	1,140	**804,270**	414,400	**189,295**	**106,877**	**22,772**
	Mean annual mortality from collision	2.92	25.45	2.39	4.15	3.57	1.75

Species		Little gull	Kittiwake	Common gull	Herring gull	Lesser black-backed gull	Great black-backed gull
	Increase in background mortality (%)	0.26%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

Table 2.9 Summary of changes from updated background mortality rates due to collision (year-round)

Season	Species	EIA baseline seasonal / annual mortality	Revised baseline seasonal / annual mortality	EIA predicted collision mortality	EIA increase in baseline mortality (%)	Revised increase in baseline mortality (%)
Annual (largest BDMPS)	Kittiwake	143,119	**143,757**	25.45	0.02%	No change
	Herring gull	37,353	**37,440**	4.15	0.01%	No change
	Lesser black-backed gull	29,853	**29,781**	3.57	0.01%	No change
	Great black-backed gull[1]	4,162	**1,719**	1.75	0.04%	**0.10%**
Annual (Bio-geographic)	Kittiwake	800700	**804,270**	25.45	<0.01%	No change
	Herring gull	188856	**189,295**	4.15	<0.01%	No change
	Lesser black-backed gull	107,136	**106,877**	3.57	<0.01%	No change
	Great black-backed gull	21,855	**22,772**	1.75	<0.01%	No change
[1] The largest BDMPS used for annual assessment has now changed to the non-breeding season (UK south-west and Channel) to **17,742** from 44,753 in the EIA, on advice from Natural England ((RR-061) B20).						

2.2.2.1 Great black-backed gull

69. For Great black-backed gull, the BDMPS for breeding season has **changed** from 44,573 in the EIA (Table 12.48 in ES Chapter 12 (REP1-032)) to 13,424, using the value advised by Natural England in Table 6 of RR-061 Annex B3. Following this change, the reference population for the annual collision risk assessment is now that of the non-breeding season (17,742; as this is now the largest seasonal population) as opposed to the previous breeding season population of 44,573.

70. The annual collision predictions now result in a 0.1% increase in the background mortality, this has **changed** from 0.04% in the EIA (Table 12.48 in ES Chapter 12 (REP1-032)). However, the assessment conclusion remains **unchanged** from the EIA, resulting in a **minor adverse** effect on great black-backed gull (paragraph 12.294 in ES Chapter 12 (REP1-032)).

2.2.2.2 Other species

71. The updated background mortality rates (**Table 2.1**) resulted in changes to annual background mortality (**Table 2.8** and **Table 2.9**), and therefore also changes in the percentage increase in background mortality due to potential additional collision related mortalities. However, none of the species except for great black-backed gull showed a change in annual increase in background mortality from the EIA (**Table 2.9**). The assessment conclusions on annual project alone collision risk are therefore **unchanged** from the EIA, remaining as **minor adverse** for all species (paragraph 12.294 in ES Chapter 12 (REP1-032)).

2.2.2.3 Summary of collision risk assessment updates

72. A summary to the operation and maintenance phase collision risk assessment update is presented in **Table 2.10**. For all species except great black-backed gull, no changes in increase in background mortality have been identified. For great black backed gull, increase in background mortality would increase from 0.04% to 0.10%. Overall, no changes to the assessment conclusions, as presented in ES Chapter 12 Offshore Ornithology (REP1-032), have been identified for any species.

Table 2.10 Summary of operation and maintenance phase collision risk assessment update

Species	Predicted mortalities	BDMPS population	Updated background mortality rate	Background mortality	Original % increase in background mortality	Updated % increase in background mortality
Gannet[1]	4.20	661,888	**0.1866**	**123,508**	<0.01%	<0.01%
Gannet (70% MA)[1]	1.26	661,888	**0.1866**	**123,508**	<0.01%	<0.01%
Little gull	2.92	N/A	No change: 0.2000	N/A	N/A	N/A
Kittiwake	25.45	911,586	**0.1577**	**143,757**	0.02%	0.02%
Common gull	2.39	13,036	No change: 0.2590	3,376	0.07%	0.07%
Herring gull	4.15	217,167	**0.1724**	**37,440**	0.01%	0.01%
Lesser black-backed gull	3.57	240,750	**0.1237**	**29,781**	0.01%	0.01%
Great black-backed gull	1.75	**Updated:17,742**	**0.0969**	**1,719**	0.04%	**0.10%**

[1] Taken from Section 4 of the Applicant's Response to the Rule 9 Letter (PD1-010)

Bold indicates a change from ES Chapter 12 Offshore Ornithology (REP1-032)

3 Cumulative effects assessment update

3.1 Background and approach

73. This section provides an update to the cumulative effects assessment (CEA) and quantifies the impacts from historic operational offshore wind projects in the Irish Sea. The assessment updates the CEA presented in ES Chapter 12 (REP1-032), for species where NE raised within its RRs (RR-061) concerns regarding the conclusions of the CEA:

- Guillemot
- Herring gull
- Lesser black-backed gull
- Great black-backed gull
- Little gull

74. In addition, the CEA has also been updated for Manx shearwater. No specific concerns were raised by Natural England in respect of this species, but it is understood by the Applicant that Natural Resources Wales (NRW) is likely to raise similar concerns, and therefore the Applicant has updated the CEA for this species in anticipation of this response. The contribution of the Project to the cumulative assessment for Manx shearwater has also been updated for Rev 02 of this document to reflect the updated Project-alone values, as presented in **Section 2.2.1.4**.

75. The updated cumulative assessment has utilised data published for the Mona (Mona Examination Library: REP3-044) and Morgan Generation (Morgan Examination Library: REP1-010)) projects which has been calculated by those projects in accordance with advice provided by Natural England. A summary of the approach, and how this has been applied to the Project, is provided below. The Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets have not undertaken 'gap filling' for little gull, and therefore details of the approach used by the Project for this species are also provided below.

76. During the Section 42 consultation, Natural England (and NRW) did not consider it appropriate to base the cumulative (and hence also in-combination) assessments on many 'unknowns' for impacts from many of the historical offshore wind projects. Specifically, Natural England stated that "*the cumulative (and in-combination) assessments do not factor in impacts from a number of other projects due to a lack of data. Unknown impacts have been treated as zero, which will inevitably underestimate impacts, potentially significantly. A qualitative assessment is mentioned for consideration of some projects, but this process is not detailed, or the results fully presented. Natural*

England consider this approach to be unacceptable, and hence consider it inappropriate to comment on the potential significance of cumulative (or in-combination) presented in the PEIR submission".

77. Natural England subsequently provided written advice in October 2023 on 'gap filling' for historical offshore wind projects, where fully quantitative assessments have not previously been provided. This recommended a two-step approach, the first of which was to obtain abundance data for historical offshore windfarm projects from ES chapters or other relevant documents and use this to run cumulative displacement and collision mortality assessments. If no quantitative data were available, the second recommended step was to use nearby windfarms with published estimates of mortality as proxies, scaled according to windfarm size and turbine specifications.

78. The first step recommended by Natural England in their written advice was used in the Project CEA documented in Chapter 12 Offshore Ornithology (REP1-032), with collision mortality and abundance data obtained from project-specific documentation to derive cumulative collision and displacement mortality estimates. Qualitative assessments for historical offshore windfarm projects, for which quantitative consideration of collision and displacement impacts was not undertaken in project-specific documentation, were also presented. As advised by Natural England in its October 2023 written advice, historic projects approaching end-of-life with limited (or no) overlap with the Project timeframe were not included in the CEA (Barrow, North Hoyle and Arklow Bank Phase 1).

79. For the second step, Natural England recommended that nearby windfarms should be used as proxies to estimate impacts for projects where quantitative data were unavailable was not undertaken for the CEA. However, the Applicant did not consider it appropriate to apply proxy data to another windfarm in the area, as this would have been collected over a specific temporal and spatial scale relevant to that project, and therefore the data could not be used in a consistent or robust manner. This view was shared by the Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets. Notwithstanding this advice, the Applicant presented an analysis for all relevant species within ES Chapter 12 Offshore Ornithology (REP1-032), to consider whether the contribution of the historic projects would affect the CEA conclusions. In its RRs, Natural England appears to have accepted the conclusions of these analyses for all species not identified above (RR-061).

80. Natural England has raised specific concerns in its RRs (RR-061) in relation to guillemot, little gull, herring gull, lesser black-backed gull and great black-backed gull (**Table 1.1**). In respect of these species, Natural England has stated that it does not consider the CEA to be sufficiently robust due to the lack of quantitative consideration of some historic projects.

81. To address respective concerns raised by Natural England for the Project and via RRs for the Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets, the ornithological consultants for those projects have obtained data on seabird distribution from the Marine Ecosystems Research Programme (MERP; guillemot, herring gull and lesser black-backed gull) (Waggitt *et al*., 2020) and The Seabird Mapping and Sensitivity Tool (SeaMaST; great black-backed gull (and also little gull, see below)) (Bradbury et al., 2014). Further information on the approach used to calculate density and abundance estimates is presented in the Mona Offshore Wind Project Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-fulling Historical Projects Technical Note (RPS, 2024a). It is understood that the method used for the gap-filling was discussed at a meeting between Natural England and the Morgan Generation and Mona projects, where Natural England indicated agreement with the proposed approach.

82. The Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets have agreed to share the results of their gap-filling approach with the Applicant to ensure consistency and alignment between the projects' respective CEAs. This also follows Natural England advice that Irish Sea offshore wind farms should collaborate to use the same data to conduct the CEA. As set out in the Mona project gap-filling note (RPS, 2024a), consented turbine parameters (as opposed to as-built parameters) have been used for collision risk modelling, where these are available. However, for some projects (Robin Rigg, Rhyl Flats, Walney 1 and 2 and West of Duddon Sands), consented data are unavailable or incomplete, and therefore as-built parameters have been used.

83. For the assessment of cumulative collision risk for herring gull, lesser black-backed gull and great back-backed gull, the avoidance rate presented in the Mona Offshore Wind Project Technical Note (0.9939; RPS, 2024a) was adjusted to the 'large gull' rate recommended in the joint SNCB advice note (0.9940; SNCBs, 2024).

3.1.1 Little gull approach

84. Little or no data for little gull was available from other projects considered within the CEA. The Applicant's position, as set out in ES Chapter 12 Offshore Ornithology (REP1-032), was that this reflected the low densities of this species at other project sites, and therefore there was no measurable collision risk and no contribution from other projects to the cumulative effects. In its RRs (RR-061), Natural England raised concerns around this conclusion and asked that the Applicant review the contribution of other projects to the cumulative effect.

85. The projects considered in the CEA (see **Table 3.3**) were assessed to determine the quality of quantitative data available from their offshore ornithology surveys. The applicant was only able to find data showing the presence of little gull for the Morgan Generation Offshore Wind Project (Table D.6; NIRAS, 2024a), and a Collision Risk Model (CRM) was run to confirm the Morgan Offshore Wind Project Generation Assets position that the low numbers of little gull would result in no measurable effect for collision risk (i.e., at or close to zero) as per Table 1.2 in the Morgan ES CRM technical report (NIRAS, 2024b).

86. For other projects, where good quality survey data was available but did not identify the presence of little gull, it was concluded that for those projects little gulls are not typically present and that little gull density and abundance (and hence collision risk) for those projects was zero. This approach was not applied to projects where the data available was poor or there was none available – these projects being the focus for the gap fill; Burbo Bank, Gwynt y Môr, Rhyl Flats, Robin Rigg, Walney 1 & 2, and West of Duddon Sands.

87. To gap-fill on little gull presence/absence and predicted densities within these project areas, data from the SeaMaST dataset (Bradbury *et al.,* 2014) was interrogated on QGIS, which presents density data over a period spanning 1979–2012. Little gull density data was extracted, and mean densities (birds/km^2) extrapolated for each OWF project in consideration.

88. The '*winter Boat Plus Aerial Density LU*' and '*summer Boat Plus Aerial Density LU*' datasets were used for the density estimates, as these provided the most comprehensive cover within the SeaMaST dataset. As bird behaviour (i.e. sitting or flying) was not specified within the datasets, it was assumed that this included both sitting and flying observations. However, as no information on the proportions of sitting or flying birds was available, all birds were assumed to be flying; CRM outputs are therefore likely to be precautionary (overestimates).

89. The raster datasets (density values attached to 3x3 km squares) were overlaid with OWF shapefiles, with values from all overlapping squares from the raster file extracted and used to form a mean value for 'summer' and 'winter' periods. No BDMPS seasonal periods (Furness, 2015) are available for little gull, and no seasonal definitions are given in Table 1 of Annex 1 of the SeaMaST II report (WWT Consulting, 2015). Therefore, the generic seasonal definitions used in SeaMaST I, outlined in paragraph 2.6 of the SeaMaST II report (WWT Consulting, 2015) were used to assign densities to months of the year. These definitions are:

- Summer – April to September
- Winter – October to March

90. From the extracted SeaMaST data, the two OWFs with the highest calculated densities (birds/km^2) were selected for CRM. These were Burbo Bank and West of Duddon Sands, with summer and winter little gull densities of 0.000 – 0.000120, and 0.000 – 0.000114 birds/km^2, respectively. These two projects also represent small and large array examples within the CEA (25 and 108 turbines, respectively). If predicted collision mortality for little gulls in these historical projects is at or close to zero, then it can be concluded with certainty that for the remaining gap-fill projects (all with lower estimated densities), very low or no mortality would also be predicted, and there would be no requirement to run additional CRMs for these projects.

91. The CRMs were run using the Avian Stochastic CRM tool (McGregor *et al.,* 2018), with Option 2 outputs taken as the collision mortality estimates. A full list of the little gull input parameters can be seen in **Table A.1** in **Appendix 1: CRM Input Parameters**. Note that due to an error in the little gull flight height distribution data within the Avian Stochastic CRM tool (McGregor et al., 2018), flight heights were input manually from Johnston *et al.* (2014a and b) using the 'maximum probability' values from the Johnston *et al.* dataset. The avoidance rate (AR) applied was the 'All gull rate' (0.9929 (±0.0003)) as recommended in the joint SNCBs advice note on collision risk modelling (SNCBs, 2024). Other little gull input parameters were taken from the Morecambe ES (Table 12.44 in ES Chapter 12 (REP1-032)).

92. The design parameters for the relevant OWF arrays were drawn from a number of sources. There was limited documentation online for both Burbo Bank OWF and West of Duddon Sands OWF. Most of the parameters were taken from The Crown Estate's (TCE) cumulative ornithological collision risk database (TCE, 2019). The consented parameters were used where possible; however these were too incomplete for West of Duddon Sands to be deemed suitable, therefore the 'as-built' parameters were used (as outlined in **Paragraph 82** above).

93. Proxy values for tidal offset and wind availability/proportional operation time (%) were taken from nearby projects for which this data is readily available (Morgan, Awel y Môr, and Burbo Bank Extension OWFs). The parameters for the Morgan Offshore Wind Project Generation Assets CRM runs were taken from **Table 1.4** in the Morgan Offshore Wind Project Generation Assets ES CRM technical report (NIRAS, 2024b).The sources are detailed below along with the parameters used in **Table 3.1** and **Table 3.2**.

Table 3.1 Wind farm parameters used within the CRMs for the historical projects gap-filling

Project	Number of turbines [1]	Turbine capacity (mw)[1]	Air gap (m from HAT)[1]	Rotor radius (m)[1]	Tidal offset (m)	Average RPM[1]	Max blade width (m)[1]	Blade pitch (°)[1]	Latitude (decimal degrees)[1]	Width (km)[1]	Large Array Correction (Y/N)
Burbo Bank OWF (consented)	30	3	24.5	45	4.46[2]	16.1	3.5	6	53.48	5.3	N
West of Duddon Sands OWF (As-built)	108	3.6	22	60	4.00[3]	13	4.2	15	53.98	11.9	Y

1 – Wind farm parameters from the Cumulative Ornithological Collision Risk Database (TCE, 2019).

2 – Tidal offset value taken from Awel y Môr OWF as a proxy, since it was the closest project to Burbo Bank for which this CRM input parameter could be found. Awel y Môr ES Volume 4, Annex 4.3: Offshore Ornithology Collision Risk Modelling (APEM, 2022).

3 – Tidal offset value taken Morgan OWF as a proxy, since it was the closest project to West of Duddon Sands for which this CRM input parameter could be found (NIRAS, 2024b).

Table 3.2 Proxy turbine operational time values for the projects

Monthly proportion of time operational	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Burbo Bank OWF[1]	90%	85%	86%	80%	82%	77%	81%	81%	82%	87%	89%	86%
West of Duddon Sands OWF[2]	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%

1 – Turbine operational time taken from Burbo Bank Extension OWF as a proxy with the assumption the close proximity of this project to Burbo Bank OWF means the two projects share similar wind availability percentages, downtime is incorporated into this value. Dong Energy – Burbo Bank Extension Offshore Wind Farm Environmental Statement Chapter 15, Technical Annex 4: Collision Risk Modelling (NIRAS, 2013).

2 – Turbine operational time taken from Morgan OWF as a proxy since it was the closest project for which this CRM input parameter could be found. Morgan Offshore Wind Project: Generation Assets ES Volume 4, Annex 5.3: Offshore Ornithology CRM technical report (NIRAS, 2024b).

3.2 Results

3.2.1 Cumulative assessment of operation and maintenance phase disturbance, displacement and barrier effects

3.2.1.1 Guillemot

94. In the ES Chapter 12 Offshore Ornithology (REP1-032), it was considered very unlikely that the contribution of historic projects where no quantitative data are available would affect the conclusions of the cumulative assessment. However, after performing a gap-filling exercise for historical projects, values have been attributed to the three projects (Burbo Bank, Gwynt y Môr and Rhyl Flats) that had no quantitative data available in the EIA (paragraph 12.375 in ES Chapter 12 (REP1-032)). These values (99, 354 and 117, respectively) are all included within the updated assessment below and can be seen in **Table 3.3** alongside all values for OWFs considered in the CEA.

Table 3.3 Abundance values used in guillemot displacement CEA following gap filling, with the assessment being based on annual values. Breakdown of values by season given where available.

Project*	Annual abundance (CEA values)	Breeding season abundance	Non-breeding season abundance
Awel y Môr[1, 4]	4,488	1,569	2,919
Burbo Bank[2]	99	41	58
Burbo Bank Extension[1, 4]	2,562	1,000	1,561
Erebus[1]	35,339	7,001	28,338
Gwynt y Môr[2]	354	149	205
Holyhead Deep (tidal)[1, 4]	8	N/A	N/A
Morlais/West Anglesey (tidal)[1, 4]	46	N/A	N/A
Mona[1]	7,976	4,220	3,756
Morgan[3]	7,834	4,010	3,824
Ormonde[2]	968	912	56
Rhyl Flats[2]	117	49	68
Robin Rigg[2]	226	138	88
TwinHub[1, 4]	256	39	217
Walney 1 & 2[2]	388	161	227
Walney 3 & 4[1, 4]	6,096	4,169	1,927
West of Duddon Sands[2]	1,487	1,321	166
West of Orkney[1, 4]	9,136	4,861	4,275
White Cross[1, 4]	4,363	3,304	1,059

Project*	Annual abundance (CEA values)	Breeding season abundance	Non-breeding season abundance
Morecambe	**14,689**	6,374	8,315
Total	**96,378**	39,318	57,059

1 – Project specific abundances presented in Table 1.4 of Mona Offshore Ornithology Errata Clarification note (RPS, 2024b).

2 – Project specific abundances presented in Table A.10 of Mona Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling of Historical Projects Technical Note (RPS, 2024a).

3 – Project specific abundances presented in Table A.4 of Morgan Offshore CEA and In-combination Gap-filling of Historical Projects Note (NIRAS, 2024c).

4 – Predicted collision mortality presented in Table 12.47 of Morecambe Offshore Wind Farm Environmental Statement Volume 5 Chapter 12 Offshore Ornithology (REP1-032).

* - Where projects reference "1, 4", this refers to the source of annual abundances being from the Morecambe ES Chapter 12 (REP1-032), with the seasonal values taken from the Mona offshore ornithology errata clarification note.

95. The estimated number of guillemot subject to operational disturbance/displacement year-round from each relevant project is 96,378 individuals, which is **changed** from 101,526 in the EIA (Table 12.60 in ES Chapter 12 (REP1-032)). The total (cumulative) number of guillemots which could potentially suffer mortality as a consequence of displacement is estimated at between 289 and 6,746 individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in **Table 3.4**), which is **changed** from 305 – 7,107 in the EIA (see Table 12.61 in ES Chapter 12 (REP1-032)). The addition of average predicted underwater collision mortality from the Morlais and Holyhead Deep tidal energy sites is **unchanged** from the EIA (46 and eight, respectively; see paragraph 12.372 in ES Chapter 12 (REP1-032)), resulting in a total mortality of 343 to 6,800 birds per annum, which is **changed** from 359 – 7,161 in the EIA (paragraph 12.372 in ES Chapter 12 (REP1-032)).

96. Using the updated average baseline mortality rate for guillemot of 0.1405 (see Table 2.1), the number of individuals subject to mortality from the largest BDMPS population (Furness, 2015) throughout the year (breeding season: 1,145,528) would be 160,947 (1,145,528 x 0.1405) which is **changed** from 163,811 in the EIA (paragraph 12.373 in ES Chapter 12 (REP1-032)). The addition of a maximum of 6,800 individuals (i.e. the maximum potential mortality, as per **Paragraph 95** above) would increase the background mortality by 4.23%, this is **changed** from 4.37% in the EIA (paragraph 12.373 in ES Chapter 12 (REP1-032)). In relation to the biogeographic population with connectivity to UK waters, 4,125,000 (Furness, 2015), the number of individuals subject to mortality would be 579,563 (4,125,000 x 0.1405) which is **changed** from 589,875 in the EIA (paragraph 12.373 in ES Chapter 12 (REP1-032)). The addition of 343 – 6,800 (i.e. the maximum potential mortality, as per **Paragraph 95** above) individuals would increase background mortality by 0.06% – 1.17%, respectively. This is **changed** from 0.06% – 1.21% in the EIA (paragraph 12.373 in ES Chapter 12 (REP1-032)).

97. However, as per the reasons set out in **Paragraph 16** of this document and in paragraphs 12.198 to 12.206 of ES Chapter 12 (REP1-032), the maximum values set out above are considered to be precautionary and unlikely to reflect the actual effect. Therefore, a lower value (derived from a displacement rate of 50% and mortality of 1%) is considered to be realistic. It remains – as in the EIA – that for a threshold of 1% mortality to be exceeded, the displacement and mortality rates would have to be in excess of 50% and 3%, respectively (refer to Table 12.61 in ES Chapter 12 (REP1-032)), which would be significantly above realistic, evidence-based rates (paragraph 12.198 to 12.206 of ES Chapter 12 (REP1-032)).

98. Based on the information given above, the assessment conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.376 in ES Chapter 12 (REP1-032)) and is insignificant in EIA terms.

99. Notwithstanding this conclusion, the Applicant has undertaken PVA for the predicted cumulative effects on guillemot, the results of which are set out in the following section.

Table 3.4 Updated annual guillemot cumulative disturbance and displacement mortality during operation and maintenance

Annual	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	96	193	289	386	482	964	1928	2891	4819	7710	9638
20%	193	386	578	771	964	1928	3855	5783	9638	15420	19276
30%	289	578	867	1157	1446	2891	5783	8674	14457	23131	28913
40%	386	771	1157	1542	1928	3855	7710	11565	19276	30841	38551
50%	482	964	1446	1928	2409	4819	9638	14457	24094	38551	48189
60%	578	1157	1735	2313	2891	5783	11565	17348	28913	46261	57827
70%	675	1349	2024	2699	3373	6746	13493	20239	33732	53971	67464
80%	771	1542	2313	3084	3855	7710	15420	23131	38551	61682	77102
90%	867	1735	2602	3470	4337	8674	17348	26022	43370	69392	86740
100%	964	1928	2891	3855	4819	9638	19276	28913	48189	77102	96378

Note: The cells show the number of birds subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

Guillemot Population Viability Analysis (PVA)

Approach

100. A PVA was undertaken for guillemot under four impact scenarios to demonstrate 1 – 4% additional mortality, reflecting the range of predicted cumulative mortality (i.e. a maximum increase of 4.23% assuming 70% displacement and 10% mortality of displaced birds; refer to **Paragraph 96**). These four impact scenarios of 1 – 4% would represent a mortality of between 1,609 and 6,438 individuals. This PVA uses the updated background mortality rate advised by Natural England (see **Table 2.1**).

101. The PVA used the Seabird PVA Tool developed by Natural England (Searle *et al*. 2019) via the 'Shiny App' interface, using the density independent run type. Although density dependence is a natural occurrence and prevents populations from growing or declining exponentially, there is insufficient understanding of natural density dependent processes to enable reliable models. Therefore, it was considered more appropriate to use density independent models for seabird assessments, despite their biological implausibility (i.e., they would lead to an infinite increase or decline to extinction).

102. Environmental and demographic stochasticity were incorporated into the PVA model. Environmental stochasticity accounts for the variation arising from environmental changes affecting individuals in the same group, and demographic stochasticity accounts for individual-level variation affecting the fate of individuals between age-classes. The use of stochastic models is recommended by SNCBs and produces more precautionary PVA outputs than deterministic models (Cook and Robinson, 2016).

103. The two metrics used to determine effects in the PVA are the median of the ratio of impacted to un-impacted annual population growth rate (referred to as the Counterfactual of Population Growth Rate (CPGR)) and the median of the ratio of impacted to un-impacted population size (referred to as the Counterfactual of Population Size (CPS)). The two metrics are integrally linked because the predicted population size (CPS) is a product of the annual population growth rate (CPGR).

104. Species parameters used in the model are provided in **Appendix 3**. Survival rates were derived from the national values presented in Horswill and Robinson (2015).

Results

105. The PVA predicts that a range of cumulative annual displacement impacts from OWFs (1,609 – 6,438 individuals) would reduce the annual growth rate of the largest seasonal BDMPS population (1,145,528) by 0.09% – 0.37%, respectively. This would result in a 3.30% – 12.53% reduction in population

size, respectively, relative to the unimpacted population by the end of the 35-year model run. All four impact scenarios are summarised in **Table 3.5** below.

106. In all four scenarios (1 – 4% additional mortality), the PVA predicted positive growth rates for the BDMPS population of 1.0333 – 1.0304, respectively, compared with 1.0343 for the unimpacted population. This indicates a slowing of the population growth rate, rather than a population decline, across all four scenarios of potential displacement mortality. It is noted that all presented scenarios would arise as a result of high displacement and mortality rates that exceed ‘realistic’ scenarios. Accordingly, there would be no change to the assessment conclusions, i.e. that the cumulative guillemot mortality would be a **minor adverse** effect and not significant.

Table 3.5 Guillemot PVA results

Scenario	Predicted mortality	Growth rate	Median CPGR	Median CPS	Reduction in growth rate	Reduction in population size
Baseline (unimpacted)	0	1.0343	1.0000	1.0000	N/A	N/A
1% additional mortality	1609	1.0333	0.9991	0.9670	0.09%	3.30%
2% additional mortality	3219	1.0324	0.9981	0.9351	0.19%	6.49%
3% additional mortality	4828	1.0314	0.9972	0.9044	0.28%	9.56%
4% additional mortality	6438	1.0304	0.9963	0.8747	0.37%	12.53%

3.2.1.2 Manx shearwater

107. In ES Chapter 12 Offshore Ornithology (REP1-032), it was considered very unlikely that the contribution of historic projects where no quantitative data are available would affect the conclusions of the cumulative assessment. However, after performing a gap-filling exercise for historical projects, values have been attributed to the five projects (Burbo Bank, Gwynt y Môr and Rhyl Flats, Robin Rigg and Walney 1&2) that had no quantitative data available in the EIA (paragraph 12.383 in ES Chapter 12 (REP1-032)). These values are all included within the updated assessment below and are presented in **Table 3.6**, alongside all values for OWFs considered in the CEA.

Table 3.6 Abundance values used in Manx shearwater displacement CEA following gap filling, with the assessment being based on annual values. Breakdown of values by season where available.

Project*	Annual abundance (CEA values)	Breeding season abundance	Autumn passage abundance	Spring passage abundance
Awel y Môr[1, 4]	417	26	214	177
Burbo Bank Extension[2]	444	443	1	0
Burbo Bank[2]	3	2	1	0
Erebus[1, 4]	2,115	1,540	557	18
Gwynt y Môr[2]	17	13	3	1
Holyhead Deep (tidal)[1]	0	0	0	0
Morlais/West Anglesey (tidal)[1]	0	0	0	0
Mona[1]	1,271	1,249	16	6
Morgan[3]	2,165	1,254	911	0
Ormonde[2]	1,002	1,001	1	0
Rampion[1]	33	33	0	0
Rampion 2[1]	0	0	0	0
Robin Rigg[2]	4	3	1	0
Rhyl Flats[2]	5	4	1	0
TwinHub[1, 4]	1,274	1,270	3	1
Walney 1 & 2[2]	19	14	4	1
Walney 3 & 4[1, 3]	914	588	324	2
West of Duddon Sands[2]	548	544	3	1
West of Orkney[1]	11	8	3	0
White Cross[1, 4]	12,181	33	22	12,126
Morecambe	**5,537**	5,161	376	0

Project*	Annual abundance (CEA values)	Breeding season abundance	Autumn passage abundance	Spring passage abundance
Total	**27,960**	13,186	2,441	12,333

1 – Project specific abundances presented in Table 1.13 of Mona Offshore Ornithology Errata Clarification note (RPS, 2024b).

2 – Project specific abundances presented in Table A.14 of Mona Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling of Historical Projects Technical Note (RPS, 2024a).

3 – Project specific abundances presented in Table A.7 of Morgan Offshore CEA and In-combination Gap-filling of Historical Projects Note (NIRAS, 2024c).

4 – Predicted collision mortality presented in Table 12.64 of Morecambe Offshore Wind Farm Environmental Statement Volume 5 Chapter 12 Offshore Ornithology (REP1-032).

* - Where projects reference "1, 4", this refers to the source of annual abundances being from the Morecambe ES Chapter 12 (REP1-032), with the seasonal values taken from the Mona offshore ornithology errata clarification note (RPS, 2024b). Similarly, "1, 3" represents a mix of values from sources 1 and 3.

108. The total estimated number of Manx shearwaters subject to operational disturbance/displacement year-round from each relevant project is **27,960** individuals, which is **changed** from 31,095 in the EIA (**Table 12.60** in **ES Chapter 12** (REP1-032)). The total (cumulative) number of Manx shearwaters which could potentially suffer mortality as a consequence of displacement is estimated at between **84** and **1,957** individuals (displacement/mortality range of 30%/1% to 70%/10%; see cells highlighted in **Table 3.7**), which is **changed** from 93 to 2,177 birds in the EIA (see Table 12.65 in ES Chapter 12 (REP1-032)). No additional underwater collision mortality from the Morlais and Holyhead Deep tidal energy sites is predicted.

109. Using the average baseline mortality rate for Manx shearwater of 0.1300 (see **Table 2.1**), the number of individuals subject to mortality from the largest BDMPS population (Furness, 2015) throughout the year (breeding season: 1,821,518) would be 236,797 (1,821,518 x 0.1300) which is **changed** from 236,801 in the EIA (paragraph 12.382 in ES Chapter 12 (REP1-032)). The addition of a maximum of 1,957 individuals (i.e. the maximum potential mortality, as per **Paragraph 108** above) would increase the background mortality by 0.83%, this is **changed** from 0.92% in the EIA (paragraph 12.382 in ES Chapter 12 (REP1-032)). In relation to the biogeographic population with connectivity to UK waters, 2,000,000 (Furness, 2015), the number of individuals subject to mortality would be 260,000 (2,000,000 x 0.1300) which is **unchanged** from the EIA (paragraph 12.382 in ES Chapter 12 (REP1-032)). The addition of 84 to 1,957 individuals would increase background mortality by 0.03% – 0.75%, respectively. This is **changed** from the EIA (0.04% - 0.84%; paragraph **12.382** in ES Chapter 12 (REP1-032)).

110. As predicted increase in mortality is below 1% for all scenarios, the year-round impact magnitude has therefore been assessed as **negligible**. As the species is of **low** sensitivity to disturbance, the effect significance would be **negligible**

and not significant in EIA terms. The assessment conclusion is therefore **unchanged** from the EIA (paragraph 12.384 in ES Chapter 12 (REP1-032)).

Table 3.7 Updated annual Manx shearwater cumulative disturbance and displacement mortality during operation and maintenance

Annual	Mortality										
Displacement	1%	2%	3%	4%	5%	10%	20%	30%	50%	80%	100%
10%	28	56	84	112	140	280	559	839	1398	2237	2796
20%	56	112	168	224	280	559	1118	1678	2796	4474	5592
30%	84	168	252	336	419	839	1678	2516	4194	6710	8388
40%	112	224	336	447	559	1118	2237	3355	5592	8947	11184
50%	140	280	419	559	699	1398	2796	4194	6990	11184	13980
60%	168	336	503	671	839	1678	3355	5033	8388	13421	16776
70%	196	391	587	783	979	1957	3914	5872	9786	15658	19572
80%	224	447	671	895	1118	2237	4474	6710	11184	17894	22368
90%	252	503	755	1007	1258	2516	5033	7549	12582	20131	25164
100%	280	559	839	1118	1398	2796	5592	8388	13980	22368	27960

Note: The cells show the number of birds subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022). Numbers highlighted in red represent displacement impacts which would lead to a >1% increase in the background mortality rate.

3.2.2 Cumulative assessment of operation and maintenance phase collision risk

3.2.2.1 Herring gull

111. The estimated herring gull cumulative collision risk is presented in **Table 3.8**. The total annual (cumulative) number of herring gulls which could potentially suffer mortality as a consequence of collision has been estimated at 254 individuals. At the average baseline mortality rate for herring gull of 0.1724, the number of individuals subject to mortality from the largest BDMPS population throughout the year would be 37,440 (217,167 x 0.1724) The addition of 254 individuals to this increases the background mortality rate by 0.68%. This is **changed** from an increase of 0.43% in the EIA (paragraph 12.407 in ES Chapter 12 (REP1-032)). This magnitude of increase in mortality would not materially affect the background mortality of the population and would be undetectable.

112. The year-round impact magnitude has therefore been assessed as **negligible**. As the species is of **high** sensitivity to collision risk, the effect significance would be **minor adverse** and not significant in EIA terms. The conclusion of the EIA in respect of cumulative operational collision risk to herring gull is therefore **unchanged** from that presented in ES Chapter 12 Offshore Ornithology (REP1-032).

Table 3.8 Herring gull annual and seasonal cumulative collision mortality estimates using the 'large gull' avoidance rate (0.9940)

Project	Annual	Breeding	Non-breeding
Awel y Môr[1]	3.56	2.00	1.56
Burbo Bank[2]	3.32	1.82	1.50
Burbo Bank Extension[1]	12.95	Unavailable	Unavailable
Erebus[1]	4.52	2.78	1.74
Gwynt y Môr[2]	38.25	20.97	17.28
Holyhead Deep (tidal)*	0.00	0.00	0.00
Morlais/West Anglesey (tidal)*	0.00	0.00	0.00
Mona[1]	1.49	0.03	1.46
Morgan[1]	11.63	2.53	9.10
Ormonde[1]	0.43	Unavailable	Unavailable
Rhyl Flats[2]	7.50	5.10	2.40
Robin Rigg[2]	9.98	6.81	3.18
TwinHub[2]	12.54	Unavailable	Unavailable
Walney 1[2]	17.68	14.51	3.17

Project	Annual	Breeding	Non-breeding
Walney 2[2]	12.51	4.73	7.78
Walney 3 & 4[1]	74.40	45.60	28.80
West of Duddon Sands[1]	38.98	31.84	7.14
West of Orkney[1]	0.00	0.00	0.00
White Cross[1]	0.30	0.30	0.00
Morecambe[3]	**4.16**	1.78	2.38
Total	**254.20**	140.78	87.49

Notes

*underwater collision

1 - Predicted collision mortality presented in Table 1.9 of Mona Offshore Ornithology Errata Clarification note (RPS, 2024b), adjusted using the 'large gull' avoidance rate (0.9940).

2 - Predicted collision mortality presented in Table A.41 of Mona Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (RPS, 2024a), adjusted using the 'large gull' avoidance rate (0.9940).

3 - Predicted collision mortality presented in Table 12.47 of Morecambe Offshore Wind Farm Environmental Statement Volume 5 Chapter 12 Offshore Ornithology.

3.2.2.2 Lesser black-backed gull

113. The estimated lesser black-backed gull cumulative collision risk is given in **Table 3.9**. The total annual (cumulative) number of lesser black-backed gulls which could potentially suffer mortality as a consequence of collision has been estimated at 279 individuals. At the average baseline mortality rate for herring gull of 0.1237, the number of individuals subject to mortality from the largest BDMPS population throughout the year would be 29,781 (240,750 x 0.1237). The addition of 279 individuals to this increases the background mortality rate by 0.94%. This is **changed** from an increase of 0.93% in the EIA (paragraph 12.411 in ES Chapter 12 (REP1-032)). This magnitude of increase in mortality would not materially affect the background mortality of the population and would be undetectable.

114. The year-round impact magnitude has therefore been assessed as **negligible**. As the species is of **high** sensitivity to collision risk, the effect significance would be **minor adverse** and not significant in EIA terms. The conclusion of the EIA in respect of cumulative operational collision risk to lesser black-backed gull is therefore **unchanged** from that presented in ES Chapter 12 Offshore Ornithology (REP1-032).

Table 3.9 Lesser black-backed gull annual and seasonal cumulative collision mortality estimates using the 'large gull' avoidance rate (0.9940)

Project	Annual	Pre-breeding	Breeding	Post-breeding	Non-breeding
Awel y Môr[2]	0.00	0.00	0.00	0.00	Unavailable
Burbo Bank[3]	2.07	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension[2]	52.80	Unavailable	Unavailable	Unavailable	Unavailable
Erebus[2]	8.08	0.00	7.49	0.59	Unavailable
Gwynt y Môr[3]	7.20	Unavailable	Unavailable	Unavailable	Unavailable
Holyhead Deep (tidal)*	0.00	0.00	0.00	0.00	0.00
Morlais/West Anglesey (tidal)*	0.00	0.00	0.00	0.00	0.00
Mona[2]	1.89	0.82	0.32	0.00	0.75
Morgan[2]	0.97	0.00	0.00	0.54	Unavailable
Ormonde[2]	26.52	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats[3]	0.69	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg[3]	5.33	0.22	4.34	0.40	0.37
TwinHub[2]	3.28	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2[2]	68.64	Unavailable	Unavailable	Unavailable	Unavailable
Walney 3 & 4[2]	35.15	3.12	8.76	7.44	15.84
West of Duddon Sands[2]	62.88	Unavailable	Unavailable	Unavailable	Unavailable
West of Orkney	0.00	0.00	0.00	0.00	0.00
White Cross[2]	0.40	0.00	0.40	0.00	0.00
Morecambe[1]	**3.57**	0.15	2.02	1.25	0.15
Total	**279.46**	4.30	23.33	10.22	17.11

Notes

*underwater collision

1 - Predicted collision mortality presented in Table 12.47 of Morecambe Offshore Wind Farm Environmental Statement Volume 5 Chapter 12 Offshore Ornithology.

2 - Predicted collision mortality presented in Table 1.18 of Mona Offshore Ornithology Errata Clarification note (RPS, 2024b), adjusted using the 'large gull' avoidance rate (0.9940).

3 - Predicted collision mortality presented in Table A.44 of Mona Offshore Ornithology CEA and In-combination Gap-filling Historical Projects Technical Note (RPS, 2024a), adjusted using the 'large gull' avoidance rate (0.9940).

3.2.2.3 Great black-backed gull

115. The estimated great black-backed gull cumulative collision risk is given in **Table 3.10**. The total annual (cumulative) number of great black-backed gulls which could potentially suffer mortality as a consequence of collision has been estimated at 161 individuals. At the average baseline mortality rate for great black-backed gull of 0.0969, the number of individuals subject to mortality from the largest BDMPS population throughout the year would be 1,719 (17,742 x 0.0969). The addition of 161 individuals to this increases the background mortality rate by 9.37%. This is **changed** from the EIA, where an increase of 2.81% was predicted (paragraph 12.413 in ES Chapter 12 (REP1-032)), reflecting the increase in mortality (from 117 to 161) and, more significantly, the reduced reference population used for the estimation (from 44,753 to 17,742 individuals). In relation to the biogeographic population with connectivity to UK waters (235,000; Furness 2015), the number of individuals subject to mortality annually would be 22,772 (235,000 x 0.0969). The addition of 161 individuals would increase background mortality by 0.71%. This magnitude of increase in mortality would be above the threshold where such an effect may be considered significant (i.e. >1%) in respect of the BDMPS population, but would not be significant (<1%) in terms of the biogeographic population. As an effect on the BDMPS population is considered possible, an updated PVA for this species has been undertaken, the results of which are presented below.

Table 3.10 Great black-backed gull annual and seasonal cumulative collision mortality estimates using the 'large gull' avoidance rate (0.9940)

Project	Annual	Breeding	Non-breeding
Awel y Môr[2]	5.84	5.23	0.61
Burbo Bank[3]	2.26	1.10	1.16
Burbo Bank Extension[3]	6.59	3.36	3.23
Erebus[3]	0.81	0.00	0.81
Gwynt y Môr[3]	10.09	4.80	5.29
Holyhead Deep (tidal)*	0.00	0.00	0.00
Morlais/West Anglesey (tidal)*	0.00	0.00	0.00
Mona[3]	4.75	1.64	3.11
Morgan[3]	2.76	2.07	0.70
Ormonde[3]	0.29	Unavailable	Unavailable
Rampion[3]	37.45	4.68	32.76
Rampion 2[3]	19.51	6.15	13.37
Rhyl Flats[3]	1.87	0.69	1.18
Robin Rigg[3]	4.08	1.52	2.56
TwinHub[3]	7.09	Unavailable	Unavailable

Project	Annual	Breeding	Non-breeding
Walney 1[3]	4.17	2.16	2.01
Walney 2[3]	4.09	1.70	2.39
Walney 3 & 4[3]	25.53	5.79	19.74
West of Duddon Sands[3]	8.19	5.08	3.12
West of Orkney[3]	12.96	Unavailable	Unavailable
White Cross[3]	0.91	0.91	0.00
Morecambe[1]	**1.75**	**0.66**	**1.10**
Total	**161.03**	**47.56**	**93.13**

Notes

*underwater collision

1 - Predicted collision mortality presented in Table 12.47 of Morecambe Offshore Wind Farm Environmental Statement Volume 5 Chapter 12 Offshore Ornithology.

2 - Predicted collision mortality presented in Table 5.119 of Mona Offshore Wind Project Environmental Statement Volume 2 - Chapter 5: Offshore Ornithology (F02; RPS, 2024c), adjusted using the 'large gull' avoidance rate (0.9940).

3 - Predicted collision mortality presented in Table A.37 of Mona Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (RPS, 2024a), adjusted using the 'large gull' avoidance rate (0.9940).

Great black-backed gull Population Viability Analysis (PVA) update

Approach

116. A PVA was undertaken for great black-backed gull, due to the predicted annual collision mortality from OWFs (161 individuals) exceeding a 1% threshold in relation to the background mortality of the largest seasonal population for the region (UK south-west and Channel; Furness 2015). This updates the great black-backed gull PVA presented in ES Chapter 12 Offshore Ornithology (REP1-032) and incorporates both the revised cumulative mortality estimate and the amended BDMPS population of 17,742 individuals as the annual reference population, as advised by Natural England.

117. For information on the Seabird PVA Tool, refer to **Paragraphs 101** to **103** above.

118. Species parameters used in the model are provided in **Appendix 3**. Survival rates were derived from the national values presented in Horswill and Robinson (2015); since great black-backed gull juvenile and immature survival rates are unknown, Horswill and Robinson (2015) recommended using the survival rates of other large gull species when conducting population modelling for great black-backed gull. Therefore, the survival rates used in the PVA are based on the rates for herring gull as presented in Horswill and Robinson (2015).

Results

119. The updated PVA predicts that the cumulative annual great black-backed gull collision impact from OWFs (161 individuals) would reduce the annual growth rate of the largest seasonal BDMPS population (17,742) by 0.47%, and result in 15.52% decrease in population size relative to the unimpacted population by the end of the 35-year model run. However, the PVA also predicted a positive growth rate for the BDMPS population of 1.1279 at the identified level of impact, compared with 1.332 with the unimpacted population. This indicates that a slowing of the population growth rate, rather than a population decline, is likely as a result of cumulative collision mortality.

120. A summary of the PVA outputs is provided in **Table 3.11** for three scenarios – baseline (unimpacted), cumulative collision mortality including the Project, and cumulative collision mortality excluding the Project. This confirms that the Project alone would make a very small difference to the PVA, with the reduction in growth rate predicted to be 0.46% (compared to 0.47% if the Project was excluded) and reduction in population size at the end of the 35-year period of 15.36% (compared to 15.52%) for all cumulative projects excluding the Project.

121. Based on the available data, it is considered that the great black-backed gull cumulative collision risk mortality would continue to represent a **low magnitude adverse** impact. As the species is of **high sensitivity** to collision risk, the cumulative effect significance would continue to be **moderate adverse** and significant in EIA terms. This is **unchanged** from the assessment conclusions presented in ES Chapter 12 Offshore Ornithology (REP1-032).

122. It is noted that the Project has provided mitigation that has reduced collision risk to this species (i.e. through increased air gap to 25m above HAT), and also that the Project makes a very small contribution to the cumulative effect (1.1% of total predicted mortality). It is unlikely that the contribution of the Project would make any measurable difference to the assessment outcome, or that the contribution of the Project could be significantly reduced by additional mitigation (even if that was possible) that the Project could deliver. A review of the effect of further increase in air gap is presented in **Section 4**, which confirms that this would achieve no measurable benefit to this species.

Table 3.11 Great black-backed gull PVA results

Scenario	Predicted mortality	Median growth rate	Median CPGR	Median CPS	Reduction in growth rate	Reduction in population size
Baseline (unimpacted)	0	1.1332	1.000	1.000	N/A	N/A
Cumulative collision mortality (including the Project)	161.03	1.1279	0.9953	0.8448	0.47%	15.52%
Cumulative collision mortality (excluding the Project)	159.27	1.1280	0.9954	0.8464	0.46%	15.36%

3.2.2.4 Little gull

123. The estimated cumulative annual little gull collision risk is presented in **Table 3.12** which replaces Table 12.69 in ES Chapter 12 (REP1-032), and includes the predicted density of little gulls derived from SeaMaST data for historical ‘gap fill’ projects, and derived collision mortality. The table also includes the CRM results for Morgan Generation Offshore Wind Project.

Table 3.12 Revised little gull cumulative annual mortality from collision risk during operation and maintenance.

Project	Annual mortality		
Awel y Môr	0		
Burbo Bank Extension	0		
Erebus	0		
Gwynt y Môr	0		
Holyhead Deep (tidal)	0		
Morlais/West Anglesey (tidal)	0		
Mona	0		
Morgan	0.59		
Ormonde	0		
TwinHub	0		
Walney 3 & 4	0		
West of Orkney	0		
White Cross	0		
‘Gap-fill’ projects	**Summer density (birds/km^2)***	**Winter density (birds/km^2)***	**Annual Mortality**
Burbo Bank	0.00	0.00012	0 (<0.01)

Project	Annual mortality		
Gwynt y Môr	0.00	0.000069	0 (<0.01)
Rhyl Flats	0.00	0.000018	0 (<0.01)
Robin Rigg	0.00	0.00	0
Walney 1 & 2	0.00	0.000047	0 (<0.01)
West of Duddon Sands	0.00	0.000114	0 (<0.01)
Total excluding the Project	**-**	**-**	**0.59**
The Project	**-**	**-**	**2.92**
Total (all projects)	**-**	**-**	**3.51**
*Densities derived from SeaMaST data and divided by generic seasonal periods of summer and winter, refer to **Paragraph 89** in **Section 3.1.1** for detail.			

124. Predicted mortality for the ‘gap-fill’ projects with the highest recorded density from the SeaMaST dataset (Burbo Bank and West of Duddon Sands) was calculated using the sCRM tool. This confirmed that effectively zero (i.e. <0.1) annual little gull mortality for both of these projects is predicted. As densities of little gull derived from the SeaMaST dataset were lower for all other gap-fill projects (**Table 3.12**), it can be assumed that negligible (i.e. effectively zero) mortality would be predicted for all the remaining gap-fill projects.

125. The cumulative annual number of little gulls which could potentially suffer mortality because of collision has been estimated as 3.51 individuals. There is no agreed BDMPS or biogeographic population value for little gull, therefore the predicted increase in background mortality is made against the minimum EU wintering population of 5,700 (EC, 2022). At the average baseline mortality rate for little gull of 0.2000 (SNCBs, 2024), the number of individuals subject to mortality from the EU wintering population would be 1,140 (5,700 x 0.2000). The addition of a maximum of four individuals to this increases the background mortality by **0.35%**, this is **changed** from 0.26% in the EIA (paragraph 12.294 in ES Chapter 12 (REP1-032)).

126. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable (see paragraph 12.400 in ES Chapter 12 (REP1-032)). The year-round impact remains as **negligible**. As the species is of **medium sensitivity** to collision risk, the effect of significant would be **minor adverse** and not significant in EIA terms. The conclusion of the EIA is therefore **unchanged** (see paragraph 12.400 in ES Chapter 12 (REP1-032)).

4 Review of effect of air gap on great black-backed gull collision risk

4.1 Introduction

127. In its relevant representations (RR-061), NE stated, in respect of effects on great black-backed gull (GBBG), that *'We recommend that the Applicant considers further avoidance or mitigation measures (e.g. increased air gap) to reduce the Project's contribution to this significant cumulative effect.'* (RR-061-83).

128. In its response to the relevant representations (PD1-011), the Applicant stated that *'In respect of increased air gap, the Applicant also reiterates the very small relative contribution of the Project to the cumulative values (which will proportionately further decrease if additional historic projects are added to the cumulative total). Because the contribution of the Project is so small, further increase in air gap would make no meaningful difference to the cumulative mortality.'* The section therefore presents analysis of the effect of increasing air gap to support the Applicant's position.

4.2 Approach

129. CRM for GBBG has been undertaken using the stochastic CRM (sCRM) tool (McGregor, 2018), in accordance with the approach used for the ES Chapter 12 Offshore Ornithology (REP1-032). The model was run for air gaps of 25m (the current worst-case scenario; Table 12.2 of ES Chapter 12 (REP1-032)), 28m and 30m above HAT. All other parameters used in the model were unchanged from those used for the DCO, with values presented using 'Option 2' of the sCRM tool, which assumes an even distribution of birds across the height of the rotors. Values have been estimated as follows:

- Estimated annual mortality as a result of the Project for each modelled air gap (equivalent to the information presented in ES Chapter 12 Offshore Ornithology (REP1-032)), and resultant increase in background mortality in relation to the largest seasonal BDMPS[1].
- Estimated cumulative mortality when the three air gaps are applied to the Project, based on the updated cumulative totals presented in **Section 3.2.2.3**.

[1] GBBG non-breeding season BDMPS for UK South-west and Channel = 17,742 (Furness, 2015); equivalent to background mortality of 1,719 birds at an average annual mortality of 0.0969

4.3 Results

130. The results of the comparison are presented in **Table 4.1**. The original sCRM input and output files are available on request.

Table 4.1 Summary of collision risk estimates for great black-backed gull for different air gaps above HAT (mean mortality, using Option 2 of the sCRM tool)

	Air gap	25m	28m	30m
Project alone	Annual Mortality	1.750	1.472	1.319
	Increase in background mortality[1]	0.10%	0.09%	0.08%
Cumulative	Annual Mortality	161.030	160.752	160.599
	Increase in background mortality[1]	9.37%	9.35%	9.34%

[1] Assumes a reference population of 17,742 (UK South-west and Channel BDMPS for non-breeding season; Furness, 2015) and mean annual mortality rate of 0.0969 = 1,719 annual background mortality.

4.4 Conclusion

131. The results presented above confirm that increasing air gap above 25m would make a very small difference to the predicted mortality, particularly when considered for the cumulative effect. While an increase in air gap from 25m to 30m would result in a reduction of approximately 0.4 birds/annum, or 30%, in predicted collision mortality for the project alone, as the number of impacted birds is small, this would result in negligible change in background mortality (i.e. a reduction by only 0.02%).

132. For the cumulative assessment, the reduction in background mortality would also be very small (i.e. a maximum difference of 0.03%, equivalent to a 0.27% decrease in overall mortality). Such a change is likely to be undetectable at a population level, particularly when the uncertainties and level of precaution within the modelled estimates are taken into account. Therefore, the Applicant considers that a further increase in air gap would not be justified, as it would not provide measurable benefits.

5 Assessment of effects on Pen y Gogarth / Great Orme's Head SSSI

5.1 Background

133. In its written representations at Deadline 1 (REP1-099), NRW advised that the Applicant should undertake a quantitative assessment of the ornithological qualifying features of Pen-y-Gogarth / Great Orme's Head SSSI, namely kittiwake, guillemot and razorbill. Specifically, the NRW (A) advice stated:

"In our PEIR comments, NRW (A) highlighted that as the Morecambe Generation Assets project is located within foraging range of the guillemot, razorbill and kittiwake features of the Pen-y-Gogarth / Great Orme's Head SSSI, there was a need for the Applicant to present a full quantitative assessment of impacts from the proposed project on these features of the site. Whilst the Applicant presents a very high-level qualitative assessment of impacts to SSSIs in paragraphs 12.423-12.424 of Volume 5, Chapter 12 [APP-049], no quantitative assessment has been made in the submission of impacts to the guillemot, razorbill (both for displacement) or kittiwake (collision) features of this site. Therefore, the Applicant has not carried out assessment of potential impacts to this site sufficiently in order to enable the effects on the features of the site to be assessed.

"The proposed location for the Morecambe Generation Assets array area is approximately 52km from Pen-y-Gogarth / Great Orme's Head Site SSSI (Figure 1). The cliffs host a large colony of breeding seabirds, and the site is designated for breeding kittiwake, guillemot and razorbill. This is the second largest kittiwake breeding colony in Wales and the largest in North Wales, supporting approximately 790 pairs (5-year mean of peak counts 2018-2022, excluding 2020 when no data were collected due to the COVID-19 pandemic). In addition, the site supports around 1,500 guillemots and 150 razorbills each year (figures also based on 5-year mean peak 2018-2022 excluding 2020).

"NRW (A) advise that the Applicant should undertake full quantitative assessments of predicted impacts of displacement of the guillemot and razorbill and collision of the kittiwake features of the Pen-y-Gogarth / Great Orme's Head SSSI. We advise that displacement and collision risk impacts are apportioned to the site using the same approaches as used for the SPA/Ramsar assessment, i.e. to follow the NatureScot approach (as has already been done in Annex 2 of APP-070) for the breeding season and use the information in the respective Appendix A tables from Furness (2015) for the non-breeding seasons – as the SSSI colony will not be specifically listed in the Furness (2015) tables, we suggest that apportionment is informed by use of the adult proportion of birds for the 'western non SPA colonies' in the

Furness 2015 Appendix A tables. We would be happy to discuss appropriate approaches further with the Applicant if required.

"Guillemot and razorbill displacement assessments should be based on the displacement matrix approach and due to the uncertainty around specific displacement and mortality rates the assessments should consider a range of displacement rates (i.e. for auks 30-70% displacement and 1-10% mortality), as has been undertaken by the Applicant in their other assessments. Kittiwake collision assessments should be based on the stochastic collision risk model (sCRM) as used by the Applicant for their other collision assessments, using the same input parameters for bird biometrics, flight speeds, avoidance rates, nocturnal activity etc (as was provided to the Applicant by NE). If apportioned impacts equate to 1% or greater of baseline mortality then further consideration should be given through PVA. If this is the case, NRW (A) can discuss and advise appropriate input parameters with the Applicant.

"NRW (A) also advise that the Applicant considers assessment of cumulative impacts to this SSSI of the Morecambe Generation Assets project cumulatively with other plans and projects. This is particularly as the Awel y Môr, Mona and Morgan generation assets projects are all located within foraging range of all three features of the Pen y Gogarth / Great Orme's Head SSSI.

"We note that quantitative assessments of impacts to this site have been conducted by the Awel-y-Môr Applicant in their Deadline 3a submission and are also being undertaken by the Mona project and Morgan Generation Assets Applicants. We note that a recent update to the Mona assessment for this site has been submitted by the Applicant at Deadline 4. Whilst we have not yet fully reviewed this document, we understand that this includes cumulative assessments. We suggest that the Morecambe Generation Assets Applicant discusses approaches with the Mona and Morgan Generation Applicants to ensure consistent approaches are undertaken."

134. The qualitative assessment of SSSIs provided in paragraphs 12.423 - 12.424 of ES Volume 5, Chapter 12 [REP1-032] concluded that impacts on individual SSSIs would be of negligible magnitude (except for great black-backed gull associated with Puffin Island SSSI) and as a worst-case scenario, for SSSIs supporting species with high sensitivity to collision or disturbance the effect significance would be minor adverse and not significant (except for Puffin Island SSSI). However, the Applicant recognises the value of presenting a quantitative assessment of Pen y Gogarth / Great Orme's Head SSSI, noting that the Mona Offshore Wind Project and Awel y Môr Offshore Wind Farm have also undertaken a quantitative assessment. This updated assessment is provided below.

5.2 Approach

135. For each of the three qualifying species (guillemot, razorbill and kittiwake), an assessment has been made of the potential effects during the operational phase of the Project-alone, and cumulatively with other relevant projects. These effects are then considered in EIA terms, and a statement is provided as to whether the assessment changes the conclusions of the EIA in respect of Pen y Gogarth / Great Orme's Head SSSI.

136. Where predicted effects (either in Project-alone and/or cumulatively with other projects) equate to an increase of greater than 1% of baseline mortality of the SSSI population, further assessment is provided through PVA to determine the significance of the mortality for the population in question. This is the approach recommended by Parker *et al*. (2022). Generally, where the background mortality is predicted to increase by less than 0.1% and/or apportioned mortality is significantly below one individual, it has been assumed that changes would be undetectable against natural variation, and no contribution by the Project to cumulative effects has been assumed.

5.2.1 Guillemot

5.2.1.1 Status

137. Guillemot is designated as a primary component of the breeding seabird colony at Pen y Gogarth / Great Orme's Head SSSI (CCW, 2008). The most recent count (June 2023) is 2,670 individuals (SMP, 2024); however to provide a more accurate population estimate a correction factor of 1.49 has been applied (Burnell *et al*., 2023). This provides an adult population of 3,978 guillemots at Pen y Gogarth/Great Orme's Head SSSI; this is used as the reference population for the assessment.

138. Based on the most recent SSSI population of assumed breeding adults, and an annual breeding adult baseline mortality rate of 0.061 (1 – 0.939; Horswill and Robinson 2015), the expected annual mortality from the SSSI population would be 243 breeding adults.

5.2.1.2 Functional linkage and apportionment

139. The mean maximum foraging range of guillemot is 73.2km (±80.5km) and the maximum foraging range is 338km (Woodward *et al*., 2019). The Project is located 53.78km from Pen y Gogarth / Great Orme's Head SSSI, therefore the Project is within the mean maximum foraging range for guillemots from the SSSI colony during the breeding season.

140. The NatureScot apportioning tool (NatureScot, 2018) has been used to estimate the proportion of guillemots from the SSSI present at the windfarm

site during the breeding season. The tool estimated that 10.95% of adult birds present during the breeding season are likely to originate from Pen y Gogarth / Great Orme's Head SSSI.

141. Outside the breeding season, breeding guillemots from Pen y Gogarth / Great Orme's Head SSSI are assumed to range widely and to mix with guillemots of all ages from other colonies. The relevant non-breeding season reference population is the UK Western Waters BDMPS, consisting of 1,139,220 individuals (August to February) (Furness, 2015).

142. In order to apportion potential effects on guillemot during the non-breeding season, it is first necessary to estimate the non-breeding population. The guillemot population at Pen y Gogarth/Great Orme's Head SSSI in 2000 was 1,512 individuals; this is the June 2000 count provided on the SMP website (SMP, 2024). Data from 2000 is considered suitable to use in this instance as it correlates with the data used in Furness (2015) for 'West coast UK non-SPA populations'. To provide a more accurate population estimate a correction factor of 1.49 has been applied (Burnell *et al*., 2023). This provides a non-breeding adult population of 2,253 guillemots for Pen y Gogarth/Great Orme's Head SSSI. The total adult guillemot population within the 'UK Western waters' during the non-breeding period is 656,156 birds (Furness 2015), therefore, the adults at Pen y Gogarth/Great Orme's Head SSSI represent approximately 0.34% of the adult BDMPS population during this period, assuming that 100% of adults stay within the BDMPS.

5.2.1.3 Potential project-alone effects

143. The mean peak abundance of guillemots present within the windfarm site and 2km buffer during the breeding season was 6,374 (95% confidence limits: 3,968 – 9,514) individuals (refer to Appendix 12.1 of the ES). Assuming that 10.95% of adult birds present during the breeding season are likely to originate from Pen y Gogarth / Great Orme's Head SSSI, 698 (434 – 1,042) guillemots within the windfarm site were likely to be adults from the SSSI.

144. The mean peak abundance of guillemots present within the windfarm site and 2km buffer during the non-breeding season was 8,315 (6,085-12,047) individuals (refer to Appendix 12.1 of the ES). Assuming that 0.34% of adults within the wider BDMPS originate from Pen y Gogarth/Great Orme's Head SSSI, 28 (21 – 41) guillemots within the windfarm site were likely to be adults from the SSSI.

145. **Table 5.1** sets out the predicted impacts on guillemots from Pen y Gogarth/Great Orme's Head SSSI due to displacement. Displacement rates of 30% to 70% are considered for this species, along with a range of mortality rates of 1% to 10% of displaced birds (UK SNCBs, 2017).

Table 5.1 Guillemot – predicted operation and maintenance phase displacement and mortality for Pen y Gogarth/Great Orme's Head SSSI

Mean peak abundance estimate type	Mean peak abundance estimate (windfarm site)	No. of SSSI breeding adults present (non-breeding season)[2]	Annual mortality range[3]	Annual baseline mortality increase range[4]
Upper 95% CI	9,514 (breeding) 12,047 (non-breeding) 21,562 (year-round)	1,042 (breeding) 41 (non-breeding) 1,083 (year-round)	3.25 – 75.81	1.34 – 31.24%
Mean	6,374 (breeding) 8,315 (non-breeding) 14,689 (year-round)	698 (breeding) 28 (non-breeding) 726 (year-round)	2.18 – 50.82	0.90 – 20.94%
Lower 95% CI	3,968 (breeding) 6,085 (non-breeding) 10,054 (year-round)	434 (breeding) 21 (non-breeding) 455 (year-round)	1.37 – 31.85	0.56 – 13.13%

146. Based on the mean peak abundances, the total number of guillemots from Pen y Gogarth/Great Orme's Head SSSI at risk of displacement is 686 birds. At displacement rates of 30% to 70%, and mortality rates of 1% to 10% for displaced birds, between two and 51 breeding adults from the SSSI are predicted to die each year due to displacement from the Project.

147. Assuming a displacement rate of 70% and a mortality rate of 10% of displaced birds, annual mortality within the SSSI breeding adult population would increase by 20.94% (50.82 birds). These displacement and mortality rates are much higher than evidence suggested would actually be the case. Using an evidence-based displacement rate of 50%, and a mortality rate for displaced birds of 1%, annual mortality in the population would instead increase by 1.50% (3.63 birds).

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2 Assumes 10.95% of birds present during the breeding season and 0.34% of birds present during the non-breeding season are Pen y Gogarth/Great Orme's Head SSSI breeding adults

3 Assumes displacement rates of 30-70% and mortality rates of 1-10%

4 Background adult mortality rate of 6.1% (Horswill and Robinson, 2015)

5.2.1.4 Potential cumulative effects

148. **Table 5.2**, **Table 5.3**, and **Table 5.4** present the predicted cumulative disturbance and displacement impact to the breeding guillemot population of Pen y Gogarth/Great Orme's Head SSSI. The list of offshore wind projects is the same as the list of projects in the CEA of ES Chapter 12 (REP1-032) and takes into consideration the results of the gap-filling exercise by The Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets to ensure consistency and alignment between the projects' respective CEAs.

149. Since the assessment is concerned with impacts on the breeding population of Pen y Gogarth/Great Orme's Head SSSI, it has been necessary to apply a correction factor to the apportioned abundances from each project in order to calculate the proportion of adults in the population. This has been taken from Furness (2015).

150. The total population of adult guillemots from Pen y Gogarth/Great Orme's Head SSSI at risk of cumulative disturbance and displacement effects is predicted to be 1,458 birds (**Table 5.2**). At displacement rates of 30% to 70%, and mortality rates of 1% to 10% for displaced birds, between four and 92 breeding adults from the SSSI are predicted to die each year due to cumulative displacement (**Table 5.3**).

151. Assuming a displacement rate of 70% and a mortality rate of 10% of displaced birds, annual mortality within the SSSI breeding adult population would increase by 37.86% (91.87 birds). These displacement and mortality rates are much higher than evidence suggests would actually be the case. Evidence to support this is presented in Paragraphs 1171 to 1172 of the RIAA (REP1-012) and Paragraphs 12.202-12.203 of ES Chapter 12 (REP1-032). Using an evidence-based displacement rate of 50%, and a mortality rate for displaced birds of 1%, annual mortality in the population would instead increase by 2.70% (6.56 birds; **Table 5.4**). Including additional apportioned mortality from the Morlais and Holyhead tidal projects (total 1.47 birds), the annual mortality would increase to 3.30% (8.03 birds).

Table 5.2 Apportioning of guillemot to enable cumulative assessment of disturbance and displacement for Pen y Gogarth/Great Orme's Head SSSI

	Breeding					Non-breeding				
Project	**Breeding abundance**	**Breeding apportioning proxy**	**Breeding apportioning rate to SSSI**	**Proportion of adults (Furness 2015)**	**Apportioned breeding population**	**Non-breeding abundance**	**Non-breeding apportioning rate to SSSI**	**Proportion of adults (Furness 2015)**	**Apportioned breeding population**	**Population for assessment**
Awel y Môr	1,569	Awel y Môr	36.50%	57.00%	326	2,919	0.34%	57.00%	5.66	**332.09**
Burbo Bank	41	Mona	15.60%	57.00%	4	58	0.34%	57.00%	0.11	**3.76**
Burbo Bank Extension	1,000	Mona	15.60%	57.00%	89	1,561	0.34%	57.00%	3.03	**91.95**
Erebus*	7,001	N/A	0%	57.00%	0	28,338	0.34%	57.00%	54.92	**54.92**
Gwynt y Môr	149	Awel y Môr	25.40%	57.00%	22	205	0.34%	57.00%	0.40	**21.97**
Mona	4,220	Mona	15.60%	57.00%	375	3,756	0.34%	57.00%	7.28	**382.52**
Morgan	4,010	Morgan	2%	57.00%	46	3,824	0.34%	57.00%	7.41	**53.12**
Ormonde	912	Morgan	2%	57.00%	10	56	0.34%	57.00%	0.11	**10.51**
Rhyl Flats	49	Awel y Môr	48.60%	57.00%	14	68	0.34%	57.00%	0.13	**13.71**
Robin Rigg*	138	N/A	0%	57.00%	0	88	0.34%	57.00%	0.17	**0.17**
TwinHub*	39	N/A	0%	57.00%	0	217	0.34%	57.00%	0.42	**0.42**
Walney 1 & 2	161	Morgan	2%	57.00%	2	227	0.34%	57.00%	0.44	**2.28**
Walney 3 & 4	4,169	Morgan	2%	57.00%	48	1,927	0.34%	57.00%	3.73	**51.26**
West of Duddon Sands	1,321	Morgan	2%	57.00%	15	166	0.34%	57.00%	0.32	**15.38**
West of Orkney*	4,861	N/A	0%	57.00%	0	4,275	0.34%	57.00%	8.28	**8.28**
White Cross*	3,304	N/A	0%	57.00%	0	1,059	0.34%	57.00%	2.05	**2.05**
Morecambe	**6,374**	**Morecambe**	**10.95%**	**57.00%**	**398**	**8,315**	**0.34%**	**57.00%**	**16.11**	**413.95**
Total	**39,318**				**1,348**	**57,059**			**110.58**	**1,458.33**

*no connectivity during the breeding season

Table 5.3 Annual cumulative displacement matrix for guillemot from Pen y Gogarth/Great Orme's Head SSSI

Annual	**Mortality**										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	1.31	2.62	3.94	5.25	6.56	13.12	26.25	39.37	65.62	105.00	131.25
20%	2.62	5.25	7.87	10.50	13.12	26.25	52.50	78.75	131.25	210.00	262.50
30%	3.94	7.87	11.81	15.75	19.69	39.37	78.75	118.12	196.87	315.00	393.75
40%	5.25	10.50	15.75	21.00	26.25	52.50	105.00	157.50	262.50	420.00	525.00
50%	6.56	13.12	19.69	26.25	32.81	65.62	131.25	196.87	328.12	525.00	656.25
60%	7.87	15.75	23.62	31.50	39.37	78.75	157.50	236.25	393.75	630.00	787.50
70%	9.19	18.37	27.56	36.75	45.94	91.87	183.75	275.62	459.37	735.00	918.75
80%	10.50	21.00	31.50	42.00	52.50	105.00	210.00	315.00	525.00	840.00	1050.00
90%	13.12	26.25	39.37	52.50	65.62	131.25	262.50	393.75	656.25	1050.00	1312.50
100%	14.58	29.17	43.75	58.33	72.92	145.83	291.67	437.50	729.17	1166.66	1458.33

Note: The cells show the number of birds subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022).

Table 5.4 Estimated cumulative change in background mortality rate for guillemot from Pen y Gogarth/Great Orme's Head SSSI

Annual	**Mortality**										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	0.54%	1.08%	1.62%	2.16%	2.70%	5.41%	10.82%	16.23%	27.04%	43.27%	54.09%
20%	1.08%	2.16%	3.25%	4.33%	5.41%	10.82%	21.64%	32.45%	54.09%	86.54%	108.18%
30%	1.62%	3.25%	4.87%	6.49%	8.11%	16.23%	32.45%	48.68%	81.13%	129.81%	162.27%
40%	2.16%	4.33%	6.49%	8.65%	10.82%	21.64%	43.27%	64.91%	108.18%	173.08%	216.35%
50%	2.70%	5.41%	8.11%	10.82%	13.52%	27.04%	54.09%	81.13%	135.22%	216.35%	270.44%
60%	3.25%	6.49%	9.74%	12.98%	16.23%	32.45%	64.91%	97.36%	162.27%	259.62%	324.53%
70%	3.79%	7.57%	11.36%	15.14%	18.93%	37.86%	75.72%	113.59%	189.31%	302.89%	378.62%
80%	4.33%	8.65%	12.98%	17.31%	21.64%	43.27%	86.54%	129.81%	216.35%	346.17%	432.71%
90%	5.41%	10.82%	16.23%	21.64%	27.04%	54.09%	108.18%	162.27%	270.44%	432.71%	540.88%
100%	6.01%	12.02%	18.03%	24.04%	30.05%	60.10%	120.20%	180.29%	300.49%	480.79%	600.98%
Note: Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022).											

5.2.1.5 Population Viability Analysis (PVA)

Approach

152. A PVA was undertaken for breeding guillemots from Pen y Gogarth/Great Orme's Head SSSI, due to the predicted Project alone and cumulative annual displacement mortality exceeding a 1% threshold in relation to the background mortality of the SSSI population (**Paragraphs 147 and 151**).

153. Species parameters used in the model are provided in **Appendix 3**. Survival rates were derived from the national values presented in Horswill and Robinson (2015). The PVA used the Seabird PVA Tool developed by Natural England (Searle *et al*. 2019) and the most recent version of the 'Shiny App' interface (November 2024); for information on the Seabird PVA Tool, refer to **Paragraphs 101** to **103** above.

Results

154. For the Project alone, and assuming realistic displacement of 50% and 1% mortality of displaced birds, the PVA predicts that the annual guillemot displacement mortality impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.10%, and result in a 3.61% decrease in population size relative to the unimpacted population by the end of the 35-year model run. The PVA also predicted a positive median growth rate for the SSSI population of 1.0333 at the identified level of impact, compared with 1.0344 with the unimpacted population. This indicates that a slight slowing of the population growth rate, rather than a population decline, is likely as a result of Project alone displacement mortality.

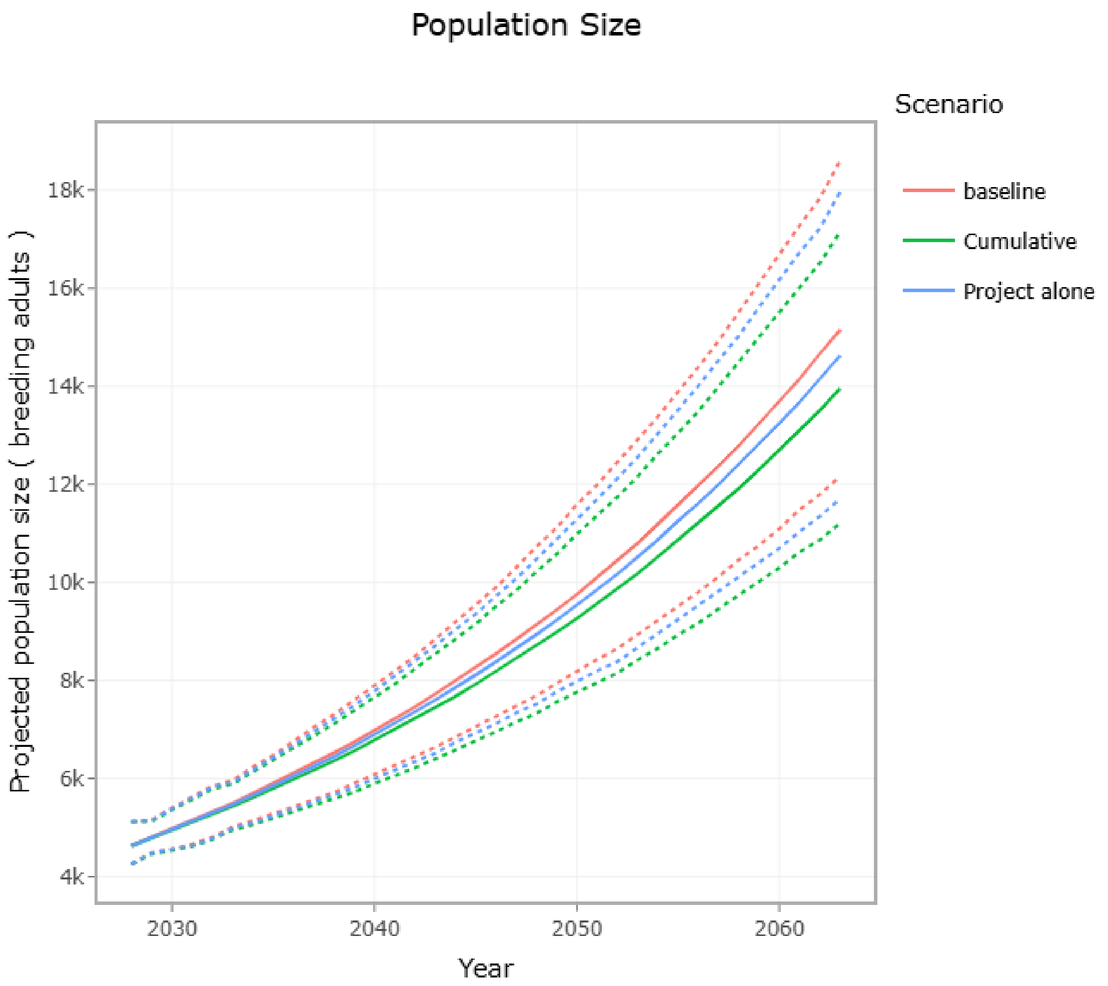
155. Cumulatively with other projects, the PVA predicts that the annual guillemot displacement mortality impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.23%, and result in a 7.84% decrease in population size relative to the unimpacted population by the end of the 35-year model run. However, the PVA also predicted a positive median growth rate for the SSSI population of 1.0320 at the identified level of impact, compared with 1.0344 for the unimpacted population. This indicates that a slowing of the population growth rate, rather than a population decline, is likely as a result of cumulative displacement mortality.

156. **Table 5.5** provides a summary of the PVA results, and **Plate 5.1** presents a visual representation of the predicted population growth under the baseline, Project alone impact, and cumulative impact scenarios.

Table 5.5 Pen y Gogarth/Great Orme's Head SSSI guillemot PVA results

Scenario	Additional annual mortality	Median growth rate	Median CPGR	Median CPS	Reduction in growth rate (CPGR)	Reduction in population size (CPS)
Baseline (unimpacted)	0	1.0344	1.0000	1.0000	N/A	N/A
Project alone displacement mortality	3.63	1.0333	0.9990	0.9639	0.10%	3.61%
Cumulative displacement mortality	8.03	1.0320	0.9977	0.9216	0.23%	7.84%

Plate 5.1 Pen y Gogarth/Great Orme's Head SSSI guillemot PVA projected population size (dashed lines represent upper and lower confidence intervals)



5.2.2 Razorbill

5.2.2.1 Status

157. Razorbill is designated as a primary feature component of the breeding seabird colony at Pen y Gogarth / Great Orme's Head SSSI (CCW, 2008). The most recent count (June 2023) is 370 individuals (SMP, 2024); however to provide a more accurate population estimate a correction factor of 1.34 has been applied (Burnell *et al*., 2023). This provides an adult population of 496 razorbills at Pen y Gogarth/Great Orme's Head SSSI; this is used as the reference population for the assessment.

158. Based on the most recent SSSI population of assumed breeding adults, and an annual breeding adult baseline mortality rate of 0.105 (1 – 0.895; Horswill and Robinson, 2015), the expected annual mortality from the SSSI population would be 52 breeding adults.

5.2.2.2 Functional linkage and apportionment

159. The mean maximum foraging range of razorbill is 88.7km (±75.9km) and the maximum foraging range is 313km (Woodward *et al*., 2019). The Project is located approximately 53.78km from Pen y Gogarth / Great Orme's Head SSSI, therefore the Project is within the mean maximum foraging range for razorbills from the SSSI colony during the breeding season.

160. The NatureScot apportioning tool (NatureScot, 2018) has been used to estimate the proportion of razorbills from the SSSI present at the windfarm site during the breeding season. The tool estimated that 11.21% of adult birds present during the breeding season are likely to originate from Pen y Gogarth / Great Orme's Head SSSI.

161. Outside the breeding season, razorbills from the SSSI are assumed to range widely and to mix with razorbills of all ages from other colonies. The relevant non-breeding season reference population is the UK Western Waters BDMPS, consisting of 606,914 individuals during autumn and spring passage periods (August to October and January to March), and 341,422 individuals during winter (November and December) (Furness, 2015).

162. To estimate the potential effect on razorbill during the non-breeding periods, it is first necessary to estimate the non-breeding population. The razorbill population at Pen y Gogarth/Great Orme's Head SSSI in 2000 was 225 individuals; this is the June 2000 count provided on the Seabird Monitoring Programme website (SMP, 2024). Data from 2000 is considered suitable to use as it correlates with the data used in Furness (2015) for 'UK western non-SPA colonies'. To provide a more accurate population estimate a correction

factor of 1.34 has been applied (Burnell et al., 2023). This provides an adult population of 302 razorbills at Pen y Gogarth/Great Orme's Head SSSI.

163. The total adult razorbill population within the 'UK Western waters' during the spring and autumn migration periods is 316,928 birds (Furness 2015). Therefore, the population of 302 adults at Pen y Gogarth/Great Orme's Head SSSI represent approximately 0.09% of the adult BDMPS population during these periods, if the Mona Offshore Wind Project approach is followed (RPS, 2024d) which presumes that 98% of adult birds stay within the BDMPS during this period. This approach is considered appropriate, as it aligns with the published information for comparable SPAs within the UK western waters BDMPS in Furness (2015).

164. The total adult razorbill population within the 'UK Western waters' during the winter period is 179,183 birds (Furness 2015). Therefore, the population of 302 adults at Pen y Gogarth/Great Orme's Head SSSI represent approximately 0.07% of the adult BDMPS population during this period, if the Mona Offshore Wind Project approach is followed (RPS 2024d) which presumes that 40% of adult birds stay within the BDMPS during this period, in accordance with information for comparable SPAs in Furness (2015).

5.2.2.3 Potential project-alone effects

165. The mean peak abundance of razorbills present within the windfarm site and 2km buffer during the breeding season was 252 (21 – 605) individuals (refer to Appendix 12.1 of the ES). Assuming that 11.21% of adult birds present during the breeding season are likely to originate from Pen y Gogarth / Great Orme's Head SSSI, 28 (2 – 68) razorbills within the windfarm site were likely to be adults from the SSSI.

166. The mean peak abundance of razorbills present within the windfarm site and 2km buffer during the autumn migration period was 694 (309 – 1,070) individuals (refer to Appendix 12.1 of the ES). Assuming that 0.09% of adults within the wider BDMPS originate from Pen y Gogarth/Great Orme's Head SSSI, 1 (0 – 1) razorbill within the windfarm site was likely to be an adult from the SSSI.

167. The mean peak abundance of razorbills present within the windfarm site and 2km buffer during the winter period was 651 (159 – 1297) individuals (refer to Appendix 12.1 of the ES). Assuming that 0.07% of adults within the wider BDMPS originate from Pen y Gogarth/Great Orme's Head SSSI, less than one (0 – 1) razorbill within the windfarm site was likely to be an adult from the SSSI.

168. The mean peak abundance of razorbills present within the windfarm site and 2km buffer during the spring migration period was 382 (214 – 580) individuals (refer to Appendix 12.1 of the ES). Assuming that 0.09% of adults within the wider BDMPS originate from Pen y Gogarth/Great Orme's Head SSSI, less

than one (0 – 1) razorbill within the windfarm site was likely to be an adult from the SSSI.

169. **Table 5.6** sets out the predicted impacts on razorbills from Pen y Gogarth/Great Orme's Head SSSI due to displacement. Displacement rates of 30% to 70% are considered for this species, along with a range of mortality rates of 1% to 10% of displaced birds (UK SNCBs, 2017).

Table 5.6 Razorbill - predicted operation and maintenance phase displacement and mortality for Pen y Gogarth/Great Orme's Head SSSI

Mean peak abundance estimate type	Mean peak abundance estimate (windfarm site)	No. of SSSI breeding adults present (non-breeding season)[5]	Annual mortality range[6]	Annual baseline mortality increase range[7]
Upper 95% CI	605 (breeding) 1,070 (autumn) 1,297 (winter) 580 (spring) 3,552 (year-round)	68 (breeding) 1 (autumn) 1 (winter) 1 (spring) 71 (year-round)	0 – 5	0.41 – 9.54%
Mean	252 (breeding) 694 (autumn) 651 (winter) 382 (spring) 1,979 (year-round)	28 (breeding) 1 (autumn) 0 (winter) 0 (spring) 29 (year-round)	0 – 2	0.17 – 3.90%
Lower 95% CI	21 (breeding) 309 (autumn) 159 (winter) 214 (spring) 703 (year-round)	2 (breeding) 0 (autumn) 0 (winter) 0 (spring) 2 (year-round)	0 – 0	0.01 – 0.27%

170. Based on the mean peak abundances, the total number of razorbill from Pen y Gogarth/Great Orme's Head SSSI at risk of displacement from the Project is 29 birds. At displacement rates of 30% to 70%, and mortality rates of 1% to 10% for displaced birds, 0 to 2 breeding adults from the SSSI are predicted to die each year due to displacement from the Project.

[5] Assumes 11.21% of birds present during the breeding season, 0.09% of birds during the spring and autumn migration periods and 0.07% of birds during the winter period are Pen y Gogarth/Great Orme's Head SSSI breeding adults

[6] Assumes displacement rates of 30-70% and mortality rates of 1-10%

[7] Background mortality rate of 10.5% (Horswill and Robinson, 2015)

171. Assuming a displacement rate of 70% and a mortality rate of 10% of displaced birds, annual mortality within the SSSI breeding adult population would increase by 3.9%. Using an evidence-based displacement rate of 50%, and a mortality rate for displaced birds of 1%, annual mortality in the population would instead increase by 0.28% (0.15 birds).

172. Increases in the existing mortality rate of less than 1% are likely to be undetectable against natural variation. This means that no detectable changes in mortality rates would occur in this population from the mean monthly collision estimates for the Project alone.

5.2.2.4 Potential cumulative effects

173. **Table 5.7**, **Table 5.8** and **Table 5.9** present the predicted cumulative disturbance and displacement impact to the breeding razorbill population of Pen y Gogarth/Great Orme's Head SSSI. The list of offshore wind projects is the same as the list of projects in the CEA of ES Chapter 12 (REP1-032) and takes into consideration the results of the gap-filling exercise by The Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets to ensure consistency and alignment between the projects' respective CEAs.

174. Since the assessment is concerned with impacts on the breeding population of Pen y Gogarth/Great Orme's Head SSSI, it has been necessary to apply a correction factor to the apportioned abundances from each project in order to calculate the proportion of adults in the population. This has been taken from Furness (2015).

175. The total population of adult razorbills from Pen y Gogarth/Great Orme's Head SSSI at risk of cumulative disturbance and displacement effects is predicted to be 87.5 (88) birds (**Table 5.7**). At displacement rates of 30% to 70%, and mortality rates of 1% to 10% for displaced birds, 0.24 to 5.51 breeding adults from the SSSI are predicted to die each year due to cumulative displacement **Table 5.8**).

176. Assuming a displacement rate of 70% and a mortality rate of 10% of displaced birds, annual mortality within the SSSI breeding adult population would increase by 10.58%. These displacement and mortality rates are much higher than evidence suggested would actually be the case. Using an evidence-based displacement rate of 50%, and a mortality rate for displaced birds of 1%, annual mortality in the population would instead increase by 0.76% (0.39 birds; **Table 5.9**). Including additional apportioned mortality from the Morlais and Holyhead tidal projects (total 0.52 birds), the annual mortality would increase to 1.75% (0.91 birds).

Table 5.7 Apportioning of razorbill to enable cumulative assessment of disturbance and displacement

Project	Spring (pre-breeding)				Breeding					Autumn (post-breeding)				Winter (non-breeding)				Total apportioned population for assessment
	Spring abundance	Apportioning rate to SSSI	Proportion of adults (Furness 2015)	Apportioned population	Breeding abundance	Breeding apportioning proxy	Apportioning rate to SSSI	Proportion of adults (Furness 2015)	Apportioned population	Autumn abundance	Apportioning rate to SSSI	Proportion of adults (Furness 2015)	Apportioned population	Winter abundance	Apportioning rate to SSSI	Proportion of adults (Furness 2015)	Apportioned population	
Awel y Môr	336	0.09%	57.00%	0.17	140	Awel y Môr	39.90%	57.00%	31.84	66	0.09%	57.00%	0.03	150	0.07%	57.00%	0.06	**32.11**
Burbo Bank	10	0.09%	57.00%	0.01	3	Morecambe	11.21%	57.00%	0.19	6	0.09%	57.00%	0.00	9	0.07%	57.00%	0.00	**0.19**
Burbo Bank Extension	0	0.09%	57.00%	0.00	64	Morecambe	11.21%	57.00%	4.09	0	0.09%	57.00%	0.00	29	0.07%	57.00%	0.01	**4.09**
Erebus	896	0.09%	57.00%	0.46	194	N/A	0%	57.00%	0.00	1,708	0.09%	57.00%	0.88	1,069	0.07%	57.00%	0.43	**0.88**
Gwynt y Môr	39	0.09%	57.00%	0.02	12	Awel y Môr	39.90%	57.00%	2.73	22	0.09%	57.00%	0.01	32	0.07%	57.00%	0.01	**2.74**
Mona	1,924	0.09%	57.00%	0.99	83	Mona	21.10%	57.00%	9.98	91	0.09%	57.00%	0.05	421	0.07%	57.00%	0.17	**10.03**
Morgan	166	0.09%	57.00%	0.09	120	Morgan	4%	57.00%	2.74	103	0.09%	57.00%	0.05	233	0.07%	57.00%	0.09	**2.79**
Ormonde	10	0.09%	57.00%	0.01	174	Morecambe	11.21%	57.00%	11.12	6	0.09%	57.00%	0.00	8	0.07%	57.00%	0.00	**11.12**
Rhyl Flats	12	0.09%	57.00%	0.01	4	Awel y Môr	39.90%	57.00%	0.91	7	0.09%	57.00%	0.00	10	0.07%	57.00%	0.00	**0.91**
Robin Rigg	15	0.09%	57.00%	0.01	63	N/A	0%	57.00%	0.00	11	0.09%	57.00%	0.01	14	0.07%	57.00%	0.01	**0.01**
TwinHub	0	0.09%	57.00%	0.00	12	N/A	0%	57.00%	0.00	0	0.09%	57.00%	0.00	53	0.07%	57.00%	0.02	**0.00**
Walney 1 & 2	40	0.09%	57.00%	0.02	12	Morecambe	11.21%	57.00%	0.77	25	0.09%	57.00%	0.01	34	0.07%	57.00%	0.01	**0.78**
Walney 3 & 4	0	0.09%	57.00%	0.00	76	Morecambe	11.21%	57.00%	4.86	874	0.09%	57.00%	0.45	3,066	0.07%	57.00%	1.22	**5.30**
West of Duddon Sands	0	0.09%	57.00%	0.00	0	Morecambe	11.21%	57.00%	0.00	0	0.09%	57.00%	0.00	202	0.07%	57.00%	0.08	**0.00**
West of Orkney	97	0.09%	57.00%	0.05	70	N/A	0%	57.00%	0.00	144	0.09%	57.00%	0.07	15	0.07%	57.00%	0.01	**0.07**
White Cross	345	0.09%	57.00%	0.18	40	N/A	0%	57.00%	0.00	40	0.09%	57.00%	0.02	361	0.07%	57.00%	0.14	**0.02**
Morecambe	**382**	**0.09%**	**57.00%**	**0.20**	**252**	**Morecambe**	**11.21%**	**57.00%**	**16.10**	**694**	**0.09%**	**57.00%**	**0.36**	**651**	**0.07%**	**57.00%**	**0.26**	**16.46**
Total	**4,272**			**2.19**	**1,319**				**85.32**	**3,797**			**1.95**	**6,357**			**0.00**	**87.50**

Table 5.8 Annual cumulative displacement matrix for razorbill from Pen y Gogarth/Great Orme's Head SSSI

Annual	**Mortality**										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	0.08	0.16	0.24	0.32	0.39	0.79	1.58	2.36	3.94	6.30	7.88
20%	0.16	0.32	0.47	0.63	0.79	1.58	3.15	4.73	7.88	12.60	15.75
30%	0.24	0.47	0.71	0.95	1.18	2.36	4.73	7.09	11.81	18.90	23.63
40%	0.32	0.63	0.95	1.26	1.58	3.15	6.30	9.45	15.75	25.20	31.50
50%	0.39	0.79	1.18	1.58	1.97	3.94	7.88	11.81	19.69	31.50	39.38
60%	0.47	0.95	1.42	1.89	2.36	4.73	9.45	14.18	23.63	37.80	47.25
70%	0.55	1.10	1.65	2.21	2.76	5.51	11.03	16.54	27.56	44.10	55.13
80%	0.63	1.26	1.89	2.52	3.15	6.30	12.60	18.90	31.50	50.40	63.00
90%	0.79	1.58	2.36	3.15	3.94	7.88	15.75	23.63	39.38	63.00	78.75
100%	0.88	1.75	2.63	3.50	4.38	8.75	17.50	26.25	43.75	70.00	87.50

Note: The cells show the number of birds subject to mortality (rounded to the nearest integer) at a given rate of displacement and mortality. Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022).

Table 5.9 Estimated cumulative change in background mortality rate for razorbill from Pen y Gogarth/Great Orme's Head SSSI

Annual	**Mortality**										
Displacement	**1%**	**2%**	**3%**	**4%**	**5%**	**10%**	**20%**	**30%**	**50%**	**80%**	**100%**
10%	0.15%	0.30%	0.45%	0.60%	0.76%	1.51%	3.02%	4.54%	7.56%	12.10%	15.12%
20%	0.30%	0.60%	0.91%	1.21%	1.51%	3.02%	6.05%	9.07%	15.12%	24.19%	30.24%
30%	0.45%	0.91%	1.36%	1.81%	2.27%	4.54%	9.07%	13.61%	22.68%	36.29%	45.36%
40%	0.60%	1.21%	1.81%	2.42%	3.02%	6.05%	12.10%	18.15%	30.24%	48.39%	60.49%
50%	0.76%	1.51%	2.27%	3.02%	3.78%	7.56%	15.12%	22.68%	37.80%	60.49%	75.61%
60%	0.91%	1.81%	2.72%	3.63%	4.54%	9.07%	18.15%	27.22%	45.36%	72.58%	90.73%
70%	1.06%	2.12%	3.18%	4.23%	5.29%	10.58%	21.17%	31.75%	52.92%	84.68%	105.85%
80%	1.21%	2.42%	3.63%	4.84%	6.05%	12.10%	24.19%	36.29%	60.49%	96.78%	120.97%
90%	1.51%	3.02%	4.54%	6.05%	7.56%	15.12%	30.24%	45.36%	75.61%	120.97%	151.21%
100%	1.68%	3.36%	5.04%	6.72%	8.40%	16.80%	33.60%	50.40%	84.01%	134.41%	168.01%
Note: Blue highlighted cells are considered to the most realistic scenarios, in accordance with SNCB advice (SNCBs, 2022).											

5.2.2.5 Population Viability Analysis (PVA)

177. A PVA was undertaken for breeding razorbills from Pen y Gogarth/Great Orme's Head SSSI, due to the predicted cumulative annual displacement mortality from OWFs exceeding a 1% threshold in relation to the background mortality of the SSSI (**Paragraph 176**). This threshold was not met for Project alone annual displacement mortality, however the PVA has been run for both Project alone and cumulative effects for comparative purposes.

178. Due to an apparent error in the Natural England Seabird PVA tool for razorbill (January 2025), guillemot demographic parameters were used as a proxy to run the PVA. Although this will generate slightly different values from those that would have been the case had the razorbill parameters been available, the differences would be small (due to guillemot having similar productivity and survival rates) and would not affect the conclusions of the assessment. The PVA used the Seabird PVA Tool developed by Natural England (Searle *et al*. 2019) and the most recent version of the 'Shiny App' interface (November 2024); for information on the Seabird PVA Tool, refer to **Paragraphs 101** to **103** above.

Results

179. For the Project alone, and assuming realistic displacement of 50% and 1% mortality of displaced birds, the PVA predicts that the annual razorbill displacement mortality impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.03%, and result in a 1.08% decrease in population size relative to the unimpacted population by the end of the 35-year model run. The PVA also predicted a positive median growth rate for the SSSI population of 1.0340 at the identified level of impact, compared with 1.0343 with the unimpacted population. This indicates that a slight slowing of the population growth rate, rather than a population decline, is likely as a result of Project alone displacement mortality.

180. Cumulatively with other projects, the PVA predicts that the annual guillemot displacement mortality impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.21%, and result in a 7.25 decrease in population size relative to the unimpacted population by the end of the 35-year model run. However, the PVA also predicted a positive median growth rate for the SSSI population of 1.0323 at the identified level of impact, compared with 1.0343 for the unimpacted population. This indicates that a slowing of the population growth rate, rather than a population decline, is likely as a result of cumulative displacement mortality.

181. **Table 5.10** provides a summary of the PVA results, and **Plate 5.2** presents a visual representation of the predicted population growth under the baseline, Project alone impact, and cumulative impact scenarios.

Table 5.10 Pen y Gogarth/Great Orme's Head SSSI razorbill PVA results

Scenario	Additional annual mortality	Median growth rate	Median CPGR	Median CPS	Reduction in growth rate (CPGR)	Reduction in population size (CPS)
Baseline (unimpacted)	0	1.0343	1.0000	1.0000	N/A	N/A
Project alone displacement mortality	0.15	1.0340	0.9997	0.9892	0.03%	1.08%
Cumulative displacement mortality	0.91	1.0323	0.9979	0.9275	0.21%	7.25%

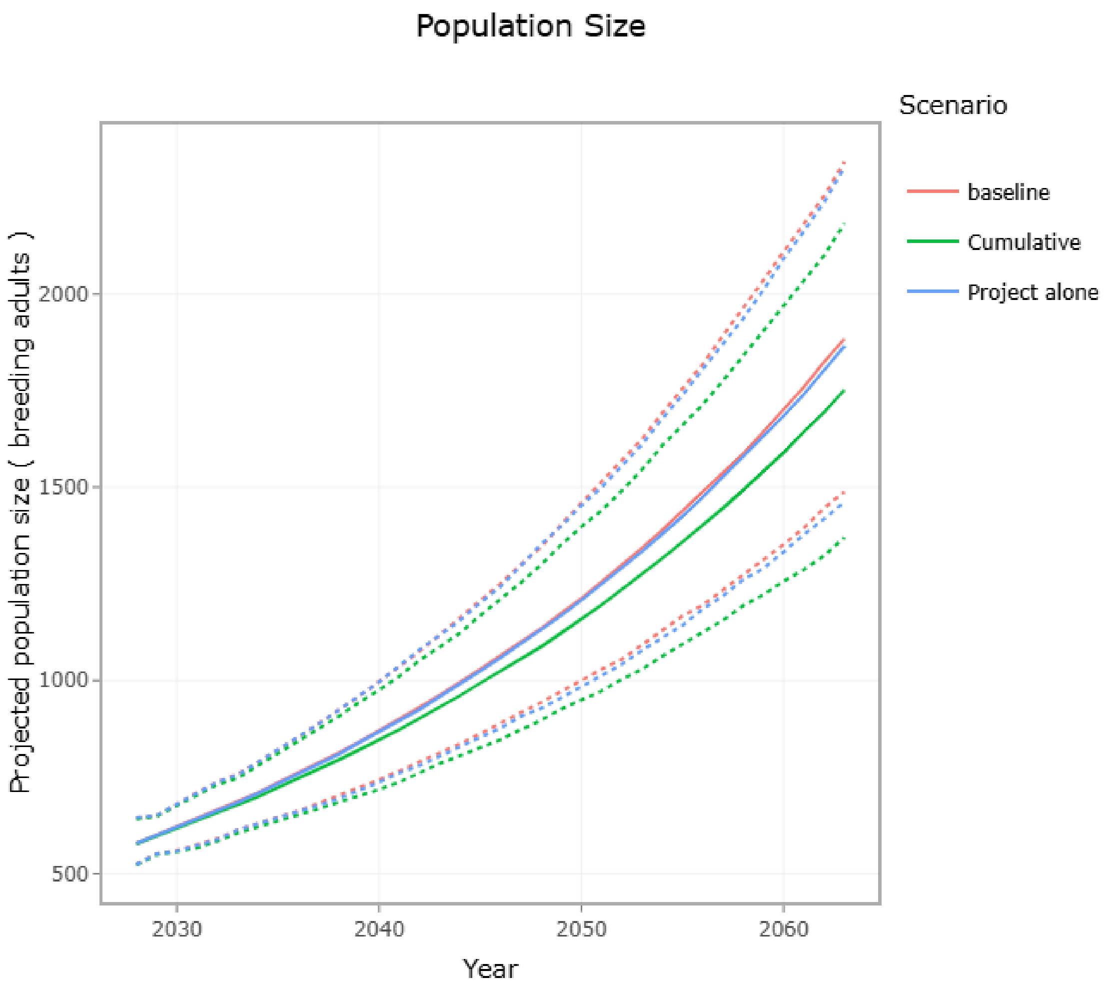


Plate 5.2 Pen y Gogarth/Great Orme's Head SSSI razorbill PVA projected population size (dashed lines represent upper and lower confidence intervals)

5.2.3 Kittiwake

5.2.3.1 Status

182. Kittiwake is designated as a primary feature component of the breeding seabird colony at Pen y Gogarth / Great Orme's Head SSSI (CCW, 2002). The most recent count (June 2023) is 564 apparently occupied nests (AON; SMP, 2024). This provides an adult population of 1,128 adults, which is used as the reference population for the assessment.

183. Based on the most recent SSSI population of assumed breeding adults, and an annual breeding adult baseline mortality rate of 0.146 (1 – 0.854; Horswill and Robinson, 2015), the expected annual mortality rate from the SSSI population would be 165 breeding adults.

5.2.3.2 Functional linkage and apportionment

184. The mean maximum foraging range of kittiwake is 156.1km (±144.5km) and the maximum foraging range is 770km (Woodward et al., 2019). The Project is located approximately 53.78km from Pen y Gogarth / Great Orme's Head SSSI, therefore the Project is within the mean maximum foraging range for kittiwakes from the SSSI colony during the breeding season.

185. The NatureScot apportioning tool (NatureScot, 2018) has been used to estimate the proportion of kittiwakes from the SSSI present at the windfarm site during the breeding season. The tool estimated that 4.93% of adult birds present during the breeding season are likely to originate from Pen y Gogarth / Great Orme's Head SSSI.

186. Outside the breeding season, breeding kittiwakes from the SSSI are considered to range widely and to mix with kittiwakes of all ages from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK Western Waters and Channel BDMPS, consisting of 911,586 individuals during autumn migration (September to December) and 627,816 during spring migration (January to February) (Furness, 2015).

187. To estimate the potential effect on kittiwake during the non-breeding periods, it is first necessary to estimate the non-breeding population. The kittiwake population at Pen y Gogarth/Great Orme's Head SSSI in 2000 was 1,147 AON, or 2,294 breeding adults; this is the June 2000 count provided on the Seabird Monitoring Programme website (SMP, 2024). Data from 2000 is considered suitable to use as it correlates with the data used in Furness (2015) for 'UK Western waters plus Channel'.

188. The total adult kittiwake population within the 'UK Western waters plus Channel' during the autumn migration period is 498,970 birds (Furness 2015). Therefore, the adults at Pen y Gogarth/Great Orme's Head SSSI represent

approximately 0.28% of the adult BDMPS population during this period, if the Mona Offshore Wind Project approach is followed (RPS, 2024d) which presumes 60% of adult birds stay within the BDMPS during this period, in accordance with information for comparable SPAs in Furness (2015).

189. The total adult kittiwake population within the ‘UK Western waters plus Channel’ during the spring migration period is 375,711 birds (Furness 2015). Therefore, the adults at Pen y Gogarth/Great Orme’s Head SSSI represent approximately 0.49% of the adult BDMPS population during this period, if the Mona Offshore Wind Project approach is followed which presumes 80% of adult birds stay within the BDMPS during this period.

5.2.3.3 Potential project-alone effects

190. **Table 5.11** sets out the predicted collision risk to kittiwakes from Pen y Gogarth/Great Orme’s Head SSSI due to the Project. Collision estimates, calculated using the sCRM, are presented by biological season. A summary of the annual outputs and the corresponding increase in the annual baseline mortality rate is also presented. Parameters used in the sCRM were agreed with Natural England during the ETG process and are described in Chapter 12 Offshore Ornithology (REP1-032) and Appendix 12.1 of the ES (APP-070).

191. Based on the mean collision rates, the annual total of breeding adult kittiwakes from Pen y Gogarth/Great Orme’s Head SSSI at risk of collision as a result of the Project is less than one adult bird (0.78). This would increase the existing mortality of the SSSI breeding population by 0.47%. Increases in the existing mortality rate of less than 1% are likely to be undetectable against natural variation. This means that no detectable changes in mortality rates would occur in this population from the mean monthly collision estimates for the Project alone.

Table 5.11 Predicted seasonal and annual collision mortality (Stochastic model Option 2, avoidance rate 0.993 (±0.0003)), for breeding adult kittiwakes at the windfarm site, apportioned to Pen y Gogarth/Great Orme's Head SSSI, with corresponding increases to baseline mortality of the population

	Breeding season (Mar – Aug)	Autumn migration (Sep – Dec)	Spring migration (Jan-Feb)	Annual
Total windfarm site collisions (mean and 95% CIs)	15.36[8] (4.17 – 33.87)	8.49 (2.20 – 18.85)	0.63 (0.00 – 1.46)	24.48 (6.37 – 54.17)
% apportioned to the SSSI	4.93%	0.28%	0.49%	-
Total SSSI collisions (mean and 95% CIs)	0.76 (0.21 – 1.67)	0.02 (0.00 – 0.05)	0.00 (0.00 – 0.01)	0.78 (0.21 – 1.73)
Baseline mortality increase[9] (mean and 95% CIs)	0.46% (0.13 – 1.01%)	0.01% (0.00 – 0.03)	0.00% (0.00 – 0.00)	0.47% (0.13 – 1.04%)

5.2.3.4 Potential cumulative effects

192. **Table 5.12** presents the predicted cumulative impact of collision risk to the breeding kittiwake population of Pen y Gogarth/Great Orme's Head SSSI. The list of offshore wind projects is the same as the list of projects in the CEA of ES Chapter 12 (REP1-032) and takes into consideration the results of the gap-filling exercise by The Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets undertaken to ensure consistency and alignment between the projects' respective CEAs. The proportion of adults in the population is taken from Furness (2015).

193. Since the assessment is concerned with impacts on the breeding population of Pen y Gogarth/Great Orme's Head SSSI, it has been necessary to apply a correction factor to the apportioned impacts from each project in order to calculate the proportion of adults in the population. This has been taken from Furness (2015).

194. The annual cumulative collision mortality impact on Pen y Gogarth/Great Orme's Head SSSI breeding kittiwakes from the Project alongside other offshore wind projects is predicted to be 8.16 adult birds. When considering the latest population estimate of 564 apparently occupied nests (1,128 adult birds) in 2023 and the baseline mortality rate of 0.146, the baseline mortality

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[8] Breeding season collision values reduced to 94.1% of modelled value to reflect proportion of adult birds recorded during site surveys.
[9] Assuming predicted annual SSSI mortality of 165 birds (1,128 x 0.146)

at this SSSI can be estimated at 165 birds. Based on this assumption, the additional impact of up to 8.16 adult birds annually would result in an increase in the baseline mortality of 4.95%.

Table 5.12 Apportioning of kittiwake collision impacts to enable cumulative assessment

Project	Spring migration (pre-breeding)				Breeding					Autumn migration (post-breeding)				Total apportioned impact for assessment
	Un-apportioned impact	Apportioning rate to SSSI	Proportion of adults (Furness, 2015)	Apportioned impact	Un-apportioned impact	Breeding apportioning proxy	Apportioning rate to SSSI	Proportion of adults (Furness, 2015)	Apportioned impact	Un-apportioned impact	Apportioning rate to SSSI	Proportion of adults (Furness, 2015)	Apportioned impact	
Awel y Môr	15.30	0.49%	53.00%	0.04	11.66	Awel y Môr	53.00%	53.00%	3.28	8.29	0.28%	53.00%	0.01	**3.33**
Burbo Bank	0.54	0.49%	53.00%	0.00	0.84	Morecambe	4.93%	53.00%	0.02	0.84	0.28%	53.00%	0.00	**0.02**
Burbo Bank Extension	0.00	0.49%	53.00%	0.00	23.04	Morecambe	4.93%	53.00%	0.60	0.00	0.28%	53.00%	0.00	**0.60**
Erebus	12.51	0.49%	53.00%	0.03	0.50	N/A	0.00%	53.00%	0.00	24.64	0.28%	53.00%	0.04	**0.07**
Gwynt y Môr	0.84	0.49%	53.00%	0.00	1.45	Awel y Môr	53.00%	53.00%	0.41	1.33	0.28%	53.00%	0.00	**0.41**
Holyhead Deep (tidal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morlais/West Anglesey (tidal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mona	8.74	0.49%	53.00%	0.02	15.52	Mona	15.60%	53.00%	1.28	8.41	0.28%	53.00%	0.01	**1.32**
Morgan	13.18	0.49%	53.00%	0.03	5.00	Morgan	7.00%	53.00%	0.19	21.63	0.28%	53.00%	0.03	**0.25**
Ormonde	0.00	0.49%	53.00%	0.00	3.27	Morecambe	4.93%	53.00%	0.09	0.00	0.28%	53.00%	0.00	**0.09**
Rampion	41.76	0.49%	53.00%	0.11	70.56	N/A	0.00%	53.00%	0.00	15.84	0.28%	53.00%	0.02	**0.13**
Rampion 2	17.00	0.49%	53.00%	0.04	1.00	N/A	0.00%	53.00%	0.00	10.00	0.28%	53.00%	0.01	**0.06**
Rhyl Flats	0.75	0.49%	53.00%	0.00	1.34	Awel y Môr	53.00%	53.00%	0.38	1.18	0.28%	53.00%	0.00	**0.38**
Robin Rigg	0.74	0.49%	53.00%	0.00	1.33	Morecambe	4.93%	53.00%	0.03	1.27	0.28%	53.00%	0.00	**0.04**
TwinHub	0.00	0.49%	53.00%	0.00	9.78	N/A	0.00%	53.00%	0.00	0.00	0.28%	53.00%	0.00	**0.00**
Walney 1	1.16	0.49%	53.00%	0.00	1.81	Morecambe	4.93%	53.00%	0.05	1.87	0.28%	53.00%	0.00	**0.05**
Walney 2	0.56	0.49%	53.00%	0.00	3.26	Morecambe	4.93%	53.00%	0.09	0.71	0.28%	53.00%	0.00	**0.09**
Walney 3 & 4	15.19	0.49%	53.00%	0.04	18.79	Morecambe	4.93%	53.00%	0.49	86.40	0.28%	53.00%	0.13	**0.66**
West of Duddon Sands	2.59	0.49%	53.00%	0.01	3.99	Morecambe	4.93%	53.00%	0.10	4.16	0.28%	53.00%	0.01	**0.12**
West of Orkney	20.99	0.49%	53.00%	0.05	17.06	N/A	0.00%	53.00%	0.00	16.44	0.28%	53.00%	0.02	**0.08**
White Cross	9.26	0.49%	53.00%	0.02	3.70	N/A	0.00%	53.00%	0.00	1.85	0.28%	53.00%	0.00	**0.03**
Morecambe	**0.62**	**0.49%**	**53.00%**	**0.00**	**16.32**	**Morecambe**	**4.93%**	**53.00%**	**0.43**	**8.50**	**0.28%**	**53.00%**	**0.01**	**0.44**
Total	**161.73**			**0.42**	**210.22**				**7.43**	**213.36**			**0.32**	**8.16**

5.2.3.5 Population Viability Analysis (PVA)

Approach

195. A PVA was undertaken for breeding kittiwakes from Pen y Gogarth/Great Orme's Head SSSI, due to the predicted cumulative annual collision mortality from OWFs exceeding a 1% threshold in relation to the background mortality of the SSSI population (**Paragraph 194**). This threshold was not met for Project alone annual collision mortality, however the PVA has been run for both Project alone and cumulative effects for comparative purposes.

196. Species parameters used in the model are provided in **Appendix 3**. Survival rates were derived from the national values presented in Horswill and Robinson (2015). The PVA used the Seabird PVA Tool developed by Natural England (Searle et al. 2019) and the most recent version of the 'Shiny App' interface (November 2024); for information on the Seabird PVA Tool, refer to **Paragraphs 101** to **103** above.

Results

197. For the Project alone, the PVA predicts that the annual kittiwake collision impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.09%, and result in a 2.88% decrease in population size relative to the unimpacted population by the end of the 35-year model run. The PVA also predicted a positive median growth rate for the SSSI population of 1.0132 at the identified level of impact, compared with 1.0140 with the unimpacted population. This indicates that a slight slowing of the population growth rate, rather than a population decline, is likely as a result of Project alone collision mortality.

198. Cumulatively with other OWFs, the PVA predicts that the annual kittiwake collision impact would reduce the annual growth rate of the Pen y Gogarth/Great Orme's Head SSSI population by 0.86%, and result in a 22.66% decrease in population size relative to the unimpacted population by the end of the 35-year model run. However, the PVA also predicted a positive median growth rate for the SSSI population of 1.0054 at the identified level of impact, compared with 1.0140 for the unimpacted population. This indicates that a slowing of the population growth rate, rather than a population decline, is likely as a result of cumulative collision mortality.

199. **Table 5.13** provides a summary of the PVA results, and **Plate 5.3** presents a visual representation of the predicted population growth under the baseline, Project alone impact, and cumulative impact scenarios.

Table 5.13 Pen y Gogarth/Great Orme's Head SSSI kittiwake PVA results

Scenario	Additional annual mortality	Median growth rate	Median CPGR	Median CPS	Reduction in growth rate (CPGR)	Reduction in population size (CPS)
Baseline (unimpacted)	0	1.0140	1.0000	1.0000	N/A	N/A
Project alone collision mortality	0.78	1.0132	0.9991	0.9712	0.09%	2.88%
Cumulative collision mortality	8.16	1.0054	0.9914	0.7734	0.86%	22.66%

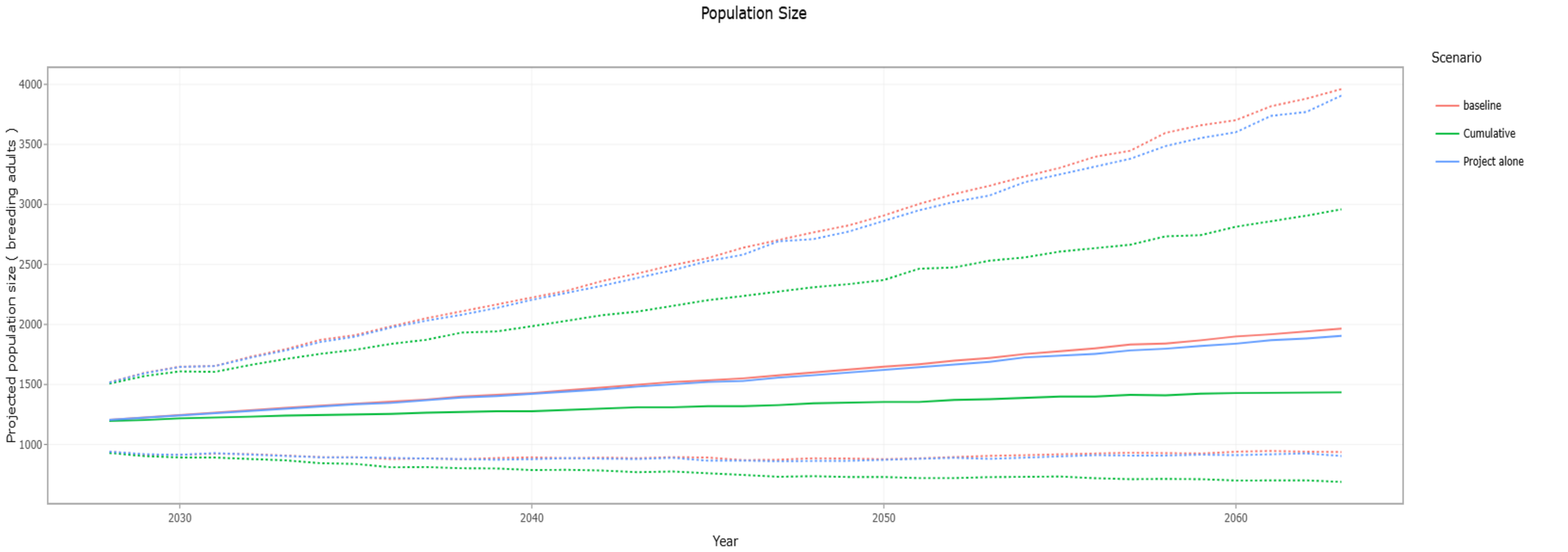

Plate 5.3 Pen y Gogarth/Great Orme's Head SSSI kittiwake PVA projected population size (dashed lines represent upper and lower confidence intervals)

5.3 Assessment Summary

5.3.1 Project-alone

200. Project-alone effects on guillemot, razorbill and kittiwake from Pen y Gogarth / Great Orme's Head SSSI are anticipated to be very small, with predicted increases in annual mortality of 1.5% for guillemot, 0.28% for razorbill and 0.47% for kittiwake. Increases in the existing mortality rate of less than 1% are likely to be undetectable against natural variation. This means that no detectable changes in mortality rates would occur in the SSSI populations from the Project alone.

201. For guillemot, the Project-alone effect is considered to be of **minor adverse** impact magnitude, and for razorbill and kittiwake it is considered to be of **negligible** impact magnitude. Guillemot and razorbill are considered to be of **medium** sensitivity to disturbance and kittiwake is of **medium** sensitivity to collision risk, therefore the effect on all three species would be **minor adverse** and not significant in EIA terms.

5.3.2 Cumulative effects

202. Cumulative effects on guillemot, razorbill and kittiwake from Pen y Gogarth / Great Orme's Head SSSI are anticipated to be relatively small, with predicted increases in annual mortality of 3.3% for guillemot, 1.75% for razorbill and 4.95% for kittiwake. PVA has identified that the populations of these three species would not be prevented from growing due to the Project and other projects considered in the cumulative assessment, although there would be a slowing in the population growth rate for each species.

203. For guillemot, razorbill and kittiwake, the cumulative effect on Pen y Gogarth / Great Orme's Head SSSI is considered to be of **minor adverse** impact magnitude. Guillemot and razorbill are considered to be of **medium** sensitivity to disturbance and kittiwake is of **medium** sensitivity to collision risk, therefore the effect on all three species would be **minor adverse** and not significant in EIA terms.

5.4 Conclusion

204. The assessment of Pen y Gogarth/Great Orme's Head SSSI has not identified any significant adverse effects that are likely to occur in respect of guillemot, razorbill and kittiwake, either from the Project alone or cumulatively with other projects. This does not change the overall conclusions of the EIA, which predicted no significant cumulative adverse effects on this SSSI.

6 References

APEM (2022) Awel y Môr Offshore Wind Farm Category 6: Environmental Statement Volume 4, Annex 4.3: Offshore Ornithology Collision Risk Modelling Revision B. Application reference 6.4.4.3. April 2022.

Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G. & Hume, D. (2014) Mapping Seabird Sensitivity to Offshore Wind Farms. PLoS ONE. 9. E106366. 10.1371/journal.pone.0106366. Data accessed via: https://www.data.gov.uk/dataset/96fce7bb-6561-4084-97cb-6ba92d982903/seabird-mapping-sensitivity-tool-seamast

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

Cook, A.S.C.P. & Robinson, R.A. (2016) Testing sensitivity of metrics of seabird population response to offshore wind farm effects, JNCC Report No. 553, Joint Nature Conservation Committee (JNCC), Peterborough, ISSN 0963-8091.

Countryside Council for Wales (CCW, 2008) Pen y Gogarth / Great Orme's Head SSSI citation.

European Commission (2022) Population status and trends of birds under Article 12 of the Birds Directive. https://nature-art12.eionet.europa.eu/article12/ (Accessed November 2024)

Furness, R.W. (2015) Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Report Number 164.

Horswill, C. & Robinson R. A. (2015) Review of seabird demographic rates and density dependence. JNCC Report No. 552. Joint Nature Conservation Committee, Peterborough

Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, E.H.K. (2014a) Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology, 51, 31-41.

Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, N.H.K. (2014b) corrigendum. Journal of Applied Ecology, 51, doi: 10.1111/1365-2664.12260

McGregor, R.M., King, S., Donovan, C.R., Caneco, B., Webb, A (2018) A Stochastic Collision Risk Model for Seabirds in Flight. Marine Scotland. https://dmpstats.shinyapps.io/avian_stochcrm/

Natural England (2024) Seabird Mapping & Sensitivity Tool (SeaMaST).

NatureScot (2018). Interim Guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs.

NIRAS (2013) Burbo Bank Extension Offshore Wind Farm. ES Chapter 15 Ornithology, Technical Annex4: Collision Risk Modelling. January 2013. Accessed: https://tethys.pnnl.gov/sites/default/files/publications/Burbo-Bank-Extension-ES-Vol2.pdf

NIRAS (2024a) Morgan Offshore Wind Project: Generation Assets. Environmental Statement Volume 4, Annex 5.1: Offshore ornithology baseline characterisation. Document reference: F4.5.1. April 2024.

NIRAS (2024b) Morgan Offshore Wind Project: Generation Assets. Environmental Statement Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report. Document reference: F4.5.3. April 2024.

NIRAS (2024c) Morgan Offshore Wind Project: Generation Assets Offshore Ornithology CEA and In-combination Gap-filling of Historical Projects Note. Document reference: S_D1_4.5. 03 October 2024. Examination Library: REP1-010

Royal HaskoningDHV (2024) Morecambe Offshore Wind Farm: Generation Assets Environmental Statement Volume 5 Chapter 12 – Offshore Ornithology.

RPS (2024a) Mona Offshore Wind Project Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-fulling Historical Projects Technical Note. 30 September 2024. Examination Library: REP3-044.

RPS (2024b) Mona Offshore Wind Project Offshore Ornithology Errata Clarification Note. 30 September 2024. Examination Library: REP3-073.

RPS (2024c) Mona Offshore Wind Project Environmental Statement Volume 2 – Chapter 5: Offshore Ornithology (F02). 27 August 2024.

RPS (2024d) Mona Offshore Wind Project Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head SSSI (F02). 4 November 2024.

Seabird Monitoring Programme (SMP, 2024). Seabird Monitoring Programme website. Available at https://app.bto.org/seabirds/public/index.jsp.

Searle, K., Mobbs, D., Daunt, F., & Butler, A. (2019) A Population Viability Analysis Modelling Tool for Seabird Species. Centre for Ecology & Hydrology report for Natural England. Natural England Commissioned Report NECR274.

SNCBs (2024). Joint advice note from the Statutory Nature Conservation Bodies (SNCBs) regarding bird collision risk modelling for offshore wind developments. JNCC, Natural England, Natural Resources Wales, NatureScot (August 2024)

The Crown Estate (2019). 2017-2019, Royal Haskoning, Cumulative Ornithological Collision Risk Database. Available at https://www.marinedataexchange.co.uk/details/TCE-2373/2017-2019-royal-haskoning-cumulative-ornithological-collision-risk-database.

Waggitt, J. J., Evans, P. G., Andrade, J., Banks, A. N., Boisseau, O., Bolton, M., ... & Hiddink, J. G. (2020) Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), 253-269.

Woodward, I., Thaxter, C.B., Owen, E., Cook, A.S.C.P. (2019). Desk-based revision of seabird foraging ranges used for HRA screening.

WWT Consulting (2015) Update to databases and modelling. On behalf of Natural England. Date: Jul 2015.

Appendix 1: Little Gull CRM Input Parameters

Table A.1 Little gull input parameters used in the sCRM

Species	Flight type	% flights upwind	Body length m (±SD)	Wingspan m (±SD)	Flight speed m/s ()	Nocturnal activity (±SD)	Avoidance rate (±SD)
Little gull	Flapping	50	0.26[1] (±0.005)	0.78[1] (±0.0125)	11.51 (0)	0.25[2](0)	0.9929 (±0.0003)[3]
1 – Default values used in the Avian Stochastic CRM (McGregor *et al.*, 2018) see tool documentation for further background. 2 – From Garthe and Hüppop (2004) and Furness (2013) 3 – From the joint SNCBs advice note (SNCBs, 2024)							

Table A.2 Little gull monthly densities (birds/km²) used in the sCRM

Project	Density	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Burbo Bank[1]	Mean (birds/km²)	0.000120	0.000120	0.000120	0.00	0.00	0.00	0.00	0.00	0.000120	0.000120	0.000120
	SD (birds/km²)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Morgan[2]	Mean (birds/km²)	0.10	0.00	0.00	0.015	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD (birds/km²)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
West of Duddon Sands[1]	Mean (birds/km²)	0.000114	0.000114	0.000114	0.00	0.00	0.00	0.00	0.00	0.000114	0.000114	0.000114
	SD (birds/km²)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 – Values derived from SeaMaST data interrogation (Bradbury *et al*., 2014)												

Project	Density	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2 – Values taken from the Morgan Offshore Wind Project offshore ornithology baseline characterisation report (NIRAS, 2024a)												

Appendix 2: Little gull CRM outputs

Table A.3 Annual Option 2 outputs for little gull sCRM

Project	Mean	SD	CV	Median	LCL 2.5%	UCL 97.5%
Burbo Bank	0.001	0	0.042	0.001	0.001	0.001
Morgan	0.589	0.028	0.048	0.588	0.535	0.643
West of Duddon Sands	0.004	0	0.042	0.004	0.004	0.004

Appendix 3: Population Viability Analyses input parameters

Table A.4 Guillemot input parameters used in the CEA PVA

Parameter	Value
PVA model run type	simplescenarios
Model to use for environmental stochasticity	betagamma
Model for density dependence	No dd.
Include demographic stochasticity in the model?	Yes
Number of simulations	5000
Random seed	10
Years for burn-in	4
Case study selected	None
Species chosen to set initial values	Common Guillemot
Age at first breeding	6
Upper constraint on productivity in the model?	Yes, constrained to 1 per pair
Number of sub-populations	1
Are demographic rates applied separately to each subpopulation?	No
Units for initial population size	All individuals
Are baseline demographic rates specified separately for immatures?	Yes
Initial population values	1,145,528 in 2024
Productivity rate per pair	Mean 0.672, SD 0.147
Adult survival rate	Mean 0.939, SD 0.015
Immature survival rate – age class 0 to 1	Mean 0.56, SD 0.00001
Immature survival rate – age class 1 to 2	Mean 0.792, SD 0.00001
Immature survival rate – age class 2 to 3	Mean 0.917, SD 0.00001
Immature survival rate – age class 3 to 4	Mean 0.939, SD 0.015
Immature survival rate – age class 4 to 5	Mean 0.939, SD 0.015
Immature survival rate – age class 5 to 6	Mean 0.939, SD 0.015
Number of impact scenarios	4
Are impacts applied separately to each subpopulation?	No
Are impacts of scenarios specified separately for immatures?	Yes
Are standard errors of impacts available?	No

Parameter	Value
Should random seeds be matched for impact scenarios?	Yes
Are impacts specified as relative value or absolute harvest?	Relative
Years in which impacts are assumed to begin and end	2028 to 2063
Scenario A: 1% mortality	
Impact on productivity rate	None
Impact on adult survival rate	0.001405
Impact on immature survival rate	None
Scenario B: 2% mortality	
Impact on productivity rate	None
Impact on adult survival rate	0.00281
Impact on immature survival rate	None
Scenario C: 3% mortality	
Impact on productivity rate	None
Impact on adult survival rate	0.004215
Impact on immature survival rate	None
Scenario D: 4% mortality	
Impact on productivity rate	None
Impact on adult survival rate	0.00562
Impact on immature survival rate	None
First year to include in outputs	2028
Final year to include in outputs	2063
How should outputs be produced, in terms of ages?	Whole population

Table A.5 Great black-backed gull input parameters used in the CEA PVA

Parameter	Value
PVA model run type	simplescenarios
Model to use for environmental stochasticity	betagamma
Model for density dependence	No dd.
Include demographic stochasticity in the model?	Yes
Number of simulations	5000
Random seed	10
Years for burn-in	4
Case study selected	None
Species chosen to set initial values	Great black-backed gull
Age at first breeding	5
Upper constraint on productivity in the model?	Yes, constrained to 3 per pair
Number of sub-populations	1
Are demographic rates applied separately to each subpopulation?	No
Units for initial population size	All individuals
Are baseline demographic rates specified separately for immatures?	Yes
Initial population values	17,742 in 2024
Productivity rate per pair	Mean 1.139, SD 0.533
Adult survival rate	Mean 0.930, SD 0.0001
Immature survival rate – age class 0 to 1	Mean 0.798, SD 0.0001
Immature survival rate – age class 1 to 2	Mean 0.930, SD 0.0001
Immature survival rate – age class 2 to 3	Mean 0.930, SD 0.0001
Immature survival rate – age class 3 to 4	Mean 0.930, SD 0.0001
Immature survival rate – age class 4 to 5	Mean 0.930, SD 0.0001
Number of impact scenarios	2
Are impacts applied separately to each subpopulation?	No
Are impacts of scenarios specified separately for immatures?	Yes
Are standard errors of impacts available?	No
Should random seeds be matched for impact scenarios?	Yes
Are impacts specified as relative value or absolute harvest?	Relative

Parameter	Value
Years in which impacts are assumed to begin and end	2028 to 2063
Scenario A: With Morecambe	
Impact on productivity rate	None
Impact on adult survival rate	0.00090762
Impact on immature survival rate	None
Scenario B: Without Morecambe	
Impact on productivity rate	None
Impact on adult survival rate	0.008977
Impact on immature survival rate	None
First year to include in outputs	2028
Final year to include in outputs	2063
How should outputs be produced, in terms of ages?	Whole population

Table A.6 Guillemot input parameters used in the Pen y Gogarth / Great Orme's Head SSSI PVA

Parameter	Value
PVA model run type	simplescenarios
Model to use for environmental stochasticity	betagamma
Model for density dependence	No dd.
Include demographic stochasticity in the model?	Yes
Number of simulations	5000
Random seed	10
Years for burn-in	4
Case study selected	None
Species chosen to set initial values	Common Guillemot
Age at first breeding	6
Upper constraint on productivity in the model?	Yes, constrained to 1 per pair
Number of sub-populations	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
Initial population values	3,978 in 2023
Productivity rate per pair	Mean 0.672, SD 0.147
Adult survival rate	Mean 0.939, SD 0.015
Immature survival rate – age class 0 to 1	Mean 0.56, SD 0.00001
Immature survival rate – age class 1 to 2	Mean 0.792, SD 0.00001
Immature survival rate – age class 2 to 3	Mean 0.917, SD 0.00001
Immature survival rate – age class 3 to 4	Mean 0.939, SD 0.015
Immature survival rate – age class 4 to 5	Mean 0.939, SD 0.015
Immature survival rate – age class 5 to 6	Mean 0.939, SD 0.015
Number of impact scenarios	2
Are impacts applied separately to each subpopulation?	No
Are impacts of scenarios specified separately for immatures?	Yes
Are standard errors of impacts available?	No

Parameter	Value
Should random seeds be matched for impact scenarios?	No
Are impacts specified as relative value or absolute harvest?	Relative
Years in which impacts are assumed to begin and end	2028 to 2063
Scenario A: Project alone	
Impact on productivity rate	None
Impact on adult survival rate	0.000913 (3.63 / 3978)
Impact on immature survival rate	None
Scenario B: Cumulative	
Impact on productivity rate	None
Impact on adult survival rate	0.002019 (8.03 / 3978)
Impact on immature survival rate	None
First year to include in outputs	2028
Final year to include in outputs	2063
How should outputs be produced, in terms of ages?	Breeding adults

Table A.7 Razorbill input parameters used in the Pen y Gogarth / Great Orme's Head SSSI PVA

Parameter	Value
PVA model run type	simplescenarios
Model to use for environmental stochasticity	betagamma
Model for density dependence	No dd.
Include demographic stochasticity in the model?	Yes
Number of simulations	5000
Random seed	10
Years for burn-in	4
Case study selected	None
Species chosen to set initial values	Guillemot
Age at first breeding	6
Upper constraint on productivity in the model?	Yes, constrained to 1 per pair
Number of sub-populations	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
Initial population values	496 in 2023
Productivity rate per pair	Mean 0.672, SD 0.147
Adult survival rate	Mean 0.939, SD 0.015
Immature survival rate – age class 0 to 1	Mean 0.56, SD 0.00001
Immature survival rate – age class 1 to 2	Mean 0.792, SD 0.00001
Immature survival rate – age class 2 to 3	Mean 0.917, SD 0.00001
Immature survival rate – age class 3 to 4	Mean 0.939, SD 0.015
Immature survival rate – age class 4 to 5	Mean 0.939, SD 0.015
Immature survival rate – age class 5 to 6	Mean 0.939, SD 0.015
Number of impact scenarios	2
Are impacts applied separately to each subpopulation?	No
Are impacts of scenarios specified separately for immatures?	Yes
Are standard errors of impacts available?	No
Should random seeds be matched for impact scenarios?	No

Parameter	Value
Are impacts specified as relative value or absolute harvest?	Relative
Years in which impacts are assumed to begin and end	2028 to 2063
Scenario A: Project alone	
Impact on productivity rate	None
Impact on adult survival rate	0.000302 (0.15 / 496)
Impact on immature survival rate	None
Scenario B: Cumulative	
Impact on productivity rate	None
Impact on adult survival rate	0.001835 (0.91 / 496)
Impact on immature survival rate	None
First year to include in outputs	2028
Final year to include in outputs	2063
How should outputs be produced, in terms of ages?	Breeding adults

Table A.8 Kittiwake input parameters used in the Pen y Gogarth / Great Orme's Head SSSI PVA

Parameter	Value
PVA model run type	simplescenarios
Model to use for environmental stochasticity	betagamma
Model for density dependence	No dd.
Include demographic stochasticity in the model?	Yes
Number of simulations	5000
Random seed	10
Years for burn-in	4
Case study selected	None
Species chosen to set initial values	Black-legged kittiwake
Age at first breeding	4
Upper constraint on productivity in the model?	Yes, constrained to 2 per pair
Number of sub-populations	1
Are demographic rates applied separately to each subpopulation?	No
Units for initial population size	Breeding adults

Parameter	Value
Are baseline demographic rates specified separately for immatures?	Yes
Initial population size	1,128 in 2023
Productivity rate per pair	Mean 0.690, SD 0.296
Adult survival rate	Mean 0.854, SD 0.051
Immature survival rate – age class 0 to 1	Mean 0.79, SD 0.00001
Immature survival rate – age class 1 to 2	Mean 0.854, SD 0.051
Immature survival rate – age class 2 to 3	Mean 0.854, SD 0.051
Immature survival rate – age class 3 to 4	Mean 0.854, SD 0.051
Number of impact scenarios	2
Are impacts applied separately to each subpopulation?	No
Are impacts of scenarios specified separately for immatures?	Yes
Are standard errors of impacts available?	No
Should random seeds be matched for impact scenarios?	No
Are impacts specified as relative value or absolute harvest?	Relative
Years in which impacts are assumed to begin and end	2028 to 2063
Scenario A: Project alone	
Impact on productivity rate	None
Impact on adult survival rate	0.000691 (0.78 / 1128)
Impact on immature survival rate	None
Scenario B: Cumulative	
Impact on productivity rate	None
Impact on adult survival rate	0.007234 (8.16 / 1128)
Impact on immature survival rate	None
First year to include in outputs	2028
Final year to include in outputs	2063
How should outputs be produced, in terms of ages?	Breeding adults