Morecambe Offshore Windfarm: Generation Assets

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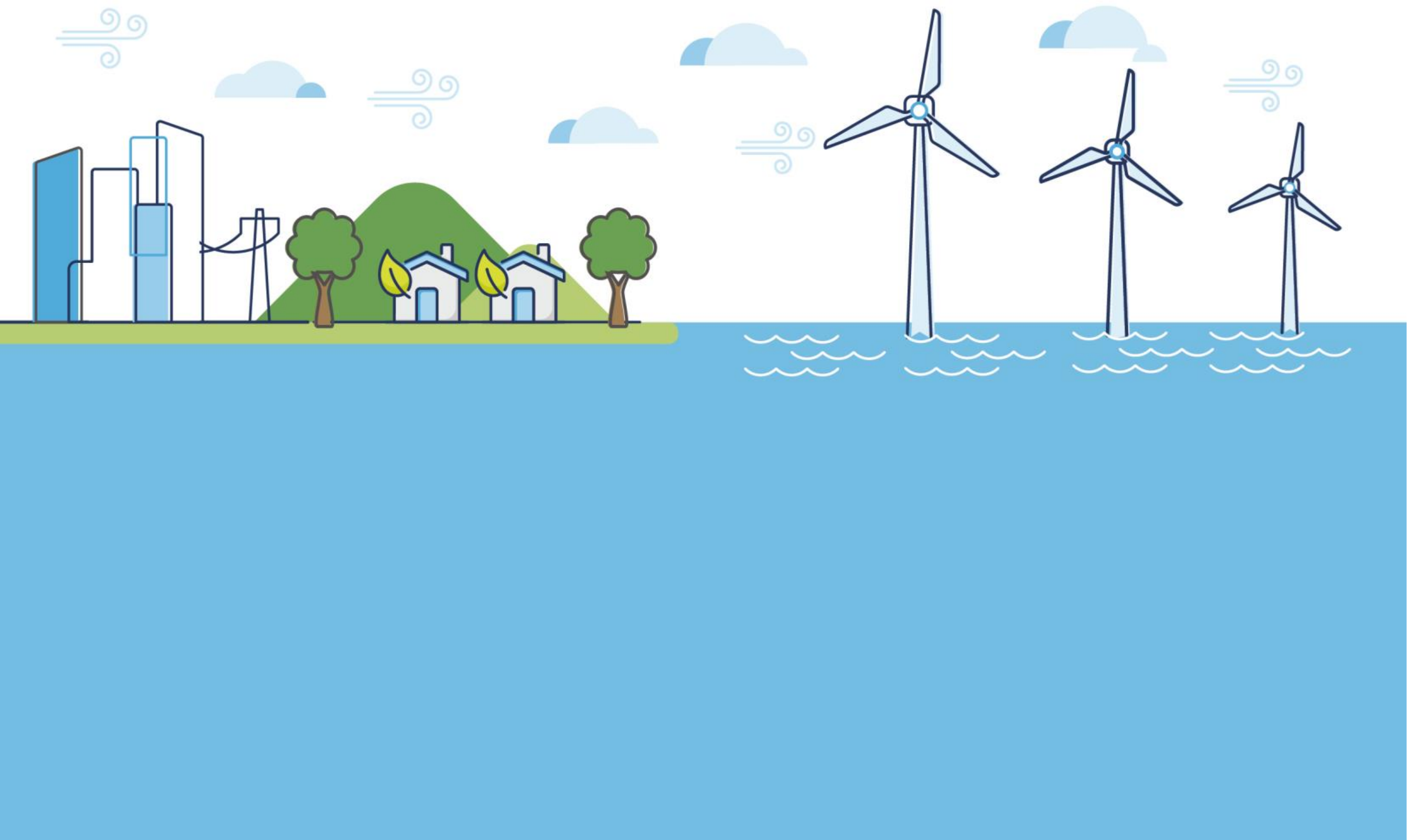

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Glossary of Acronyms

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) (APP-049) 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). 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**. It also provides commentary **Section 2.1.1** on the August 2024 collision risk guidance as noted in the Rule 8 letter (PD-010).

Table 1.1 Summary of 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 (APP-049).	**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 (APP-049). 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 (APP-049).	**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 (APP-049).	
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 (APP-049).	**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**

2 Project-alone effects assessment update

2.1 Approach

3. 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 (APP-049)). 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

4. 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 (APP-049)	Updated average mortality rate	Initial BDMPS reference population (APP-049)	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 (APP-049)	Updated average mortality rate	Initial BDMPS reference population (APP-049)	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

5. 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 (APP-049).

6. 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

7. 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 (APP-049), 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

8. 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 (APP-049) 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

9. 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 (APP-049)). 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 (APP-049)).

10. 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 (APP-049) 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 (APP-049)). The addition of a maximum of four individuals (i.e. the maximum potential mortality, as per **Paragraph 9** above) would increase the background mortality by 0.01% and is **unchanged** from the EIA (paragraph 12.174 in ES Chapter 12 (APP-049)). 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 (APP-049)).

11. 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

12. 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 (APP-049)). 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 (APP-049)).

13. 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 (APP-049)). The addition of a maximum of 446 individuals (i.e. the maximum potential mortality, as per **Paragraph 12** 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 (APP-049)). 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 (APP-049)). Therefore, the assessment conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.209 in ES Chapter 12 (APP-049)).

14. 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

15. 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 (APP-049)). 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 (APP-049)).

16. 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 (APP-049)). The addition of a maximum of 582 individuals (i.e. the maximum potential mortality, as per **Paragraph 15** above) would increase the background mortality by 0.36%, this is **unchanged** from the EIA (paragraph 12.211 in ES Chapter 12 (APP-049)). 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 (APP-049)) Therefore the assessment

conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.212 in ES Chapter 12 (APP-049)).

17. 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

18. 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 (APP-049)).

19. 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 (APP-049)). The addition of a maximum of 1,028 individuals (i.e. the maximum potential mortality, as per **Paragraph 18** above) would increase background mortality by 0.64%, this is **changed** from 0.63% in the EIA (paragraph 12.214 in ES Chapter 12 (APP-049)). 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 (APP-049)). 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 (APP-049)).

20. 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

21. 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 (APP-049)). 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 (APP-049)).

22. 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 (APP-049)). The addition of a maximum of 18 individuals (i.e. the maximum potential mortality, as per **Paragraph 21** above) would increase background mortality by 0.07%, this is **changed** from 0.05% in the EIA (paragraph 12.218 in ES Chapter 12 (APP-049)). 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 (APP-049)). 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 (APP-049)).

23. 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

24. 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 (APP-049)). 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 (APP-049)).

25. 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 (APP-049)). The addition of a maximum of 49 individuals (i.e. the maximum potential mortality, as per **Paragraph 24** above) would increase background

mortality by 0.06%, this is **changed** from 0.05% in the EIA (paragraph 12.221 in ES Chapter 12 (APP-049)). 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 (APP-049)). 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 (APP-049)).

26. 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

27. 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 (APP-049)). 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 (APP-049)).

28. 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 (APP-049)). The addition of a maximum of 46 individuals (i.e. the maximum potential mortality, as per paragraph 27 above) would increase background mortality by 0.10%, this is **changed** from 0.08% the EIA (paragraph 12.224 in ES Chapter 12 (APP-049)). 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 (APP-049)). 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 (APP-049)).

29. 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

30. 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 (APP-049)). 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 (APP-049)).

31. 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 (APP-049)). The addition of a maximum of 27 individuals (i.e. the maximum potential mortality, as per **Paragraph 30** above) would increase background mortality by 0.03%, this is **changed** from 0.02% in the EIA (paragraph 12.227 in ES Chapter 12 (APP-049)). 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 (APP-049)). 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 (APP-049)).

32. 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

33. 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 (APP-049)).

34. 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 (APP-049)). The addition of a maximum of 139 (i.e. the maximum potential mortality, as per **Paragraph 33** 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 (APP-049)). 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 (APP-049)). 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 (APP-049)).

35. 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

36. 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 by NE (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 (**Table 2.1**). This has made **no material change** on any of the results in the displacement effects assessment for Manx shearwater.

37. Therefore, the assessment conclusions for Manx shearwater during the breeding season (**negligible adverse**; paragraph 12.237 in ES Chapter 12 (APP-049)), autumn migration period (**negligible adverse**; paragraph 12.240 in ES Chapter 12 (APP-049)), spring migration period (**negligible adverse**; paragraph 12.243 in ES Chapter 12 (APP-049)), and year-round (**negligible adverse**; paragraph 12.246 in ES Chapter 12 (APP-049)), are **unchanged** from the EIA.

2.2.1.5 Red-throated diver

Autumn migration period

38. 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 (APP-049)). 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 (APP-049)).

39. 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 (APP-049)). 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 (APP-049)).

40. 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

41. 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 (APP-049)). 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 (APP-049)).

42. 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 (APP-049)). 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 (APP-049)). 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 (APP-049)). 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 (APP-049)). 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 (APP-049)).

43. 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

44. 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 (APP-049)). 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 (APP-049)).

45. 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 (APP-049)). The addition of a maximum of one individual (i.e. the maximum potential mortality, as per **Paragraph 44** 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 (APP-049)). 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 (APP-049)). 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 (APP-049)). 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 (APP-049)).

46. 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)

47. 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 [APP-049]).

48. 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 [APP-049]). The addition of a maximum of two individuals (i.e. the maximum potential mortality, as per **Paragraph 47** 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 (APP-049)). 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 (APP-049)). The addition of a maximum of two birds (i.e. the maximum potential mortality, as per **Paragraph 47** above) would increase the background mortality rate by 0.03%, this is **unchanged** from the EIA (paragraph 12.275 in ES Chapter 12 (APP-049)).

49. 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 (APP-049)). 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 (APP-049)). 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 (APP-049)). 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 (APP-049)).

50. 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

51. A summary to the operation and maintenance phase displacement assessment update is presented in **Table 2.2**. 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 (APP-049), have been identified for any species as a result of these small changes.

Table 2.2 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 (APP-049)	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 (APP-049)

2.2.2 Updates to collision risk assessments

52. 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 (APP-049)). **Table 2.3** below replaces that table and highlights the material changes to the assessment outputs. **Table 2.4** summarises the changes with comparison against the values from the EIA.

*Table 2.3 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 2.4 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

53. 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 (APP-049)) 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.

54. 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 (APP-049)). 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 (APP-049)).

2.2.2.2 Other species

55. The updated background mortality rates (**Table 2.1**) resulted in changes to annual background mortality (**Table 2.3** and **Table 2.4**), 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 2.4**). 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 (APP-049)).

2.2.2.3 Summary of collision risk assessment updates

56. A summary to the operation and maintenance phase collision risk assessment update is presented in **Table 2.5**. 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 (APP-049), have been identified for any species.

Table 2.5 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 (APP-049)

3 Cumulative effects assessment update

3.1 Background and approach

57. 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 (APP-049), 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

58. 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.

59. 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.

60. 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*".

61. 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.

62. The first step recommended by Natural England in their written advice was used in the Project CEA documented in Chapter 12 Offshore Ornithology (APP-049), 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).

63. 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 (APP-049), 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).

64. 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.

65. 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.

66. 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.

67. 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

68. 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 (APP-049), 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.

69. 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).

70. 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.

71. 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.

72. 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).

73. 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

74. 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.

75. 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 (APP-049)).

76. 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 66** above).

77. 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

78. In the ES Chapter 12 Offshore Ornithology (APP-049), 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 (APP-049)). 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 (APP-049).

* - Where projects reference "1, 4", this refers to the source of annual abundances being from the Morecambe ES Chapter 12 (App-049), with the seasonal values taken from the Mona offshore ornithology errata clarification note.

79. 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 (APP-049)). 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 (APP-049)). 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 (APP-049)), 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 (APP-049)).

80. 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 (APP-049)). The addition of a maximum of 6,800 individuals (i.e. the maximum potential mortality, as per **Paragraph 79** 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 (APP-049)). 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 (APP-049)). The addition of 343 – 6,800 (i.e. the maximum potential mortality, as per **Paragraph 79** 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 (APP-049)).

81. However, as per the reasons set out in **Paragraph 13** of this document and in paragraphs 12.198 to 12.206 of ES Chapter 12 (APP-049), 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 (APP-049)), which would be significantly above realistic, evidence-based rates (paragraph 12.198 to 12.206 of ES Chapter 12 (APP-049)).

82. Based on the information given above, the assessment conclusion is **unchanged** from the EIA as **minor adverse** (paragraph 12.376 in ES Chapter 12 (APP-049)) and is insignificant in EIA terms.

83. 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

84. 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 80**). 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**).

85. 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).

86. 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).

87. 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).

88. 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

89. 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.

90. 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

91. In ES Chapter 12 Offshore Ornithology (APP-049), 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 (APP-049)). 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	**8,972**	4,705	2,650	1,617

Project*	Annual abundance (CEA values)	Breeding season abundance	Autumn passage abundance	Spring passage abundance
Total	**31,395**	12,730	4,715	13,950
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 (APP-049). * - Where projects reference "1, 4", this refers to the source of annual abundances being from the Morecambe ES Chapter 12 (App-049), 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.				

92. The total estimated number of Manx shearwaters subject to operational disturbance/displacement year-round from each relevant project is **31,395** individuals, which is **changed** from 31,095 in the EIA (**Table 12.60** in **ES Chapter 12** (APP-049)). The total (cumulative) number of Manx shearwaters which could potentially suffer mortality as a consequence of displacement is estimated at between **94** and **2,198** 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 (APP-049)). No additional underwater collision mortality from the Morlais and Holyhead Deep tidal energy sites is predicted.

93. 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 (APP-049)). The addition of a maximum of 2,198 individuals (i.e. the maximum potential mortality, as per **Paragraph 92** above) would increase the background mortality by 0.93%, this is **changed** from 0.92% in the EIA (paragraph 12.382 in ES Chapter 12 (APP-049)). 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 (APP-049)). The addition of 94 to 2,198 individuals would increase background mortality by 0.04% – 0.84%, respectively. This is **unchanged** from the EIA (paragraph **12.382** in ES Chapter 12 (APP-049)).

94. 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 (APP-049)).

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%	31	63	94	126	157	314	628	942	1570	2512	3140
20%	63	126	188	251	314	628	1256	1884	3140	5023	6279
30%	94	188	283	377	471	942	1884	2826	4709	7535	9419
40%	126	251	377	502	628	1256	2512	3767	6279	10046	12558
50%	157	314	471	628	785	1570	3140	4709	7849	12558	15698
60%	188	377	565	753	942	1884	3767	5651	9419	15070	18837
70%	220	440	659	879	1099	2198	4395	6593	10988	17581	21977
80%	251	502	753	1005	1256	2512	5023	7535	12558	20093	25116
90%	283	565	848	1130	1413	2826	5651	8477	14128	22604	28256
100%	314	628	942	1256	1570	3140	6279	9419	15698	25116	31395

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

95. 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 (APP-049)). This magnitude of increase in mortality would not materially affect the background mortality of the population and would be undetectable.

96. 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 (APP-049).

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

97. 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 (APP-049)). This magnitude of increase in mortality would not materially affect the background mortality of the population and would be undetectable.

98. 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 (APP-049).

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

99. 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 (APP-049)), 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

100. 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 (APP-049) 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.

101. For information on the Seabird PVA Tool, refer to **Paragraphs 85** to **87** above.

102. 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

103. 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.

104. 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.

105. 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 (APP-049).

106. 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

107. The estimated cumulative annual little gull collision risk is presented in **Table 3.12** which replaces Table 12.69 in ES Chapter 12 (APP-049), 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 73** in **Section 3.1.1** for detail.			

108. 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.

109. 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 (APP-049)).

110. 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 (APP-049)). 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 (APP-049)).

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

4.1 Introduction

111. 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).

112. 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

113. 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 (APP-049). The model was run for air gaps of 25m (the current worst-case scenario; Table 12.2 of ES Chapter 12 (APP-049)), 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 (APP-049)), 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

114. 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

115. 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%).

116. 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 References

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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)
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

Parameter	Value
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
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