



THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES

2010

East Anglia TWO Offshore Wind Farm

Appendix A16c to the Natural England Deadline 12 Submission

Natural England's Comments on Offshore Ornithology Cumulative and In-Combination Risk and Displacement Update [REP11-027]

For:

The construction and operation of East Anglia TWO Offshore Wind Farm, a 900MW wind farm which could consist of up to 75 turbines, generators and associated infrastructure, located 37km from Lowestoft and 32km from Southwold.

Planning Inspectorate Reference: EN010078

28th June 2021



Contents

Natural England's Comments on Offshore Ornithology Cumulative and In-Combination Risk and Displacement Update [REP11-027]	2
1. Summary	2
2. Detailed Comments on Updated Assessments	3
2.1 Figures included for Hornsea 3	3
2.2 Hornsea 4 and Dudgeon and Sheringham Extension projects (DEP and SEP)	4
2.3 East Anglia Three Non-Material Change (NMC)	5
3. Summary of Natural England Advice on Cumulative and In-Combination Assessments Covered in REP11-027	6
Annex 1: Environmental Impacts Assessment (EIA) Cumulative Impacts Detailed Comments/Conclusions	9
1. Summary	9
2. EIA Impacts from EA1N and EA2 Cumulatively with Other Plans and Projects	10
2.1 EIA Impacts from Operational Collision Risk from East Anglia One North and East Anglia Two Cumulatively with Other Plans and Projects	10
2.1.1 Gannet Cumulative Impacts	10
2.1.2 Kittiwake Cumulative Operational Collision Risk	17
2.1.3 Lesser black-backed gull (LBBG) Cumulative Operational Collision Risk	19
2.1.4 Herring Gull Cumulative Operational Collision Risk	22
2.1.5 Great Black-Backed Gull (GBBG) Cumulative Operational Collision Risk	23
2.1.6 Guillemot Cumulative Operational Displacement	25
2.1.7 Razorbill Cumulative Operational Displacement	28
Annex 2: Habitats Regulations Assessment (HRA) In-Combination Impacts Detailed Comments/Conclusions	32
1. Summary	32
2. Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects	33
2.1. Flamborough & Filey Coast (FFC) SPA: Gannet – Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects: Operational Collision Risk, Displacement and Collision + Displacement	33
2.2 Flamborough & Filey Coast (FFC) SPA: Kittiwake – Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects: Operational Collision Risk	40
2.3 Flamborough & Filey Coast (FFC) SPA: Guillemot – Impacts from EA1N and EA2 In-Combination With Other Plans and Projects: Operational Displacement	46
2.4 Flamborough & Filey Coast (FFC) SPA: Razorbill – Impacts from EA1N and EA2 In-COMBINATION with Other Plans and Projects: Operational Displacement	51
2.5 Flamborough & Filey Coast (FFC) SPA: Seabird Assemblage – Impacts from EA1N and EA2 In-Combination with Other Plans and Projects: Operational Displacement and Collision	56
2.6 Alde-Ore Estuary SPA: Lesser Black-Backed Gull – Impacts from EA1N and EA2 In-Combination with other Plans and Projects: Operational Collision Risk	57



Natural England's Comments on Offshore Ornithology Cumulative and In-Combination Risk and Displacement Update [REP11-027]

This document is applicable to both the East Anglia ONE North (EA1N) and East Anglia TWO (EA2) applications, and therefore is endorsed with the yellow and blue icon used to identify materially identical documentation in accordance with the Examining Authority's (ExA) procedural decisions on document management of 23rd December 2019. Whilst for completeness of the record this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it again for the other project.

1. Summary

1. Natural England welcome the updated offshore ornithological cumulative and in-combination assessments submitted by the Applicant at Deadline 11 [REP11-027] and in general we broadly agree with the figures presented.
2. We note that the cumulative/in-combination displacement assessments of red throated diver (RTD) are not covered in REP11-027. Natural England has provided advice on RTD displacement (cumulative and in-combination) during the EA1N and EA2 examinations in REP4-087, REP6-113, REP7-070, REP8-159 and REP9-067. Our advice regarding RTD remains as set out in these documents.
3. Natural England welcomes that the gannet and kittiwake figures included in Tables A0.1 and A0.2 of REP11-027 for East Anglia Two have been updated to be based on the full breeding season.
4. We note that the Norfolk Vanguard project is to be redetermined. Therefore, we now advise that the project be treated in the same way as Norfolk Boreas, EA1N and EA2, i.e. that it is included in the cumulative totals with these projects and Hornsea 3 (now that updated figures are available for all species for this project). Hence totals are provided for all projects up to EA1N and EA2 (so including Vanguard, Boreas and Hornsea 3) but excluding Hornsea 4, Dudgeon Extension and Sheringham Extension (for reasons set out below), and then totals where all projects are included.



2. Detailed Comments on Updated Assessments

2.1 Figures included for Hornsea 3

5. We welcome that the Applicants have included updated figures for Hornsea 3 in the assessments in Tables A0.1-A0.8 of REP11-027, based on the document provided to the Applicants' by Ørsted. Natural England has now completed our review of the updated data provided by Ørsted for Hornsea 3. We can confirm agreement with the central/mean EIA and HRA scale collision predictions using our advised input parameters for collision risk and of abundances for displacement, and advise they are suitable to include for the Hornsea 3 project in cumulative and in-combination assessments.
6. The figures we consider appropriate to use for the Hornsea 3 project based on the information provided to use by Ørsted are presented in Table 1 below:

Collision risk

Table 1 Natural England calculated EIA and HRA scale collision predictions for Hornsea 3 based on data recently provided by Ørsted

	Annual EIA scale collision prediction for Hornsea 3	Flamborough and Filey Coast SPA (gannet and kittiwake) / Alde-Ore Estuary SPA (LBBG) annual collision prediction for Hornsea 3
Gannet	19	7
Kittiwake	123	(74)*
Lesser black-backed gull (LBBG)	9	0
Herring gull	5	-
Great black-backed gull (GBBG)	36	-

* Noting the contribution from this project is set to 0 in the in-combination assessment as compensated for

7. Natural England has checked the Hornsea 3 figures we consider appropriate to use (as shown above) against those the Applicants have included in the updated cumulative and in-combination collision assessments in Tables A0.1-A0.5 of REP11-027. The annual collision predictions the Applicants have included for Hornsea 3 for gannet, kittiwake, LBBG, herring gull and GBBG for EIA scale, for gannet and kittiwake at Flamborough and Filey Coast SPA, and LBBG at the Alde-Ore Estuary SPA are considered appropriate based on the information provided to us by Ørsted.



Displacement

Table 2 Natural England calculated EIA and HRA scale abundance figures for Hornsea 3 based on data recently provided by Ørsted

	EIA scale abundance for Hornsea 3					FFC SPA abundance for Hornsea 3				
	Pre breeding / spring	Breeding	Post breeding / autumn	Non-breeding	Total	Pre breeding / spring	Breeding	Post breeding / autumn	Non-breeding	Total
Gannet	524	1333	984	-	2841	32	844	47	-	924
Guillemot	-	13374	-	17772	31146	-	0	-	782	782
Razorbill	2105	630	2021	3649	8405	72	0	69	99	240

8. Natural England has checked the Hornsea 3 figures we consider appropriate to use (as shown above in Table 2) against those the Applicants have included in the updated cumulative and in-combination displacement assessments in Tables A0.6-A0.8 of REP11-027. The seasonal and annual abundances the Applicants have included for Hornsea 3 for guillemot and razorbill for EIA scale in REP11-027 are the same as those Natural England consider appropriate based on the information provided to us by Ørsted. We note there is a slight discrepancy for gannet for the spring migration season – Natural England calculates the Hornsea 3 abundance to be 524, whereas the Applicants have calculated this as 527 in Table A0.8 of REP11-027. This means there is a slight difference in the annual EIA abundance total where Natural England makes it 2,841, whilst the Applicants have presented 2,844 in Table A0.8. This also slightly affects the Applicants' spring migration figure for the FFC SPA for gannet.
9. However, whilst the updated Hornsea 3 abundance figures included for FFC SPA for the non-breeding season for guillemot and for the autumn, non-breeding and spring for razorbill are the same as those considered appropriate by Natural England, we note there are discrepancies between the breeding season figures included by the Applicants and those considered appropriate by Natural England (Natural England considers it appropriate for 0 birds to be apportioned in the breeding season to the FFC SPA for both guillemot and razorbill). This has an associated impact on the annual abundance figures.

2.2 Hornsea 4 and Dudgeon and Sheringham Extension projects (DEP and SEP)

10. As per our advice during the Norfolk Boreas examination, we note that the figures for Hornsea 4 come from the PEIR for that project. These figures and the methodologies to produce them are hence subject to ongoing discussions through the evidence plan process and therefore have an element of uncertainty associated with them and are subject to change. For example, the CRM figures presented in the Hornsea 4 PEIR



were undertaken using the stochastic CRM, and therefore are potentially affected by the issues currently being investigated with this model.

11. Whilst we welcome the inclusion by the Applicants of the PEIR figures for Dudgeon and Sheringham OWF extensions (DEP and SEP), we note that these figures are subject to ongoing discussions through the evidence plan process and hence also have an element of uncertainty associated with them and are subject to change.
12. **The inevitable uncertainty around the Hornsea 4, DEP and SEP figures means that Natural England is not in a position to advise that a significant adverse impact for cumulative impacts at EIA scale, or that an AEoI for in-combination impacts at HRA, can be ruled out for any relevant species or feature of an SPA when the Hornsea 4, DEP and SEP projects are included in the totals.**

2.3 East Anglia Three Non-Material Change (NMC)

13. Natural England understands that the figures included in the cumulative/in-combination collision risk tables (Tables A0.1-A0.5) of REP11-027 for East Anglia Three have been updated with numbers from collision risk modelling undertaken as part of a non-material change (NMC) application that has been granted (BEIS 2021¹). We understand that this NMC is sought to:
 - a) increase the maximum tip height of 247m to 262m (relative to Lowest Astronomic Tide (LAT));
 - b) increase in the minimum air draft of all WTGs from 22m to 24m (relative to (Mean High Water Springs (MHWS));
 - c) increase the maximum rotor diameter from 220m to 230m; and
 - d) reduce the maximum, total number of WTGs from 172 to 121.
14. The proposed amendments were considered by the Secretary of State (SoS) as a NMC, as the changes would not result in any further environmental impacts and will remain within the parameters consented by the 2017 Order (BEIS 2021).
15. Natural England has recently provided advice to BEIS regarding East Anglia One Limited (EAOL) who are seeking to amend the Development Consent Order (DCO) to reduce the maximum number of turbines to reflect the 102 turbines installed for the

¹ BEIS (2021) <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010056/EN010056-002489-210415%20Decision%20Letter%20-%20EA3%20NMC.pdf>



project. In this advice, which has been submitted into the Examination for the ExA to consider [REP11-121], Natural England questions whether such a NMC (if granted) provides the legal certainty required to rely on the as-built parameters for the purposes of HRA, including the use of 'as built' values from e.g. collision modelling in an in-combination assessment.

16. In the absence of the required legal certainty, we advise that the collision predictions included in the cumulative and in-combination assessments for the East Anglia 3 project are those for the consented project rather than for the NMC.
17. Natural England recognises the desirability of establishing environmental 'headroom' in order to facilitate further offshore wind development and is keen to ensure this is achieved in a legally robust manner. In addition, please be advised that if this is eventually an accepted route for as built project values to come forward, the full assessment using Natural England's advised values and parameters must be made available and a best practice approach agreed across the industry.

3. Summary of Natural England Advice on Cumulative and In-Combination Assessments Covered in REP11-027

18. Natural England has reviewed the evidence presented in the updated assessments in REP11-027 and as set out in **Section 2.1** and **Section 2.3** above. We have also amended the totals to the abundance figures for Hornsea 3 in the displacement assessments to those we consider appropriate for use, and the collision predictions included for East Anglia 3 to the consented values. We have used these updated cumulative and in-combination figures to update our advice on these matters for considering all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, EA1N and EA2, for both excluding and including the Hornsea 4, Dudgeon extension (DEP) and Sheringham extension (SEP) projects where the figures are from the PEIRs and hence subject to change.
19. A summary of our advice is presented in Table 3 and detailed advice around how these conclusions were reached are set out in Annex 1 (for EIA) and Annex 2 (for HRA).
20. The East Anglia One North and East Anglia Two projects make contributions to cumulative and in-combination effects on several seabirds at both the EIA scale and with respect to qualifying features of seabird colony SPAs through collision mortality,



particularly with respect to North Sea populations of great black-backed gull, gannet and kittiwake, Flamborough and Filey Coast SPA kittiwake and gannet, and Alde-Ore Estuary SPA lesser black-backed gull (see Table 3).

Table 3 Summary of conclusions for assessments of EA1N and EA2 cumulative / in-combination impacts with other plans and projects for species and designated site features covered by the Applicants' updated assessments in REP11-027

EIA species	EA1N and EA2 Cumulatively with Other Plans & Projects
Gannet: collision	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
Gannet: displacement	No significant adverse impact excl. H4, DEP & SEP Unable to rule of significant adverse impact incl. H4, DEP & SEP
Gannet: collision + displacement	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
Kittiwake: collision	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
Lesser black-backed gull: collision	No significant adverse impact excl. H4, DEP & SEP Unable to rule of significant adverse impact incl. H4, DEP & SEP
Herring gull: collision	<u>East Anglia One North:</u> No significant adverse impact excl. & incl. H4, DEP & SEP <u>East Anglia Two:</u> No significant adverse impact excl. H4, DEP & SEP Unable to rule of significant adverse impact incl. H4, DEP & SEP
Great black-backed gull: collision	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
Guillemot: displacement	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
Razorbill: displacement	Unable to rule out significant adverse impact excl. & incl. H4, DEP & SEP
HRA species & site	EA1N and EA2 in-combination with other plans & projects
Gannet, Flamborough & Filey Coast SPA: collision	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Gannet, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Gannet, Flamborough & Filey Coast SPA: collision + displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Kittiwake, Flamborough & Filey Coast SPA: collision	Unable to rule out AEol excl. and incl. H4, DEP & SEP
Guillemot, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Razorbill, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Assemblage, Flamborough & Filey Coast SPA	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Lesser black-backed gull, Alde-Ore Estuary SPA: collision	Unable to rule out AEol excl. H4, DEP & SEP (no collisions apportioned from H4, DEP & SEP)



21. Natural England has previously provided regulators with our advice regarding our concerns about predicted level of cumulative/in-combination impacts on North Sea seabirds, e.g. EIA great black-backed gull at East Anglia 3, Norfolk Vanguard and Norfolk Boreas, Flamborough and Filey Coast (FFC) SPA kittiwakes at Hornsea 2, Hornsea 3 and Norfolk Vanguard. These concerns have intensified given the three further offshore wind farm NSIPs now submitted to PINS (Norfolk Boreas, East Anglia One North, East Anglia Two), with three further projects planned to submit in the next 12 months (Hornsea 4, Dudgeon extension and Sheringham extension), and additional Extensions projects and Round 4 to follow. Therefore, Natural England considers that without major project-level mitigation being applied to all relevant projects coming forward, there is a significant risk of large-scale impacts on seabird populations.



Annex 1: Environmental Impacts Assessment (EIA) Cumulative Impacts Detailed Comments/Conclusions

1. Summary

22. This document is a technical document submitted into the East Anglia One North and East Anglia Two examinations to provide scientific justification for Natural England's advice provided on the significance of the potential cumulative impacts at the Environmental Impact Assessment (EIA) scale, as summarised within each section.
23. We have amended the collision predictions included for each species for the East Anglia 3 project to the consented values (rather than the NMC figures as included by the Applicants, for the reasons set out in **Section 2.3** above. We have also amended the abundance figures for Hornsea 3 in the displacement assessments to those we consider appropriate for use, as set out in **Section 2.1** above. Therefore, our cumulative and in-combination totals are different to those presented by the Applicants in REP11-027. This advice therefore updates that previously provided during the Norfolk Boreas examination and at Deadline 8 [REP8-159] and Deadline 9 [REP9-066] of the East Anglia One North and East Anglia Two examinations regarding cumulative collision and displacement impacts for the species covered in the Applicants' update submitted at REP11-027. Our advice considers all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, and both excluding and including the Hornsea 4, Dudgeon extension (DEP) and Sheringham extension (SEP) projects where the figures are from the PEIRs and hence subject to change. This does not update advice on red-throated diver (RTD).
24. Our advice is based on best available evidence at the time of writing and is subject to change in the future should further evidence be presented.



2. EIA Impacts from EA1N and EA2 Cumulatively with Other Plans and Projects

2.1 EIA Impacts from Operational Collision Risk from East Anglia One North and East Anglia Two Cumulatively with Other Plans and Projects

25. Table A1.01 shows the Natural England calculated cumulative collision risk total predictions for all relevant projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, but excluding Hornsea 4, Dudgeon Extension (DEP) and Sheringham Extension (SEP), and for all projects including Hornsea 4, DEP and SEP, for each of the key species considered to be at risk of collisions. The shaded cells of the table indicate where the predicted cumulative totals exceed 1% of baseline mortality of the largest BDMPS or biogeographic population.

Table A1.01 Percentage of baseline mortality for cumulative CRM for EIA for both all projects excluding Hornsea 4, DEP and SEP and also for all projects including Hornsea 4, DEP and SEP. (Using average across all age class mortality rates, as used by the Applicants)

	Cumulative collision prediction*		Largest BDMPS (North Sea) individuals, Furness (2015)	% baseline mortality largest BDMPS		Biogeographic population individuals (Furness 2015)	% baseline mortality biogeographic	
	Excl. H4, DEP & SEP**	ALL projects		Excl. H4, DEP & SEP	ALL projects		Excl. H4, DEP & SEP	ALL projects
Gannet	2,940	3,012	456,298	3.37	3.46	1,180,000	1.30	1.34
Kittiwake	4,015	4,243	829,937	3.10	3.28	5,100,000	0.50	0.53
LBBG	530	533	209,007	2.01	2.02	864,000	0.49	0.49
Herring Gull	763	766	466,511	0.95	0.95	1,098,000	0.40	0.41
GBBG	979	1,003	91,399	5.79	5.93	235,000	2.25	2.31

* Updated by Natural England from figures presented by the Applicants in REP11-027 to include consented figures for East Anglia 3. Note Natural England agree with the collision figures included by the Applicant in REP11-027.

** Note: includes all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two

2.1.1 Gannet Cumulative Impacts

a) Operational collision risk:

26. Natural England's revised calculated cumulative collision totals for gannet (i.e. including the consented predictions for East Anglia 3) of 2,940 birds for all projects excluding Hornsea 4, DEP and SEP and of 3,012 including all projects exceed 1% of baseline mortality of the North Sea BDMPS scale and the biogeographic population (Furness 2015). The figure excluding Hornsea 4, DEP and SEP equates to 3.37% of baseline mortality of the BDMPS and 1.30% of baseline



mortality of the biogeographic population, and the figure including all projects equates to 3.46% of the BDMPS and 1.34% of the biogeographic population baseline mortality (Table A1.01 above). This is significant and requires further consideration.

27. There have been no updates from the Applicants regarding EIA scale PVAs. Therefore, as was used in our Deadline 8 advice on EIA scale impacts [REP8-159], we have again utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) gannet PVAs undertaken by Norfolk Boreas (MacArthur Green 2019²), which used the 'Seabird PVA Tool'. We note that we raised some issues with these PVAs during the Boreas examination and that no changes were made to the models. However, these models nevertheless currently represent the best available evidence on which to base an assessment, though this should not be taken as a Natural England endorsement or 'acceptance' of the model outputs. With regard to the PVA metrics, we note that whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of final population size and growth rate are only available in MacArthur Green (2019) for after 30 years.
28. Using the PVA models undertaken by Norfolk Boreas, if the additional mortality from the offshore wind farms is 3,000-3,100 per annum (closest PVA outputs to the Natural England calculated cumulative collision mortality figures of 2,940 excluding Hornsea 4, DEP and SEP; and 3,012 including all projects) then:
- The BDMPS population after 30 years will be 21.33-21.95% lower than it would have been in the absence of the additional mortality using the density independent model and 21.15-21.76% lower using the density dependent model. The population growth rate would be reduced by 0.77-0.8% using the density independent model and by 0.76-0.79% using the density dependent model (Table A1.02).
 - The biogeographic population after 30 years will be 8.84-9.13% lower than it would have been in the absence of the additional mortality using the

² MacArthur Green (2019) Norfolk Boreas Offshore Wind Farm: Offshore Ornithology Assessment Update. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010087/EN010087-001420-Offshore%20Ornithology%20Assessment%20Update.pdf>



density independent model and 8.75-9.03% lower using the density dependent model. The population growth rate would be reduced by 0.3-0.31% using the density independent model and by 0.29-0.3% using the density dependent model (Table A1.02).

Table A1.02 Predicted Population impacts on the gannet BDMPs and biogeographic population for the range of mortality impacts predicted for cumulative collision. PVA Impact Metrics are as provided in Table 3.2 of MacArthur Green (2019)*. The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined cumulative collision predictions

GANNET, EIA CUMULATIVE COLLISIONS – DENSITY INDEPENDENT PVA MODELS						
Additional mortality	% baseline mortality largest BDMPs as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPs	Counterfactual of Growth Rate (CGR), BDMPs	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
3,000	3.44	0.7867	0.9923	1.33	0.9116	0.9970
3,100	3.56	0.7805	0.9920	1.38	0.9087	0.9969
3,200	3.67	0.7744	0.9918	1.42	0.9059	0.9968
GANNET, EIA CUMULATIVE COLLISIONS – DENSITY DEPENDENT PVA MODELS						
Additional mortality	% baseline mortality largest BDMPs as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPs	Counterfactual of Growth Rate (CGR), BDMPs	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
3,000	3.44	0.7885	0.9924	1.33	0.9125	0.9971
3,100	3.56	0.7824	0.9921	1.38	0.9097	0.9970
3,200	3.67	0.7761	0.9919	1.42	0.9070	0.9969

* Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

29. The northern gannet is classified as 'Least Concern' with respect to the potential for global extinction (BirdLife International 2018). However, at the UK scale the species is Amber listed in Birds of Conservation Concern (BoCC) 4 (Eaton et al. 2015). The BoCC Amber listing is due to:

- Localisation of breeding population within Important Bird Areas (IBAs)/Special Protection Areas (SPAs) (Eaton et al. 2015).
- International importance of UK population – threshold of 20% of global population (Eaton et al. 2015). It has been estimated that the UK holds 55.6% of the global population (JNCC 2016).



30. Based on current UK gannet population growth rates of ~2-3% per annum and using the PVA model outputs, then the level of additional cumulative mortality from collisions from the offshore wind farms would still allow the population to grow. However, it is not known what the growth rate of the UK gannet population will be over the next 25-30 years and this should therefore be considered when judging the significance of predicted impacts and whether a ~0.8% reduction in annual growth rate would be significant. It is considered likely that the level of predicted cumulative impact would not be significant for a population growing at 2-3% per annum. However, if the population does not grow at that level for the next 25-30 years (say if the growth rate was around 1% per annum), we consider that it is uncertain that a ~0.8% reduction in growth rate would not be significant.
31. Based on consideration of the PVA metrics as currently presented, the above conservation assessment, and given the UK's particular responsibility for gannet because of supporting over half of the global population, the predicted impacts at the North Sea population scale have the potential to give rise to significant effects. **Therefore, we are unable to rule out a significant adverse impact on gannet from cumulative collision mortality at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, EA1N and EA2. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**

b) Operational Displacement

32. Based on Natural England's revised (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted) cumulative totals, the annual total cumulative number of gannets to be at risk of displacement for all projects (including from Hornsea 4, SEP and DEP) is estimated to be 50,751.
33. For the rates considered by the Applicants of 60-80% displacement and 1% mortality, the number of predicted additional cumulative mortalities including Hornsea 4, SEP and DEP is between 305 (60% displacement and 1% mortality) and 406 (80% displacement and 1% mortality) gannets. This equates to 0.35-0.47% of baseline mortality for the largest BDMPS.
34. Given the uncertainty involved with the figures for Hornsea 4, SEP and DEP (as figures from the PEIRs for these projects), the annual cumulative total excluding these three projects is estimated to be 45,922 gannets at risk of displacement.



35. For the rates considered by the Applicants of 60-80% displacement and 1% mortality, the number of predicted additional cumulative mortalities **excluding** Hornsea 4, SEP and DEP is between 276 (60% displacement and 1% mortality) and 367 (80% displacement and 1% mortality) gannets. This equates to 0.32-0.42% of baseline mortality for the largest BDMPS.
36. Based on the above, **we advise no significant adverse impact to gannet from cumulative operational displacement at the EIA scale when the Hornsea 4, DEP and SEP projects are excluded from the cumulative total.**
37. **However, due to the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that significant impact can be ruled out for gannet for cumulative displacement impacts when the Hornsea 4, DEP and SEP projects are included in the cumulative totals.**

c) Operational Collision Risk Plus Displacement

38. As noted in our previous advice in our Deadline 8 advice [REP8-159], the SNCBs regard the two impacts (collision and displacement) as additive and advise that they should be summed. However, we acknowledge that this simplistic approach will incorporate a degree of precaution (SNCBs 2017).
39. The combined cumulative impact **excluding** Hornsea 4, DEP and SEP of collision plus displacement to gannet equals:
2,940 mortalities per annum from collisions plus up to 367 mortalities per annum from displacement = up to 3,307 mortalities. This combined cumulative impact equates to 3.79% of baseline mortality of the largest BDMPS and to 1.47% of the biogeographic population.
40. The combined cumulative impact **including** all projects of collision plus displacement to gannet equals:
3,012 mortalities per annum from collisions plus up to 406 mortalities per annum from displacement = up to 3,418 mortalities. This combined cumulative impact equates to 3.92% of baseline mortality of the largest BDMPS and to 1.52% of the biogeographic population.



41. As with gannet cumulative collision impacts, Natural England has utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) gannet PVAs undertaken by Norfolk Boreas (MacArthur Green 2019), which used the 'Seabird PVA Tool'. We note that we raised some issues with these PVAs during the Boreas examination and that no changes were made to the models. However, these models nevertheless currently represent the best available evidence on which to base an assessment, though this should not be taken as a Natural England endorsement or 'acceptance' of the model outputs. With regard to the PVA metrics, we note that whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of final population size and growth rate are only available in MacArthur Green (2019) for after 30 years.
42. Using the PVA models undertaken by Norfolk Boreas, if the additional mortality from the offshore wind farms is 3,400-3,500 per annum (closest PVA outputs to the cumulative collision + displacement mortality figures of 3,307 excluding Hornsea 4, DEP and SEP and 3,418 including all projects) then:
- The BDMPS population after 30 years will be 23.82-24.43% lower than it would have been in the absence of the additional mortality using the density independent model and 23.59-24.22% lower using the density dependent model. The population growth rate would be reduced by 0.87-0.9% using the density independent model and by 0.86-0.89% using the density dependent model (Table A1.03).
 - The biogeographic population after 30 years will be 9.96-10.25% lower than it would have been in the absence of the additional mortality using the density independent model and 9.86-10.14% lower using the density dependent model. The population growth rate would be reduced by 0.34-0.35% using the density independent model and by 0.33-0.34% using the density dependent model (Table A1.03).



Table A1.03 Predicted Population impacts on the gannet BDMPs and biogeographic population for the range of mortality impacts predicted for cumulative collision + displacement. PVA Impact Metrics are as provided in Table 4.22 of MacArthur Green (2019)*. The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined cumulative collision predictions

GANNET, EIA CUMULATIVE COLLISIONS – DENSITY INDEPENDENT PVA MODELS						
Additional mortality	% baseline mortality largest BDMPs as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPs	Counterfactual of Growth Rate (CGR), BDMPs	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
3,400	3.90	0.7618	0.9913	1.51	0.9004	0.9966
3,500	4.02	0.7557	0.9910	1.55	0.8975	0.9965
3,600	4.13	0.7495	0.9907	1.60	0.8949	0.9964
GANNET, EIA CUMULATIVE COLLISIONS – DENSITY DEPENDENT PVA MODELS						
Additional mortality	% baseline mortality largest BDMPs as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPs	Counterfactual of Growth Rate (CGR), BDMPs	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
3,400	3.90	0.7641	0.9914	1.51	0.9014	0.9967
3,500	4.02	0.7578	0.9911	1.55	0.8986	0.9966
3,600	4.13	0.7517	0.9908	1.60	0.8958	0.9965

* Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

43. The northern gannet is classified as 'Least Concern' with respect to the potential for global extinction (BirdLife International 2018). However, at the UK scale the species is Amber listed in Birds of Conservation Concern (BoCC) 4 (Eaton *et al.* 2015). The BoCC Amber listing is due to:

- Localisation of breeding population within Important Bird Areas (IBAs)/Special Protection Areas (SPAs) (Eaton *et al.* 2015).
- International importance of UK population – threshold of 20% of global population (Eaton *et al.* 2015). It has been estimated that the UK holds 55.6% of the global population (JNCC 2016).

44. As noted for gannet cumulative collisions above, based on current UK gannet population growth rates of ~2-3% per annum and using the PVA model outputs, then the level of additional cumulative mortality from collisions from the offshore wind farms would still allow the population to grow. However, it is not known what the growth rate of the UK gannet population will be over the next 25-30 years and



this should therefore be considered when judging the significance of predicted impacts and whether a ~0.9% reduction in annual growth rate would be significant. It is considered likely that the level of predicted cumulative impact would not be significant for a population growing at 2-3% per annum. However, if the population does not grow at that level for the next 25-30 years (say if the growth rate was around 1% per annum), we consider that it is uncertain that a ~0.9% reduction in growth rate would not be significant.

45. Based on consideration of the PVA metrics as currently presented, the above conservation assessment, and given the UK's particular responsibility for gannet because of supporting over half of the global population, the predicted impacts at the North Sea population scale have the potential to give rise to significant effects. **Therefore, we are unable to rule out a significant adverse impact on gannet from cumulative collision plus displacement mortality at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**

2.1.2 Kittiwake Cumulative Operational Collision Risk

46. Natural England's revised calculated cumulative collision totals for kittiwake (i.e. including the consented predictions for East Anglia 3) of 4,015 birds for all projects excluding Hornsea 4, DEP and SEP and of 4,243 including all projects exceed 1% of baseline mortality of the North Sea BDMPS scale – the figure excluding Hornsea 4, DEP and SEP equates to 3.10% of baseline mortality, and the figure including all projects equates to 3.28% (Table A1.01 above). This is significant and requires further consideration.
47. There have been no updates from the Applicants regarding EIA scale PVAs. Therefore, as was used in our Deadline 8 advice on EIA scale impacts [REP8-159], we have again utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) kittiwake PVAs undertaken by Norfolk Boreas (MacArthur Green 2019³), which used the 'Seabird PVA Tool'. We note that we raised some

³ MacArthur Green (2019) Norfolk Boreas Offshore Wind Farm: Offshore Ornithology Assessment Update. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010087/EN010087-001420-Offshore%20Ornithology%20Assessment%20Update.pdf>



issues with these PVAs during the Boreas examination and that no changes were made to the models. However, these models nevertheless currently represent the best available evidence on which to base an assessment, though this should not be taken as a Natural England endorsement or ‘acceptance’ of the model outputs. With regard to the PVA metrics, we note that whilst East Anglia One North and East Anglia Two’s lifespans are 25 years, data on counterfactuals of final population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

48. Using the density independent PVA models undertaken by Norfolk Boreas, if the additional mortality from the offshore wind farms is 4,100-4,300 per annum (closest PVA outputs to the cumulative collision mortality figures of 4,015 excluding Hornsea 4, DEP and SEP; and 4,243 including all projects) then:

- The BDMPS population after 30 years will be 16.65-17.32% lower than it would have been in the absence of the additional mortality and the population growth rate would be reduced by 0.59-0.61% (Table A1.04).
- The biogeographic population after 30 years will be 2.89-3.03% lower than it would have been in the absence of the additional mortality and the population growth rate would be reduced by 0.1% (Table A1.04).

Table A1.04 Predicted Population impacts on the kittiwake BDMPS and biogeographic population for the range of mortality impacts predicted for cumulative collision. PVA Impact Metrics are as provided in Table 3.6 of MacArthur Green (2019)*. The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined cumulative collision predictions

KITTIWAKE, EIA CUMULATIVE COLLISIONS – DENSITY INDEPENDENT PVA MODELS						
Additional mortality	% baseline mortality largest BDMPS as used by Applicants	Counterfactual of Final Population Size (CPS), BDMPS	Counterfactual of Growth Rate (CGR), BDMPS	% baseline mortality biogeographic, as used by Applicants	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
3,900	3.01	0.8410	0.9944	0.49	0.9723	0.9991
4,000	3.09	0.8376	0.9943	0.50	0.9717	0.9991
4,100	3.17	0.8335	0.9941	0.52	0.9711	0.9990
4,200	3.24	0.8302	0.9940	0.53	0.9703	0.9990
4,300	3.32	0.8268	0.9939	0.54	0.9697	0.9990
4,400	3.40	0.8229	0.9937	0.55	0.9688	0.9989

* Whilst East Anglia One North and East Anglia Two’s lifespans are 25 years, data on counterfactuals of population size and growth rate are only available in MacArthur Green (2019) for after 30 years.



49. Kittiwake are listed as 'Vulnerable' to global extinction on the IUCN Red List (raised from Least Concern to Vulnerable in 2017) as a result of breeding population declines in Europe of >40% over 39 years (Birdlife International 2018). Kittiwake is also listed as Red on BoCC4 (Eaton et al. 2015) as a result of severe population declines in the UK.
50. Based on consideration of the PVA metrics as currently presented, the above conservation assessment and particularly given the population declines at a UK and wider scale for the species, the predicted impacts at the North Sea population scale have the potential to give rise to significant effects. **Therefore, we are unable to rule out a significant adverse impact on kittiwake from cumulative collision mortality at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**

2.1.3 Lesser black-backed gull (LBBG) Cumulative Operational Collision Risk

51. Natural England's revised calculated cumulative collision totals for LBBG (i.e. including the consented predictions for East Anglia 3) of 530 birds for all projects excluding Hornsea 4, DEP and SEP and of 533 including all projects exceeds 1% of baseline mortality of the North Sea BDMPS scale (Furness 2015) – the figure excluding Hornsea 4, DEP and SEP equates to 2.01% of baseline mortality, and the figure including all projects equates to 2.02% (Table A1.01 above). This is not insignificant and requires further consideration.
52. There have been no updates from the Applicants regarding EIA scale PVAs. Therefore, as was used in our Deadline 8 advice on EIA scale impacts [REP8-159], we have again utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) LBBG PVAs undertaken by Norfolk Boreas (MacArthur Green 2019⁴), which used the 'Seabird PVA Tool'. We note that we raised some issues with these PVAs during the Boreas examination and that no changes were made to the models. However, these models nevertheless currently represent the best

⁴ MacArthur Green (2019) Norfolk Boreas Offshore Wind Farm: Offshore Ornithology Assessment Update. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010087/EN010087-001420-Offshore%20Ornithology%20Assessment%20Update.pdf>



available evidence on which to base an assessment, though this should not be taken as a Natural England endorsement or ‘acceptance’ of the model outputs. With regard to the PVA metrics, we note that whilst East Anglia One North and East Anglia Two’s lifespans are 25 years, data on counterfactuals of final population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

53. Using the density independent PVA model undertaken by Norfolk Boreas in MacArthur Green (2019), if the additional mortality from the offshore wind farms is 600 per annum (closest PVA output to the cumulative collision mortality figures of 530 excluding Hornsea 4, DEP and SEP and of 533 including all projects) then:

- The BDMPS population after 30 years will be 9.65% lower than it would have been in the absence of the additional mortality and the population growth rate would be reduced by 0.33% (Table A1.05).

Table A1.05 Predicted Population impacts on the LBBG BDMPS and biogeographic population for the range of mortality impacts predicted for cumulative collision. PVA Impact Metrics are as provided in Table 3.11 of MacArthur Green (2019)*. The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined cumulative collision predictions

LBBG, EIA CUMULATIVE COLLISIONS – DENSITY INDEPENDENT PVA MODEL			
Additional mortality	% baseline mortality largest BDMPS as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPS	Counterfactual of Growth Rate (CGR), BDMPS
500	1.90	0.9191	0.9973
600	2.28	0.9035	0.9967

* Whilst East Anglia One North and East Anglia Two’s lifespans are 25 years, data on counterfactuals of population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

54. The LBBG is classified as ‘Least Concern’ (BirdLife International 2018). The overall population trend across its range is increasing, although it has experienced recent declines at a UK level (Balmer et al. 2013). The species is Amber listed in BoCC 4 (Eaton et al. 2015) due to:

- Localisation of breeding population within Important Bird Areas (IBAs (Eaton et al. 2015)).
- International importance of UK population.



55. Quite a high proportion of birds in the largest BDMPS of 209,007 will be UK breeding birds (Furness 2015).
56. Between the 1969-70 and 1998-2002 censuses the UK LBBG population increased by 81% (only UK wide estimates considered reliable; JNCC 2019), which represents an annual average growth rate of approximately 1.8% per annum. Based on this and using the PVA model outputs, then the level of additional cumulative mortality from collisions from the offshore wind farms would still allow the population to grow. However, it is not known what the growth rate of the UK LBBG population will be over the next 25-30 years and this should therefore be considered when judging the significance of predicted impacts and whether a 0.3% reduction in annual growth rate would be significant. It is considered likely that the level of predicted cumulative impact would not be significant for a population growing at 1-2% per annum. It should also be noted there is uncertainty in the predicted collision figures due the uncertainty/variability in the input parameters and some degree of precaution in the cumulative total regarding the nocturnal activity rate and build out scenarios. It is also worth noting that there is limited evidence and therefore some uncertainty around baseline mortality rates.
57. Based on consideration of the above, the PVA metrics presented and the above conservation assessment, **we therefore advise a conclusion of no significant adverse impact from cumulative collision to LBBG at an EIA scale when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the cumulative total (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the cumulative total).**
58. **However, due to the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that significant impact can be ruled out for LBBG for cumulative collision impacts when the Hornsea 4, DEP and SEP projects are included in the cumulative totals.**



2.1.4 Herring Gull Cumulative Operational Collision Risk

59. Natural England's revised calculated cumulative collision totals for herring gull (i.e. including the consented predictions for East Anglia 3) of 763 birds for all projects excluding Hornsea 4, DEP and SEP and of 766 birds including all projects equates to 0.95% of baseline mortality of the largest BDMPS and to 0.40% (excluding Hornsea 4, DEP and SEP) and 0.41% (including all projects) of baseline mortality of the biogeographic population (Table A1.01 above). Note Natural England's calculated figures include amending the East Anglia One annual figure from 19 as included by the Applicant to the figure of 28 for the 150 turbines layout, as well as the other amendment of changing the East Anglia 3 figures from the NMC to the consented values.
60. On the basis that the East Anglia One North contribution to the cumulative collision total is 0 (see Table A0.4 of REP11-027), Natural England considers that East Anglia One North is unlikely to make any contribution to the cumulative collision totals irrespective of whether the Hornsea 4, DEP and SEP projects are included in the total. **Therefore, we advise no significant cumulative collision risk impact at the EIA scale for herring gull for East Anglia One North irrespective of whether these projects are included or excluded from the cumulative total.**
61. East Anglia Two contributes a mean collision prediction of 0.5 collisions to the cumulative total (see Table A0.4 of REP11-027).
62. Herring gull is classified as Near Threatened on the IUCN Red List as a result of population declines. The species is also Red listed on BoCC 4 (Eaton et al. 2015) as a result of population declines in the UK. There has been a 31% decline in the UK since 1999-2011. However, Natural England's recalculated cumulative collision totals for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, both including and excluding the Hornsea 4, DEP and SEP and projects equate to just under 1% of baseline mortality of the largest BDMPS and to less than 1% of baseline mortality of the biogeographic population. **Therefore, for East Anglia Two cumulatively with other plans and projects we advise no significant cumulative collision risk impact at the EIA scale for herring gull when the Hornsea 4, DEP and SEP projects are excluded from the cumulative total.** We note that the cumulative total is now approaching 1% of baseline mortality of the largest BDMPS, reinforcing



the need for herring gull CRM to have been carried out, and the need for all future offshore wind farm projects in the North Sea to do similar.

63. However, due to the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that significant impact can be ruled out for East Anglia Two for herring gull for cumulative collision impacts when the Hornsea 4, DEP and SEP projects are included in the cumulative totals.

2.1.5 Great Black-Backed Gull (GBBG) Cumulative Operational Collision Risk

64. We note there is an error in the annual total collision presented by the Applicants in Table A0.5 of REP11-027 for Hornsea 4 – the annual total should be 16.6 rather than 13.6 as presented (3 collisions in the breeding season + 13.6 collisions in the non-breeding season = annual total of 16.6). Therefore, we have included this correction in our calculations, as well as setting the figures for East Anglia 3 to the consented figures rather than those from the NMC as used by the Applicants.

65. Natural England's revised calculated cumulative collision totals for GBBG (i.e. including the consented predictions for East Anglia 3 and amending the figure used for Hornsea 4) of 979 birds for all projects excluding Hornsea 4, SEP and DEP and of 1,003 including all projects exceed 1% of baseline mortality of the North Sea BDMPS scale and the biogeographic population (Furness 2015) – the figure excluding Hornsea 4, SEP and DEP equates to 5.79% of baseline mortality of the BDMPS and 2.25% of baseline mortality of the biogeographic population, and the figure including all projects equates to 5.93% of the BDMPS and 2.31% of the biogeographic population baseline mortality (Table A1.01 above). This is not insignificant and requires further consideration.

66. There have been no updates from the Applicants regarding EIA scale PVAs. Therefore, as was used in our Deadline 8 advice on EIA scale impacts [REP8-159], we have again utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) GBBG PVAs undertaken by Norfolk Boreas (MacArthur Green 2019⁵), which used the 'Seabird PVA Tool'. We note that we raised some

⁵ MacArthur Green (2019) Norfolk Boreas Offshore Wind Farm: Offshore Ornithology Assessment Update. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp->



issues with these PVAs during the Boreas examination and that no changes were made to the models. However, these models nevertheless currently represent the best available evidence on which to base an assessment, though this should not be taken as a Natural England endorsement or 'acceptance' of the model outputs. With regard to the PVA metrics, we note that whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of final population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

67. Using the PVA models undertaken by Norfolk Boreas in MacArthur Green (2019), if the additional mortality from the offshore wind farms is 1,000-1,100 per annum (closest PVA outputs to the cumulative collision mortality figures of 979 excluding Hornsea 4, DEP and SEP and of 1,003 including all projects) then:

- The BDMPS population after 30 years will be 30.70-33.23% lower than it would have been in the absence of the additional mortality using the density independent model and 25.54-27.75% lower using the density dependent model. The population growth rate would be reduced by 1.18-1.30% using the density independent model and by 0.95-1.04% using the density dependent model (Table A1.06).
- The biogeographic population after 30 years will be 12.36-14.48% lower than it would have been in the absence of the additional mortality using the density independent model and 10.56-11.55% lower using the density dependent model. The population growth rate would be reduced by 0.46-0.50% using the density independent model and by 0.36-0.40% using the density dependent model (Table A1.06).



Table A1.06 Predicted Population impacts on the GBBG BDMPS and biogeographic population for the range of mortality impacts predicted for cumulative collision. PVA Impact Metrics are as provided in Table 3.18 of MacArthur Green (2019)*. The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined cumulative collision predictions

GBBG, EIA CUMULATIVE COLLISIONS – DENSITY INDEPENDENT PVA MODELS						
Addition al mortality	% baseline mortality largest BDMPS as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPS	Counterfactual of Growth Rate (CGR), BDMPS	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
1,000	5.91	0.6930	0.9882	2.30	0.8764	0.9954
1,100	6.51	0.6677	0.9870	2.53	0.8552	0.9950
1,200	7.10	0.6437	0.9859	2.76	0.8432	0.9945
GBBG, EIA CUMULATIVE COLLISIONS – DENSITY DEPENDENT PVA MODELS						
Addition al mortality	% baseline mortality largest BDMPS as used by Applicant	Counterfactual of Final Population Size (CPS), BDMPS	Counterfactual of Growth Rate (CGR), BDMPS	% baseline mortality biogeographic, as used by Applicant	Counterfactual of Final Population Size (CPS), biogeographic	Counterfactual of Growth Rate (CGR), biogeographic
1,000	5.91	0.7446	0.9905	2.30	0.8944	0.9964
1,100	6.51	0.7225	0.9896	2.53	0.8845	0.9960
1,200	7.10	0.7014	0.9886	2.76	0.8746	0.9957

* Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of population size and growth rate are only available in MacArthur Green (2019) for after 30 years.

68. GBBG is classed as ‘Least Concern’ of global extinction by IUCN. The overall population trend across its range is stable, although at a UK level the species is Amber listed in BoCC 4 (Eaton et al. 2015) due to moderate declines in both the breeding and non-breeding populations.

69. Based on consideration of the PVA metrics presented, the above conservation assessment and particularly that the GBBG population is stable to possibly declining and that we are not aware of any evidence to suggest that the population is going to start increasing, the predicted impacts at the North Sea population scale have the potential to give rise to significant effects. **Therefore, we are unable to rule out a significant adverse impact on GBBG from cumulative collision mortality at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**

2.1.6 Guillemot Cumulative Operational Displacement

70. Based on Natural England’s revised (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted)



cumulative totals, the annual total cumulative number of guillemots to be at risk of displacement for all projects (including from Hornsea 4, SEP and DEP) is estimated to be 438,542.

71. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **including** Hornsea 4, SEP and DEP is between 1,316 (30% displacement and 1% mortality) and 30,698 (70% displacement and 10% mortality) guillemots. This equates to 0.46-10.72% of baseline mortality for the largest BDMPS. The predicted levels of cumulative displacement impacts exceed 1% of baseline mortality of the largest BDMPS for a significant proportion of the Natural England recommended range of displacement and mortality rates (Table A1.07).
72. Given the uncertainty involved with the figures for Hornsea 4, SEP and DEP (as figures from the PEIRs for these projects), the annual cumulative total excluding these three projects is estimated to be 341,495 guillemots at risk of displacement.
73. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **excluding** Hornsea 4, SEP and DEP is between 1,024 (30% displacement and 1% mortality) and 23,905 (70% displacement and 10% mortality) guillemots. This equates to 0.36-8.35% of baseline mortality for the largest BDMPS. Again, the predicted levels of cumulative displacement impacts exceed 1% of baseline mortality of the largest BDMPS for a significant proportion of the Natural England recommended range of displacement and mortality rates (Table A1.07).
74. Table A1.07 below indicates that when considering the cumulative totals, including or excluding Hornsea 4, DEP and SEP for the Natural England recommended range of 30-70% displacement and 1-10% mortality and the predicted impacts against baseline mortality for the largest BDMPS:
- 1% of baseline mortality of the largest BDMPS is only exceeded for displacement at 70% or above and 1% mortality when Hornsea 4, DEP and SEP are included in the cumulative total, but not for any displacement scenario (30-70%) at 1% mortality when these projects are excluded from the cumulative total. At 2% mortality, 1% of baseline mortality is exceeded when displacement



exceeds 30% for including Hornsea 4, DEP and SEP or when it exceeds 40% when these projects are excluded.

- At 4% mortality and above, 1% of baseline mortality is exceeded at all displacement rates from 30-70% including or excluding Hornsea 4, DEP and SEP.

Table A1.07 Percent of baseline mortality (using 14% average across all age class mortality rates, as used by the Applicants) that predicted guillemot cumulative operational displacement impacts equate to of largest BDMPS for Natural England preferred range of 30-70% displacement and 1-10% mortality for Natural England calculated cumulative totals excluding and including Hornsea 4, SEP and DEP. Shaded cells are those where 1% of baseline mortality is exceeded

ALL PROJECTS INCLUDING HORNSEA 4, SEP & DEP							
Displacement (%)	% Baseline mortality of largest BDMPS*						
	Mortality rate (%)						
	1	2	4	5	6	8	10
30	0.46	0.92	1.84	2.30	2.76	3.68	4.60
40	0.61	1.23	2.45	3.06	3.68	4.90	6.13
50	0.77	1.53	3.06	3.83	4.60	6.13	7.66
60	0.92	1.84	3.68	4.60	5.51	7.35	9.19
70	1.07	2.14	4.29	5.36	6.43	8.58	10.72
ALL PROJECTS UP TO & INCLUDING HORNSEA 3, NORFOLK VANGURD, NORFOLK BOREAS, EAST ANGLIA ONE NORTH & EAST ANGLIA TWO, BUT EXCLUDING HORNSEA 4, SEP & DEP							
Displacement (%)	% Baseline mortality of largest BDMPS*						
	Mortality rate (%)						
	1	2	4	5	6	8	10
30	0.36	0.72	1.43	1.79	2.15	2.86	3.58
40	0.48	0.95	1.91	2.39	2.86	3.82	4.77
50	0.60	1.19	2.39	2.98	3.58	4.77	5.96
60	0.72	1.43	2.86	3.58	4.29	5.73	7.16
70	0.83	1.67	3.34	4.17	5.01	6.68	8.35

* 2,045,078 individuals for largest North Sea Population scale (from Furness 2015)

75. Guillemot are listed as 'least concern' on the IUCN Red List (Birdlife International 2018) and is also listed as amber on BoCC4 (Eaton et al. 2015).

76. While there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of projects that have been scoped into the assessment



lie in areas of the North Sea that represent low to medium levels of guillemot density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from less good areas would be lower than displacement from optimal/important areas. Therefore, we do not expect mortality rates to be at the top of the range considered for the majority of projects, though where higher densities are present, there may be exceptions.

77. Predicted cumulative mortality predictions exceed 1% of baseline mortality of the largest BDMPS at a 2% mortality rate and when displacement rates exceed between 40 and 50% displacement depending on whether Hornsea 4, DEP and SEP are included in the cumulative total or not. **Therefore, we advise a significant adverse impact to guillemot from cumulative operational displacement cannot be ruled out at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**

2.1.7 Razorbill Cumulative Operational Displacement

78. Based on Natural England's revised (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted) cumulative totals, the annual total cumulative number of razorbills to be at risk of displacement for all projects (including from Hornsea 4, SEP and DEP) is estimated to be 139,527.
79. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities including Hornsea 4, SEP and DEP is between 419 (30% displacement and 1% mortality) and 9,767 (70% displacement and 10% mortality) razorbills. This equates to 0.41-9.48% of baseline mortality for the largest BDMPS. The predicted levels of cumulative displacement impacts exceed 1% of baseline mortality of the largest BDMPS for a significant proportion of the Natural England recommended range of displacement and mortality rates (Table A1.08).



80. Given the uncertainty involved with the figures for Hornsea 4, SEP and DEP (as figures from the PEIRs for these projects), the annual cumulative total excluding these three projects is estimated to be 123,852 razorbills at risk of displacement.

81. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **excluding** Hornsea 4, SEP and DEP is between 372 (30% displacement and 1% mortality) and 8,670 (70% displacement and 10% mortality) guillemots. This equates to 0.36-8.42% of baseline mortality for the largest BDMPS. Again, the predicted levels of cumulative displacement impacts exceed 1% of baseline mortality of the largest BDMPS for a significant proportion of the Natural England recommended range of displacement and mortality rates (Table A1.08).

82. Table A1.08 below indicates that when considering the cumulative totals, either excluding or including Hornsea 4, DEP and SEP, for the Natural England recommended range of 30-70% displacement and 1-10% mortality and the predicted impacts against baseline mortality for the largest BDMPS:

- 1% of baseline mortality of the largest BDMPS is not exceeded for any displacement scenario (30-70%) at 1% mortality. At 2% mortality, 1% of baseline mortality is exceeded when displacement exceeds 30% for including Hornsea 4, DEP and SEP or when it exceeds 40% when these projects are excluded;
- At 4%-10% mortality, 1% of baseline mortality is exceeded at all displacement rates from 30-70%.



Table A1.08 Percent of baseline mortality (using 17.4% average across all age class mortality rates, as used by the Applicants) that predicted razorbill cumulative operational displacement impacts equate to of largest BDMPS for Natural England preferred range of 30-70% displacement and 1-10% mortality for calculated cumulative totals excluding and including Hornsea 4, SEP and DEP. Shaded cells are those where 1% of baseline mortality is exceeded

ALL PROJECTS INCLUDING HORNSEA 4, SEP & DEP							
Displacement (%)	% Baseline mortality of largest BDMPS*						
	Mortality rate (%)						
	1	2	4	5	6	8	10
30	0.41	0.81	1.63	2.03	2.44	3.25	4.06
40	0.54	1.08	2.17	2.71	3.25	4.34	5.42
50	0.68	1.35	2.71	3.39	4.06	5.42	6.77
60	0.81	1.63	3.25	4.06	4.88	6.50	8.13
70	0.95	1.90	3.79	4.74	5.69	7.59	9.48
ALL PROJECTS UP TO & INCLUDING HORNSEA 3, NORFOLK VANGURD, NORFOLK BOREAS, EAST ANGLIA ONE NORTH & EAST ANGLIA TWO, BUT EXCLUDING HORNSEA 4, SEP & DEP							
Displacement (%)	% Baseline mortality of largest BDMPS*						
	Mortality rate (%)						
	1	2	4	5	6	8	10
30	0.36	0.72	1.44	1.80	2.19	2.89	3.61
40	0.48	0.96	1.92	2.41	2.89	3.85	4.81
50	0.60	1.20	2.41	3.01	3.61	4.81	6.01
60	0.72	1.44	2.89	3.61	4.33	5.77	7.22
70	0.84	1.68	3.37	3.21	5.05	6.73	8.42

* 591,874 individuals for largest North Sea Population scale (from Furness 2015)

83. Razorbill are listed as ‘near threatened’ on the IUCN Red List (Birdlife International 2018) and is also listed as amber on BoCC4 (Eaton et al. 2015).

84. While there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of razorbill density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important areas. Therefore, we do not expect mortality rates to be at the top of the range considered for the majority of projects, though where higher densities are present, there may be exceptions.



85. Predicted cumulative mortality predictions exceed 1% of baseline mortality of the largest BDMPS at a 2% mortality rate and between 40 and 50% displacement depending on whether Hornsea 4, DEP and SEP are included in the cumulative total or not. **Therefore, we advise that a significant adverse impact to razorbill from cumulative operational displacement cannot be ruled out at an EIA scale for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two. This conclusion is irrespective of whether the Hornsea 4, DEP and SEP projects are included in the cumulative totals or not.**



Annex 2: Habitats Regulations Assessment (HRA) In-Combination Impacts Detailed Comments/Conclusions

1. Summary

86. This document is a technical document submitted into the East Anglia One North and East Anglia Two Examinations to provide scientific justification for Natural England's advice provided on the significance of the potential impacts on designated site features, as summarised within each section.

87. We have amended the collision predictions included for each relevant species and designated site for the East Anglia 3 project to the consented values (rather than the NMC figures as included by the Applicants, for the reasons set out in **Section 2.3** above. We have also amended the abundance figures for Hornsea 3 in the displacement assessments to those we consider appropriate for use, as set out in **Section 2.1** above. Therefore, our cumulative and in-combination totals are different to those presented by the Applicants in REP11-027. This advice therefore updates that previously provided during the Norfolk Boreas examination and at Deadline 9 [REP9-066] of the East Anglia One North and East Anglia Two examinations regarding in-combination collision and displacement impacts for the features of the Flamborough and Filey Coast (FFC) SPA and the Alde-Ore Estuary SPA covered in the Applicants' update submitted at REP11-027. Our advice considers all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, and both excluding and including the Hornsea 4, Dudgeon extension (DEP) and Sheringham extension (SEP) projects where the figures are from the PEIRs and hence subject to change. This does not update our advice on red-throated diver (RTD) at the Outer Thames Estuary SPA.

88. Our advice is based on best available evidence at the time of writing and is subject to change in the future should further evidence be presented.



2. Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects

2.1. Flamborough & Filey Coast (FFC) SPA: Gannet – Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects: Operational Collision Risk, Displacement and Collision + Displacement

89. We welcome that the in-combination assessments undertaken by the Applicants in APP-043 refer to the PVA undertaken for Hornsea 3. However, as highlighted during the Norfolk Boreas examination we had outstanding concerns with the Hornsea 3 PVAs which were not resolved by the close of the Examination, relating to the number of simulations and the demographic data not being updated (see our Deadline 6 response to the Hornsea 3 Examination – written summary of representations of ISH5⁶). However, this nevertheless represents the best available evidence on which to base an assessment, though this should not be taken as an endorsement or ‘acceptance’ of the model outputs.

90. There is no clear evidence to support the application of any particular form or magnitude of density dependence in the modelling, therefore Natural England has based its advice on the outputs of the density independent PVA model (as these make no assumptions about the form or strength of any density dependent effects). Therefore, Natural England has focused our conclusions on the PVA outputs from the density independent model for demographic rate set 2 (the rates Natural England considers to be the most appropriate) using a matched runs approach (as per Natural England advice).

⁶ Natural England (2019) Hornsea Project Three Offshore Wind Farm: Natural England Written Submission for Deadline 6 – Written Submission of Natural England’s Representations at Issue Specific Hearing 5, Offshore Ecology. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010080/EN010080-001688-Natural%20England%20-%20Written%20Submission%20of%20Natural%20England's%20Representations%20at%20Issue%20Specific%20Hearing%205%20-%20Offshore%20Ecology.pdf>



Table A2.01 Percentage of baseline mortality for in-combination impact levels for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North, East Anglia Two, both excluding and including Hornsea 4 (H4), Dudgeon extension (DEP) and Sheringham extension (SEP) for gannet for the FFC SPA. Baseline mortality calculated using adult only colony size and adult mortality rate (8.1% from Horswill & Robinson 2015).

GANNET PREDICTED IN-COMBINATION MORTALITY, HRA: FFC SPA				
	Mortality prediction	% of baseline mortality of FFC SPA designated population* (used by Applicants)	% of baseline mortality of FFC SPA 2017 count** (used by Applicants)	% of baseline mortality of FFC SPA mean of 2012, 15 & 17 census data***
In-combination CRM	293 excl. H4, SEP, DEP	16.36 excl. H4, SEP, DEP	13.51 excl. H4, SEP, DEP	14.72 excl. H4, SEP, DEP
	342 incl. H4, SEP, DEP	19.07 incl. H4, SEP, DEP	15.75 incl. H4, SEP, DEP	17.15 incl. H4, SEP, DEP
In-combination displacement (60-80% displacement and 1% mortality)	47-62 excl. H4, SEP, DEP	2.62-3.46 excl. H4, SEP, DEP	2.17-2.86 excl. H4, SEP, DEP	2.36-3.11 excl. H4, SEP, DEP
	61-82 incl. H4, SEP, DEP	3.40-4.58 incl. H4, SEP, DEP	2.81-3.78 incl. H4, SEP, DEP	3.06-4.12 incl. H4, SEP, DEP
In-combination CRM + displacement****	355 excl. H4, SEP, DEP	19.81 excl. H4, SEP, DEP	16.36 excl. H4, SEP, DEP	17.82 excl. H4, SEP, DEP
	424 incl. H4, SEP, DEP	23.66 incl. H4, SEP, DEP	19.55 incl. H4, SEP, DEP	21.28 incl. H4, SEP, DEP

* 11,061 pairs (22,122 adults), 1% baseline mortality = 18 birds

** 13,391 pairs (26,782 adults), 1% baseline mortality = 22 birds

*** 24,594 adults, 1% baseline mortality = 20 birds

**** In-combination displacement figure used in total is that for WCS of 80% displacement and 1% mortality combined with the collision predictions

In-combination collision

91. Natural England's revised calculated in-combination collision totals for FFC SPA gannet (i.e. including the consented predictions for East Anglia 3) is 293 gannets from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 342 for all projects including Hornsea 4, SEP and DEP. These predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony (see Table A2.01).

92. For the collision impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 300 per annum (closest PVA outputs to the in-combination collision mortality figure of 293 for all projects excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 25 years will be 27.9% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.4% (Table A2.02 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).



93. For the collision impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 350 per annum (closest PVA outputs to the in-combination collision mortality figure of 342 for all projects including Hornsea 4, SEP and DEP) then the population of FFC SPA after 25 years will be 31.8% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.6% (Table A2.02 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).

Table A2.02 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination collision. PVA Impact Metrics are as provided in Hornsea Project Three Offshore Wind Farm (2019). The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the in-combination collision predictions

GANNET	FFC SPA				
Additional mortality	% Baseline Mortality using designation population size (22,122 adults), as used by Applicants	% Baseline Mortality using 2017 count size (26,782 adults), as used by Applicants	% Baseline Mortality using mean of 2012, 15 & 17 census data (24,594 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
300	16.74	13.83	15.06	0.721 (0.718-0.723)	0.986
325	18.14	14.98	16.31	0.701 (0.698-0.704)	0.985
350	19.53	16.13	17.57	0.682 (0.679-0.685)	0.984
375	20.93	17.29	18.82	0.663 (0.660-0.667)	0.983
400	22.32	18.44	20.08	0.645 (0.642-0.649)	0.982
425	23.72	19.59	21.33	0.628 (0.624-0.631)	0.981

* Gannet, demographic rate set 2, counterfactuals of population size after 25 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.1 in Hornsea Project Three (2019)

** Gannet, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.3 in Hornsea Project Three (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years. No CLs given as they are the same as the median values.

In-combination displacement

94. Natural England's revised calculated in-combination displacement totals for FFC SPA gannet (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted) is 47-62 gannets from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 61-82 for all projects including Hornsea 4, SEP and DEP. These predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony (see Table A2.01).

95. For the displacement impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 50-75 per annum (closest PVA outputs to the in-combination displacement mortality figure of 47-62 for all projects excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 25



years will be 5.3-7.8% lower than it would have been in the absence of the additional mortality (Table A2.03 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).

96. For the displacement impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 75-100 per annum (closest PVA outputs to the in-combination displacement mortality figure of 61-82 for all projects including Hornsea 4, SEP and DEP) then the population of FFC SPA after 25 years will be 7.8-10.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.3-0.5% (Table A2.03 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).

Table A2.03 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination displacement. PVA Impact Metrics are as provided in Hornsea Project Three Offshore Wind Farm (2019). The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the in-combination displacement predictions

GANNET	FFC SPA				
Additional mortality	% Baseline Mortality using designation population size (22,122 adults), as used by Applicant	% Baseline Mortality using 2017 count size (26,782 adults), as used by Applicant	% Baseline Mortality using mean of 2012, 15 & 17 census data (24,594 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
50	2.79	2.30	2.51	0.947 (0.946-0.948)	0.998
75	4.19	3.46	3.76	0.922 (0.921-0.923)	0.997
100	5.58	4.61	5.02	0.897 (0.896-0.898)	0.995

* Gannet, demographic rate set 2, counterfactuals of population size after 25 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.1 in Hornsea Project Three (2019)

** Gannet, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.3 in Hornsea Project Three (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years. No CLs given as they are the same as the median values.

In-combination collision plus displacement

97. The combined in-combination impact for all projects excluding Hornsea 4, SEP and DEP of collision plus displacement to gannet from the FFC SPA equals:

- 293 mortalities per annum from collisions plus up to 62 mortalities per annum from displacement = up to 355 mortalities from the FFC SPA.

98. The combined in-combination impact for all projects including Hornsea 4, SEP and DEP of collision plus displacement to gannet from the FFC SPA equals:

- 342 mortalities per annum from collisions plus up to 82 mortalities per annum from displacement = up to 424 mortalities from the FFC SPA.



99. These combined in-combination impacts equate to over 1% of baseline mortality of the colony (see A2.01 above). Therefore, the potential combined impacts from in-combination collision plus displacement on the SPA requires further consideration.

100. For the collision plus displacement impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 375 per annum (closest PVA outputs to the in-combination collision plus displacement mortality figure of 355 for all projects excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 25 years will be 33.7% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.7% (Table A2.04 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).

101. For the collision plus displacement impacts in-combination with other plans and projects, if the additional mortality from the offshore wind farms is 450 per annum (closest PVA outputs to the in-combination collision plus displacement mortality figure of 424 for all projects including Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 38.9% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 2% (Table A2.04 below – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years).

Table A2.04 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination collision plus displacement. PVA Impact Metrics are as provided in Hornsea Project Three Offshore Wind Farm (2019). The range of predicted figures are indicated in purple. The darker shaded cells represent the level of impact closest to the combined in-combination collision plus displacement predictions

GANNET	FFC SPA				
Additional mortality	% Baseline Mortality using designation population size (22,122 adults), as used by Applicant	% Baseline Mortality using 2017 count size (26,782 adults), as used by Applicant	% Baseline Mortality using mean of 2012, 15 & 17 census data (24,594 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
375	20.93	17.29	18.82	0.663 (0.660-0.667)	0.983
400	22.32	18.44	20.08	0.645 (0.642-0.649)	0.982
425	23.72	19.59	21.33	0.628 (0.624-0.631)	0.981
450	25.11	20.74	22.59	0.611 (0.607-0.614)	0.980

* Gannet, demographic rate set 2, counterfactuals of population size after 25 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.1 in Hornsea Project Three (2019)

** Gannet, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1,000 density independent simulations. See Table A2_3.3 in Hornsea Project Three (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years. No CLs given as they are the same as the median values.



102. The gannet population of FFC SPA increased at 11.1% per annum (between 2003/4 and 2015, JNCC Seabird Monitoring Programme SMP data). Using FFC SPA census data 2002-2017 the growth rate was 9.4% per annum. However, it is not known what the growth rate of the colony will be over the next 25 years and this should therefore be considered when judging the significance of predicted impacts against the conservation objectives for the feature.
103. As was undertaken during the Norfolk Vanguard examination and used in the Norfolk Boreas examinations, Natural England has reviewed growth rates for the 22 gannet colonies across Britain, Channel Islands and Ireland with repeated census data (Cramp et al. 1974, Lloyd et al. 1991, Mitchell et al. 2004, plus more recent count data from the SMP). The Flamborough/Bempton gannet colony was founded in the late 1930s (Cramp et al. 1974) and so has been in existence now for about 80 years. Thus, by the end of the lifespan of East Anglia One North and East Anglia Two projects it will be about 110 years in age. Given the analysis of trends in gannet colony growth rates amongst a suite of long-established colonies, it is highly likely that its annual growth rate averaged over the whole period since founding will drop from its current average of c 11% over the first 80 years. The highest annual colony growth rate calculated over a period of >100 years is 4.5% at Grassholm. The Flamborough colony is unlikely to achieve a higher annual growth rate than this. The average annual growth rate calculated over a period of >90 years across the 8 gannet colonies with records exceeding 90 years is 1.8%. Amongst these colonies the mean annual growth rate over the most recent years of their records (80+ years) has been just 1.2% per annum (or 1.3% excluding Sula Sgeir (as the growth rate here may be influenced adversely by an annual licenced harvest of young birds)) compared to an average rate of 2.0% per annum during the first 80 or so years of their existence. Therefore, Natural England has considered the counterfactuals of final population size for the predicted levels of in-combination additional mortality for a range of plausible future growth rate scenarios for FFC of 1, 2, 3, 4 and 5% per annum.
104. The Conservation Objective for the gannet population of the FFC SPA is to maintain the size of the breeding population at a level which is above 8,469 pairs (16,938 adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest mean count is 24,594 adults based on the mean of the 2012, 2015 and 2017 counts.



105. For the predicted in-combination with other plans and projects collision mortality to FFC SPA gannets of 293 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the closest PVA output in Hornsea Project Three (2019) of 300 additional mortalities, the colony would be predicted to reduce from its current size of 24,594 adults for a growth rate of 1%, but would still be above the size of the 8,469 pairs or 16,938 adults. The colony would be predicted to continue to grow above the current mean population of 24,594 adults under any growth rate scenario from 2% to up to 5% per annum.
106. For the predicted in-combination with other plans and projects displacement mortality to FFC SPA gannets of 47-62 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the closest PVA outputs in Hornsea Project Three (2019) of 50-75 additional mortalities, the colony would still be predicted to grow above the current mean population of 24,594 adults under any growth rate scenario from 1% to up to 5%. This would allow the conservation objective to be met.
107. For the predicted in-combination with other plans and projects collision plus displacement mortality to FFC SPA gannets of 355 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the closest PVA output in Hornsea Project Three (2019) of 375 additional mortalities, the colony would be predicted to reduce from its current size of 24,594 adults for a growth rate of 1%, but would still be above the size of the 8,469 pairs or 16,938 adults. The colony would be predicted to continue to grow above the current mean population of 24,594 adults under any growth rate scenario from 2% to up to 5% per annum.
108. If the colony were to experience an annual growth rate of 2% or more per annum over the next 30 or so years, then the integrity of the site for this feature is high, with high rates for self-repair, and self-renewal under dynamic conditions with minimal external management. Therefore, the FFC gannet population is believed to be robust enough to allow the conservation objective to maintain the population at (or above) designation levels and sustain additional alone and in-combination mortalities from the offshore wind farms. Our justification for this position is we consider it to be highly unlikely that the FFC annual growth rate would be as low as 1%, and from the analysis of gannet colony growth rates we have conducted the current annual growth rate of c 11% appears to be relatively high for a colony



of this age and so the colony is likely to do better than a 1.3 % annual growth rate in the foreseeable future.

109. **Natural England advises that based on the above information, an adverse effect on integrity (AEol) of the gannet feature of the FFC SPA can be ruled out for in-combination collision impacts, in-combination displacement impacts and in-combination collision plus displacement impacts when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals).**

110. **However, due to the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that an AEol can be ruled out for the gannet feature of the FFC SPA for in-combination collision impacts, in-combination displacement impacts and in-combination collision plus displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.**

2.2 Flamborough & Filey Coast (FFC) SPA: Kittiwake – Impacts from EA1N AND EA2 In-Combination with Other Plans and Projects: Operational Collision Risk

111. We welcome that the in-combination assessments undertaken by the Applicants in APP-043 make reference to the PVA undertaken for Hornsea 3. However, as highlighted during the Norfolk Boreas examination we had outstanding concerns with the Hornsea 3 PVAs which were not resolved by the close of the Examination, relating to the number of simulations and the demographic data not being updated (see our Deadline 6 response to the Hornsea 3 Examination – written summary of representations of ISH5⁷). However, this nevertheless represents the best available evidence on which to base an

⁷ Natural England (2019) Hornsea Project Three Offshore Wind Farm: Natural England Written Submission for Deadline 6 – Written Submission of Natural England's Representations at Issue Specific Hearing 5, Offshore Ecology. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010080/EN010080-001688-Natural%20England%20-%20Written%20Submission%20of%20Natural%20England's%20Representations%20at%20Issue%20Specific%20Hearing%205%20-%20Offshore%20Ecology.pdf>



assessment, though this should not be taken as an endorsement or ‘acceptance’ of the model outputs.

112. There is no clear evidence to support application of any particular form or magnitude of density dependence in the modelling, therefore Natural England has based our advice on the outputs of the density independent models (as these make no assumptions about the form of strength of any density dependent effects). Therefore, Natural England has focused our conclusions on the PVA outputs from the density independent model for demographic rate set 2 using a matched runs approach.

113. Natural England’s revised calculated in-combination collision totals for FFC SPA kittiwake (i.e. including the consented predictions for East Anglia 3) is 358 kittiwakes from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 533 for all projects including Hornsea 4, SEP and DEP. These predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony (see Table A2.05).

Table A2.05 Percentage of baseline mortality for in-combination collision impacts for excluding and including Hornsea 4 (H4), Dudgeon extension (DEP) and Sheringham extension (SEP) for kittiwake for FFC SPA. Baseline mortality calculated using adult only colony size and adult mortality rate (14.6% from Horswill & Robinson 2015).

KITTIWAKE PREDICTED IN-COMBINATION CRM MORTALITY, HRA: FFC SPA			
	Mortality prediction	% of baseline mortality of FFC SPA designated population* (used by Applicant)	% of baseline mortality of FFC SPA mean 2016-17 census data**
In-combination CRM excl. H4, DEP and SEP	358	2.76	2.39
In-combination CRM incl. H4, DEP and SEP	533	4.10	3.56

* 89,040 adults, 1% baseline mortality = 130 birds

** 102,536 adults, 1% baseline mortality = 150 birds

114. If the additional mortality from the windfarm is 400 adults per annum (closest PVA outputs available in Hornsea Project Three Offshore Wind Farm 2019 to predicted 358 mortalities for in-combination total excluding Hornsea 4, DEP and SEP) then the population of FFC SPA after 25 years will be 10.2% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.4% (Table A2.06 – note GCRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years). If it is assumed that the population is stable, then this would mean that the population would be 10.2% lower than the current population size. This would be counter to the restore



conservation objective for this feature at the site and would result in an adverse effect on the integrity of the site.

115. If the additional mortality from the windfarm is 550 adults per annum (closest PVA outputs available in Hornsea Project Three Offshore Wind Farm 2019 to predicted 533 mortalities for in-combination total including Hornsea 4, DEP and SEP) then the population of FFC SPA after 25 years will be 13.8% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.6% (Table A2.06 – note GCRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years). If it is assumed that the population is stable, then this would mean that the population would be 13.8% lower than the current population size. This would be counter to the restore conservation objective for this feature at the site and would result in an adverse effect on the integrity of the site.

Table A2.06 Predicted population impacts on the kittiwake population of FFC SPA for the range of mortality impacts predicted for in-combination collision. PVA impact metrics are as provided in Hornsea Project Three Offshore Wind Farm (2019). The range of predicted in-combination figures are indicated in purple. The darker shaded cells represent the level of impact closest to the in-combination predictions.

KITTIWAKE	FFC SPA			
Additional mortality	% Baseline Mortality using designation population size (89,040 adults)	% Baseline Mortality using mean 2016-17 census data (102,536 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
350	2.69	2.34	0.910 (0.909-0.911)	0.996
400	3.08	2.67	0.898 (0.897-0.899)	0.996
450	3.46	3.01	0.885 (0.884-0.887)	0.995
500	3.85	3.34	0.874 (0.872-0.875)	0.994
550	4.23	3.67	0.862 (0.860-0.863)	0.994
600	4.62	4.01	0.850 (0.849-0.851)	0.993

* Kittiwake, demographic rate set 2, counterfactuals of population size after 25 years, estimated using a matched runs method, from 1000 density independent simulations. See Table A2_7.1 in Hornsea Project Three Offshore Wind Farm (2019)

** Kittiwake, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1000 density independent simulations. See Table A2_7.3 in Hornsea Project Three Offshore Wind Farm (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years. No CLs given as they are the same as the median values.

116. It is not known what the growth rate of the colony will be over the next 25 years and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature. There has been a 2.2% per annum decline in numbers for Flamborough Head and Bempton Cliffs colony⁸

⁸ It should be noted that the new Flamborough and Filey Coast SPA includes additional cliff areas at Filey which support kittiwake but were not previously monitored as part of the SPA, hence the reference to Flamborough Head and Bempton Cliffs.



between 1987 and 2017 (a growth rate of 0.979 per annum). Over the period 2000 to 2017 the population has shown a 0.37% per annum increase in numbers (a growth rate of 1.0037 per annum) based on census counts in SMP (JNCC 2016).

117. Across colonies in the UK the kittiwake population declined by 44% between 1998/2000 and 2015. Between the SCR Census (1985–88) and Seabird 2000 (1998–2002) for major colonies in Britain, no sites showed a per annum increase that exceeded 4.5% (see Section B of Natural England’s Deadline 4 submission for Hornsea Project 2⁹). The growth rate of the colony at Bempton/Flamborough between 2000 and 2017 was 0.37% per annum, following declines from 1987. So, it seems reasonable to assume that the FFC SPA colony growth rate is <1% per annum. Therefore, Natural England has considered the counterfactuals of final population size for the predicted levels of in-combination additional mortality for a range of plausible future growth rate scenarios for FFC of stable, 0.37, 1, and 3% per annum, as per our advice during the Norfolk Vanguard and Norfolk Boreas examinations.

118. The Conservation Objective for the kittiwake population of the FFC SPA is to restore the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. We note that in APP-043 the Applicants’ state that: *‘there is some uncertainty as to whether there were ever as many as 83,370 pairs of kittiwakes at this site’*. Natural England has reviewed the evidence and information available on the 1979, 1986 and 1987 counts in Natural England (2020)¹⁰. Based on the evidence and information available on the 1979, 1986 and 1987 counts presented in Natural England (2020), Natural England’s position is that:

‘The 1987 count of 85,395 AON kittiwake at Bempton Cliffs and Flamborough Head is accurate and valid, and Natural England will use this figure as the basis of advice on the population status of kittiwake at the colony and at a regional and national level.’

⁹ Natural England (2015) Hornsea Project Two Offshore Wind Farm – Written Submission for Deadline 4. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001163-Natural%20England.pdf>

¹⁰ Natural England (2020) Natural England Evidence Information Note EIN050: Natural England Evidence Statement Regarding Kittiwake Count Data Used to Classify the Flamborough Head & Bempton Cliffs SPA. Available from: <http://publications.naturalengland.org.uk/publication/4658653459382272>



Natural England consider that the 1986 figure is an estimated value and therefore should not be used quantitatively in any assessments.

In the absence of the original count data or forms and /or details of the methods used, Natural England are unable to verify the accuracy of the 1979 count. This is an issue for all the counts at the colony prior to the SCR counts in 1986 and 1987, but this is not a reason to doubt these counts, and they are an important element in the history of kittiwake at the site, in England, the UK and Europe.

Therefore, Natural England's position remains that the conservation objective is to restore the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

119. If we assume a 1% per annum growth rate then 400 additional mortalities per annum would result in the population being approximately 12,000-13,000 birds lower than without the additional mortality after 25 years and it would take over an additional 30 years to reach the target population compared to the no windfarm mortality scenario. If we assume a 1% per annum growth rate then 550 additional mortalities per annum would result in the population being around 18,000 birds lower than without the additional mortality after 25 years and it would take over an additional 70 years to reach the target population compared to the no windfarm mortality scenario. It is not possible to rule out adverse effect on integrity (AEoI) for these scenarios.

120. If the kittiwake population were to grow at the a rate of 3% per annum over the next 25 years, then 400 additional mortalities per annum would result in the population being approximately 20,000-birds lower than without the additional mortality after 25 years and it would take over an additional 2 years to reach the target population compared to the no windfarm mortality scenario. If we assume a 3% per annum growth rate then 550 additional mortalities per annum would result in the population being around 30,000 birds lower than without the additional mortality after 25 years and it would take over an additional 4 years to reach the target population compared to the no windfarm mortality scenario.

121. In the context of a population trajectory that is currently stable or increasing at <1% per annum an additional mortality of 400 adults per annum causing a reduction in growth rate of 0.4%, or of 550 adults per annum over 25 years causing



a reduction in growth rate of 0.6% would further harm the population and make it more difficult to restore the population to a favourable condition. Natural England is therefore currently unable to advise beyond reasonable scientific doubt that this level of impact would not be an AEol.

122. There is no evidence to suggest that the future population trend will be significantly different from the current trend of 0.37% per annum (2000-2017), for example productivity at the colony has not been increasing in recent years (see Figure A2.01) (Aitken et al. 2017). So, based on the review of growth rates above, it seems reasonable to assume that the FFC SPA colony growth rate will be <1% per annum.

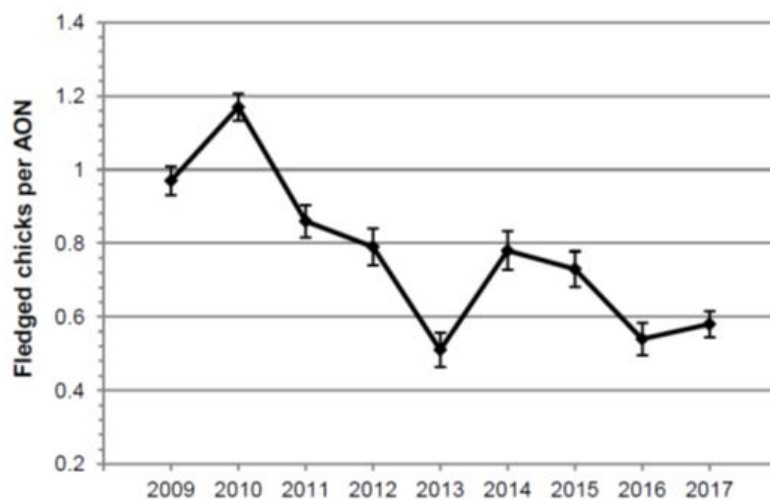


Figure A2.01 Flamborough/Bempton Black-legged kittiwake productivity 2009-2017, mean of plot results +/- SE. From Aitken et al. (2017). Note this does not include productivity data for Filey, where productivity is lower (e.g. in 2017 mean productivity for kittiwake at Filey was 0.39 (SE \pm 0.0742) chicks per AON).

123. Therefore, as this feature has a restore conservation objective, and because there are indications that the predicted level of mortality would mean the population could decline from current levels should it currently be stable, **it is not possible to rule out AEol of the kittiwake feature of the FFC SPA for collision impacts from in-combination with other plans and projects, for all projects up to and including Hornsea 3 (noting the contribution from this project is set to 0 as compensated for), Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, irrespective of whether Hornsea 4, DEP and SEP are included in the totals or not.**



2.3 Flamborough & Filey Coast (FFC) SPA: Guillemot – Impacts from EA1N and EA2 In-Combination With Other Plans and Projects: Operational Displacement

124. Based on Natural England's revised (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted) in-combination totals, the annual in-combination total number of guillemots to be at risk of displacement for all projects (including from Hornsea 4, SEP and DEP) is estimated to be 43,662.
125. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities including Hornsea 4, SEP and DEP is between 131 (30% displacement and 1% mortality) and 3,056 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 2.58-60.21% of baseline mortality for the colony (Table A2.07). This is significant and therefore requires further consideration.
126. Given the uncertainty involved with the figures for Hornsea 4, SEP and DEP (as figures from the PEIRs for these projects), the annual in-combination total excluding these three projects is estimated to be 24,975 guillemots at risk of displacement.
127. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities excluding Hornsea 4, SEP and DEP is between 75 (30% displacement and 1% mortality) and 1,748 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 1.48-34.44% of baseline mortality for the colony (Table A2.07). Again, this is significant and therefore requires further consideration.



Table A2.07 Predicted annual displacement mortalities for in-combination impact levels for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP) for guillemot for FFC SPA. Pink shaded cells indicate predicted mortalities that exceed 1% of baseline mortality – baseline mortality calculated using adult only colony size (designated size of 83,214 adults) and adult mortality rate (6.1% from Horswill & Robinson 2015) – 1% baseline mortality = 51 birds.

Guillemot in-combination mortality figures, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	75	150	375	749
	40	100	200	499	999
	50	125	250	624	1,249
	60	150	300	749	1,498
	70	175	350	874	1,748
Guillemot in-combination mortality figures, INCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	131	262	655	1,310
	40	175	349	873	1,746
	50	218	437	1,092	2,183
	60	262	524	1,310	2,620
	70	306	611	1,528	3,056

128. Whilst we welcome that the in-combination assessments undertaken by the Applicants in APP-043 make reference to the PVA undertaken for Hornsea 3, we note that the maximum additional mortality modelled in the FFC SPA guillemot PVA undertaken during the Hornsea 3 examination (Hornsea Project Three Offshore Wind Farm 2019) is 1,600 per year. This is insufficient for the current predicted worst case maximum (i.e. for 70% displacement and 10% mortality) of 1,748 for excluding Hornsea 4, SEP and DEP and of 3,056 for including Hornsea 4, SEP and DEP.

129. We have therefore utilised the outputs from the updated PVA model undertaken by Norfolk Boreas in MacArthur Green (2019¹¹) using the Natural England commissioned ‘Seabird PVA tool’. However, it was noted during the Norfolk Boreas examination that the guillemot models had been run for only 500 simulations. The Seabird PVA Tool report (Searle et al. 2019) states that *‘it is not recommended to use small values of sim.n (number of simulations) because PVAs based on small numbers of simulations are likely to be unreliable (using a value of less than 1,000*

¹¹ MacArthur Green (2019) Norfolk Boreas Offshore Wind Farm: Offshore Ornithology Assessment Update. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-001420-Offshore%20Ornithology%20Assessment%20Update.pdf>



will generate a warning message in the tool, but in practice the minimum number of simulations may need to be substantially higher than this in order to achieve reliable results)'. Natural England considers that a larger number of simulations than 500 would be needed to generate reliable results.

130. Therefore, during the Norfolk Boreas examination, Natural England re-ran the density independent PVA through the tool in order to consider the predicted counterfactual metrics across the full range of predicted impacts across 30-70% displacement and 1-10% mortality. This was done using the same input parameters for guillemot at the FFC SPA as presented by Norfolk Boreas in Appendix 3 of MacArthur Green (2019). However, we note that we were able to run the model for 5,000 simulations rather than the 500 simulations as done by Norfolk Boreas. We note that whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of final population size and growth rate were calculated for Norfolk Boreas after 30 years.

131. There is no clear evidence to support the application of any particular form or magnitude of density dependence in the modelling, therefore Natural England has based its advice on the outputs of the density independent PVA model we re-ran (as these make no assumptions about the form or strength of any density dependent effects).

132. The FFC SPA guillemot colony increased by 2.8% per annum between 1987-2008 and the designated population size is 83,214 breeding adults. The 2017 colony count indicated approximately 121,754 breeding adults across the site (Aitken et al. 2017). It is not clear whether the colony will continue to grow at the current rate for the next 25 years and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature. The Conservation Objective for the guillemot population of the FFC SPA is to maintain the size of the breeding population at a level which is above 41,607 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

133. If the additional mortality from the windfarm is 1,750-3,050 birds per annum (closest PVA outputs available to predicted 1,748 mortalities for the in-combination total excluding Hornsea 4, SEP and DEP at 70% displacement and 10% mortality and to the 3,056 in-combination total including Hornsea 4, SEP and DEP at 70%



displacement and 10% mortality) then the population of FFC SPA after 30 years will be 51.0-72.2% lower (based on Natural England's re-run PVA) than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 2.3-4.1% (see Table A2.08 – note CPS and CGRs were calculated by Natural England during the Norfolk Boreas examination for 30 years). This level of impact would be considered significant in the context of the current colony population trend.

Table A2.08 Predicted population impacts on the guillemot population of FFC SPA for the range of mortality impacts predicted for in-combination displacement. PVA impact metrics are those calculated from the Natural England re-run of the PVA using the PVA tool, based on the same input parameters for guillemot at the FFC SPA as presented by Norfolk Boreas in Appendix 3 of MacArthur Green (2019). The range of predicted in-combination figures are indicated in purple. The darker shaded cells represent the level of impact closest to the in-combination predictions.

GUILLEMOT			
Additional mortality	% Baseline Mortality using designation population size (83,214 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
1700	33.49	0.490	0.977
1750	34.48	0.480	0.977
2200	43.34	0.396	0.971
2650	52.21	0.327	0.965
3050	60.09	0.275	0.959

* Guillemot counterfactuals of population size and growth rate after 30 years, produced by Natural England during the Norfolk Boreas examination using the NE Seabird PVA Tool for 5,000 density independent simulations, using same input data as Norfolk Boreas provided in Appendix 3 of MacArthur Green (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of population size and growth rate were calculated for Norfolk Boreas after 30 years.

134. While there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of guillemot density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important areas. Therefore, we do not anticipate that mortality rates to be at the top of the range considered for projects with low/medium densities. When Hornsea 4 and DEP and SEP are excluded, Table A2.09 indicates that the mortality is unlikely to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.



135. However, the Hornsea 4 PEIR data indicates that there are high densities of guillemot present at the Hornsea 4 site compared to other projects and therefore it may be an important area for guillemot. Furthermore, Hornsea 4 is significantly closer to FFC SPA compared to other Round 3 projects, and as a result is likely to have a higher importance for foraging guillemot from the colony during the breeding season, and for dispersing guillemot in the immediate post-breeding period. For both these reasons, Natural England considers that the consequences of displacement for guillemot are likely to be significantly higher for this project, and therefore it cannot be assumed that mortality will be at the lower end of the range when the impacts of Hornsea 4 are considered. Furthermore, displacement from important breeding season foraging areas may have consequences for productivity as well as adult survival, (which displacement assessments do not consider) We also note that when Hornsea 4, DEP and SEP are included in the in-combination totals there is a higher risk of a more substantial reduction in the CGR, as shown in Table A2.09.

Table A2.09 Predicted % reductions in population growth rates from Norfolk Boreas in-combination with other plans and projects for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP). Shaded cells are those where the reduction in growth rate exceeds 0.5%, 1% or 2%.

Guillemot growth rate figures*, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.1	0.2	0.5	1.0
	40	0.1	0.3	0.7	1.3
	50	0.2	0.3	0.9	1.7
	60	0.2	0.4	1.0	2.0
	70	0.3	0.5	1.2	2.3
Guillemot growth rate figures*, INCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.2	0.4	0.9	1.8
	40	0.3	0.5	1.2	2.3
	50	0.3	0.6	1.5	2.9
	60	0.4	0.7	1.8	3.5
	70	0.5	0.9	2.3	4.1

* Guillemot counterfactuals of population growth rate after 30 years, produced by Natural England using the NE Seabird PVA Tool for 5,000 density independent simulations, using same input data as Applicant has provided in Appendix 3 of MacArthur Green (2019)

136. Based on the current population trend for the colony and the restore conservation objective, and on the basis of predicted displacement mortality for the project in-combination with other plans and projects resulting in a decline in growth rate of no more than 0.4%, **Natural England advises that an adverse effect on**



integrity (AEol) on the guillemot feature of the FFC SPA can be ruled out from displacement in-combination with other plans and projects when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals).

137. However, due to the issues identified above regarding the numbers of guillemot in Hornsea 4 array area and its proximity to FFC SPA, the increased risk of reductions in growth rate and population size when Hornsea 4, DEP and SEP are included, and the inevitable uncertainty associated with the figures for these projects due to them being from the PEIRs and hence subject to change, Natural England is not in a position to advise that an AEol can be ruled out for the guillemot feature of the FFC SPA for in-combination displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.

2.4 Flamborough & Filey Coast (FFC) SPA: Razorbill – Impacts from EA1N and EA2 In-COMBINATION with Other Plans and Projects: Operational Displacement

138. Based on Natural England's revised (i.e. including the Hornsea 3 figures Natural England consider appropriate based on the updated data from Ørsted) in-combination totals, the annual in-combination total number of razorbills to be at risk of displacement for all projects (including from Hornsea 4, SEP and DEP) is estimated to be 7,261.

139. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities including Hornsea 4, SEP and DEP is between 22 (30% displacement and 1% mortality) and 508 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 0.98-22.90% of baseline mortality for the colony (Table A2.10). This is significant at the upper level of the displacement/mortality range that the SNCBs advise for auks (70% displacement and 10% mortality) and therefore requires further consideration.

140. Given the uncertainty involved with the figures for Hornsea 4, SEP and DEP (as figures from the PEIRs for these projects), the annual in-combination total



excluding these three projects is estimated to be 6,218 razorbills at risk of displacement.

141. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities excluding Hornsea 4, SEP and DEP is between 19 (30% displacement and 1% mortality) and 435 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 0.84-19.61% of baseline mortality for the colony (Table A2.10). Again, this is significant at the upper level of the displacement/mortality range that the SNCBs advise for auks (70% displacement and 10% mortality) and therefore requires further consideration.

Table A2.10 Predicted annual displacement mortalities for in-combination impact levels for excluding and including Hornsea 4 (H4), Dudgeon extension (DEP) and Sheringham extension (SEP) for razorbill for FFC SPA. Pink shaded cells indicate predicted mortalities that exceed 1% of baseline mortality – baseline mortality calculated using adult only colony size (designated size of 21,140 adults) and adult mortality rate (10.5% from Horswill & Robinson 2015) – 1% baseline mortality = 22 birds.

Razorbill in-combination mortality figures, EXCLUDING H4, DEP & SEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	19	37	93	187
	40	25	50	124	249
	50	31	62	155	311
	60	37	75	187	373
	70	44	87	218	435
Razorbill in-combination mortality figures, INCLUDING H4, DEP & SEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	22	44	109	218
	40	29	58	145	290
	50	36	73	182	363
	60	44	87	218	436
	70	51	102	254	508

142. We welcome that the in-combination assessments undertaken by the Applicants in APP-043 make reference to the PVA undertaken for Hornsea 3. However, as highlighted during the Norfolk Boreas examination we had outstanding concerns with the Hornsea 3 PVAs which were not resolved by the close of the Examination, relating to the number of simulations and the demographic data not being updated (see our Deadline 6 response to the Hornsea



3 Examination – written summary of representations of ISH5¹²). However, this nevertheless represents the best available evidence on which to base an assessment, though this should not be taken as an endorsement or ‘acceptance’ of the model outputs.

143. There is no clear evidence to support the application of any particular form or magnitude of density dependence in the modelling, therefore Natural England has based its advice on the outputs of the density independent PVA model (as these make no assumptions about the form or strength of any density dependent effects). Therefore, Natural England has focused our conclusions on the PVA outputs from the density independent model for demographic rate set 2 (the rates Natural England considers to be the most appropriate) using a matched runs approach (as per Natural England advice).
144. The FFC SPA razorbill colony increased by 3% per annum 1987-2008 and the designated population size is 21,140 breeding adults. The 2017 colony count indicated approximately 40,506 breeding adults across the site, indicating continued increases (Aitken et al. 2017). It is not clear whether the colony will continue to grow at the current rate for the next 25 years and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature. However, colony productivity is higher than the national average. The Conservation Objective for the razorbill population of the FFC SPA is to maintain the size of the breeding population at a level which is above 10,570 breeding pairs whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.
145. If the additional mortality from the windfarm is 450-550 birds per annum (closest PVA outputs available in Hornsea Project Three Offshore Wind Farm 2019 to predicted 435 mortalities for the in-combination total excluding Hornsea 4, SEP and DEP at 70% displacement and 10% mortality and to the 508 in-combination total for including Hornsea 4, SEP and DEP at 70% displacement and 10%

¹² Natural England (2019) Hornsea Project Three Offshore Wind Farm: Natural England Written Submission for Deadline 6 – Written Submission of Natural England’s Representations at Issue Specific Hearing 5, Offshore Ecology. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010080/EN010080-001688-Natural%20England%20-%20Written%20Submission%20of%20Natural%20England’s%20Representations%20at%20Issue%20Specific%20Hearing%205%20-%20Offshore%20Ecology.pdf>



mortality) then the population of FFC SPA after 25 years will be 40.4-47.0% lower (see Table A2.11) than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 2.1-2.6% (see Table A2.11 – note CGRs are only available in Hornsea Project Three Offshore Wind Farm (2019) for 35 years). This level of impact would be considered significant in the context of the current colony population trend.

Table A2.11 Predicted population impacts on the razorbill population of FFC SPA for the range of mortality impacts predicted for in-combination displacement. PVA impact metrics are as provided in Hornsea Project Three Offshore Wind Farm (2019). The range of predicted in-combination figures are indicated in purple. The darker shaded cells represent the level of impact closest to the in-combination predictions.

RAZORBILL			
Additional mortality	% Baseline Mortality using designation population size (83,214 adults)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)**
400	18.02	0.631 (0.624-0.640)	0.981
450	20.27	0.596 (0.587-0.604)	0.979
500	22.53	0.562 (0.553-0.571)	0.976
550	24.78	0.530 (0.521-0.540)	0.974

* Razorbill, demographic rate set 2, counterfactuals of population size after 25 years, estimated using a matched runs method, from 1000 density independent simulations. See Table A2_15.1 in Hornsea Project Three Offshore Wind Farm (2019)

** Razorbill, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1000 density independent simulations. See Table A2_15.3 in Hornsea Project Three Offshore Wind Farm (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years.

146. Whilst there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of razorbill density during both the breeding (where relevant) and non-breeding seasons¹³, it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important areas. Therefore, we do not anticipate razorbill mortality rates to be at the top of the range considered for projects with low/medium densities. When Hornsea 4 and DEP and SEP are excluded, Table A2.12 indicates that the mortality is unlikely to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.



147. However, Hornsea 4 is located significantly closer to the FFC SPA compared to other Round 3 projects, and as a result is potentially of a higher importance for foraging razorbill during the breeding season and the immediate post-breeding period. As a result Natural England considers that the consequences of displacement for razorbill is likely to be higher for this project, and therefore higher mortality rates are more likely to be appropriate. In other words, it cannot be assumed that mortality will be at the lower end of the range for Hornsea 4. Furthermore, displacement from important razorbill foraging areas may have consequences for productivity as well as adult survival (which displacement assessments do not consider).

Table A2.12 Predicted % reductions in population growth rates¹⁴ from in-combination with other plans and projects for excluding and including Hornsea 4 (H4), Dudgeon extension (DEP) and Sheringham extension (SEP). Shaded cells are those where the reduction in growth rate exceeds 0.5%, 1% or 2%).

Razorbill growth rate figures*, EXCLUDING H4, DEP & SEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.2	0.2	0.5	0.9
	40	0.2	0.2	0.7	1.2
	50	0.2	0.5	0.9	1.7
	60	0.2	0.5	0.9	1.9
	70	0.2	0.5	1.2	2.1
Razorbill growth rate figures*, INCLUDING H4, DEP & SEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.2	0.2	0.7	1.2
	40	0.2	0.5	0.7	1.4
	50	0.2	0.5	0.9	1.9
	60	0.2	0.5	1.2	2.1
	70	0.5	0.7	1.4	2.6

* Razorbill, demographic rate set 2, counterfactuals of population growth rate after 35 years, estimated using a matched runs method, from 1000 density independent simulations. See Table A2_15.3 in Hornsea Project Three Offshore Wind Farm (2019). Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in Hornsea Project Three Offshore Wind Farm (2019) for after 35 years.

148. Based on the current population trend and productivity levels for the colony, and on the basis of predicted displacement mortality for the project in-combination with other plans and projects resulting in a decline in growth rate of less than 0.5% per annum, **Natural England advises that an adverse effect on integrity (AEoI) on the razorbill feature of the FFC SPA can be ruled out from displacement in-combination with other plans and projects when all projects up to and**

¹⁴ Reductions in population growth rate relate to the nearest mortality level output from the PVA model that lies above the predicted in-combination displacement mortality in A2.10 above. So for example if the predicted displacement is 110 birds and PVA outputs are given in 50 bird increments, the reduction in growth rate in the matrix is that for the 150 birds mortality level.



including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals).

149. However, due to the issues identified above regarding the proximity of Hornsea 4 to FFC SPA and the implications for displacement effects, and the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and hence being subject to change, Natural England therefore is not in a position to advise that an AEol can be ruled out for the razorbill feature of the FFC SPA for in-combination displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.

2.5 Flamborough & Filey Coast (FFC) SPA: Seabird Assemblage – Impacts from EA1N and EA2 In-Combination with Other Plans and Projects: Operational Displacement and Collision

150. Whilst the seabird assemblage feature has not been considered in the update by the Applicants in REP11-027, we have updated our in-combination advice for this feature based on the inclusion of the updated Hornsea 3 impact predictions and the inclusion of the Dudgeon extension (DEP) and Sheringham extension (SEP) projects.

151. The impacts to the assemblage qualifying feature of the FFC SPA should be assessed against the conservation objectives for abundance and diversity of the feature, namely:

- Abundance: to maintain the overall abundance of the assemblage at a level which is above 216,730 individuals whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.
- Diversity: to maintain the diversity of the assemblage – the total number of species (nine: kittiwake, gannet, guillemot, razorbill, fulmar, puffin, herring gull, shag and cormorant) comprising the seabird assemblage should not reduce over time.



152. Natural England notes that there are a number of ongoing issues with interpreting assemblage features that still need to be resolved. However, using expert judgement Natural England considers that the abundance target of the assemblage will be met, and that the assemblage diversity is not at risk from the in-combination collision and displacement impacts from offshore wind farms. Therefore, Natural England advises **that an adverse effect on integrity (AEol) of the seabird assemblage feature of the FFC SPA can be ruled out for collision and displacement impacts in-combination with other plans and projects when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals)**. However, it should be noted that Natural England are looking into assemblages as features in more detail so this advice may be subject to change in the future.

153. **However, due to the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that an AEol can be ruled out for the assemblage feature of the FFC SPA for in-combination collision and displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.**

2.6 Alde-Ore Estuary SPA: Lesser Black-Backed Gull – Impacts from EA1N and EA2 In-Combination with other Plans and Projects: Operational Collision Risk

154. We welcome that the in-combination assessments undertaken by the Applicants in APP-043 make reference to the PVA undertaken during the Norfolk Vanguard examination (MacArthur Green 2019¹⁵). However, as highlighted during the Norfolk Boreas examination we had outstanding concerns/queries regarding this PVA during the Vanguard Examination (namely regarding the adjustment of the productivity to take account of the proportion of birds that miss breeding each year; and that we were unable to check the baseline growth rate predicted by the model from the outputs of counterfactuals presented, see our Deadline 8 response

¹⁵ MacArthur Green (2019) Norfolk Vanguard Offshore Wind Farm: Responses to Natural England initial comments on the Alde-Ore Estuary SPA lesser black-backed gull PVA – Offshore Ornithology Cumulative and In-combination Collision Risk Assessment: Appendix 1. Available from: [EN010079-002883-ExA; AS; 10.D7.21A Alde Ore Estuary SPA PVA Responses.pdf \(planninginspectorate.gov.uk\)](#)



to the Vanguard examination¹⁶). However, this nevertheless represents the best available evidence on which to base an assessment, though this should not be taken as an endorsement or ‘acceptance’ of the model outputs.

155. There is no clear evidence to support application of any particular form or magnitude of density dependence in the modelling, therefore Natural England has based our advice on the outputs of the density independent models (as these make no assumptions about the form of strength of any density dependent effects). Therefore, Natural England has focused our conclusions on the PVA outputs from the density independent model for demographic rate set 1 using a matched runs approach.

156. Natural England’s revised calculated in-combination collision totals for Alde-Ore Estuary SPA LBBG (i.e. including the consented predictions for East Anglia 3) is 53 LBBG from the Alde-Ore Estuary SPA per annum for all projects excluding or including Hornsea 4, SEP and DEP (as no LBBGs are apportioned to the Alde-Ore Estuary SPA from the Hornsea 4, and a very small number predicted by the SEP and DEP projects, though these are drawn from the PEIRs and so are subject to change). Both sets of in-combination figures equate to more than 1% of baseline mortality of the colony (see Table A2.13).

Table A2.13 Percentage of baseline mortality for in-combination collision impacts for LBBG for the Alde-Ore Estuary SPA. Baseline mortality calculated using adult only colony size and adult mortality rate (11.5% from Horwill & Robinson 2015). Note no collisions are apportioned to Hornsea 4, DEP and SEP in the in-combination assessment

LBBG PREDICTED IN-COMBINATION CRM MORTALITY, HRA: ALDE-ORE ESTUARY SPA		
	Mortality prediction	% of baseline mortality of Alde-Ore SPA* (2,000 pairs 2007-14, as used by Applicants)
In-combination CRM excl. H4, DEP and SEP	53	11.50
In-combination CRM incl. H4, DEP and SEP	53	11.50

* 4,000 adults, 1% baseline mortality = 5 birds

¹⁶ Natural England (2019) Norfolk Vanguard Offshore Wind Farm Deadline 8: Natural England's Comments on Norfolk Vanguard Ltd. Deadline 7 and Deadline 7.5 submissions in relation to Offshore Ornithology Related Matters. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010079/EN010079-003121-DL8%20-%20Natural%20England%20-%20Deadline%20Submission.pdf>



157. The Conservation Objective for the LBBG population of the Alde-Ore Estuary SPA is to restore the size of the breeding population to a level which is above 14,074 whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

158. If the additional mortality from the windfarm is 55 adults per annum (closest PVA outputs available in MacArthur Green (2019) to predicted 53 mortalities for the in-combination total including or excluding Hornsea 4, DEP and SEP) then the population of the Alde-Ore Estuary SPA after 25 years will be 28.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.4% (Table A2.14 – note CGRs are only available in MacArthur Green (2019) for 30 years). If it is assumed that the population is stable, then this would mean that the population would be 28.3% lower than the current population size. This would be counter to the restore conservation objective for this feature of the site.

Table A2.14 Predicted population impacts on the LBBG population of the Alde-Ore Estuary SPA for the range of mortality impacts predicted for in-combination with other plans and projects. PVA impact metrics are as provided in MacArthur Green (2019). The shaded cells represent the level of impact closest to the in-combination predictions.

LBBG – ALDE-ORE ESTUARY SPA			
Additional mortality	% Baseline Mortality using population size of 4,000 adults (2007-2014), as used by the Applicants	Density Independent Model	
		Counterfactual of Final Population Size (CPS) after 30yrs – see Table 2 of MacArthur Green (2019)	Counterfactual of Growth rate (CGR) after 30yrs – see Table 3 of MacArthur Green (2019)*
55	11.96	0.717 (0.666-0.774)	0.986 (0.983-0.990)

* The Norfolk Vanguard Applicant confirmed that the headings for the median and lower CIs are the wrong way around in MacArthur Green (2019). So, we have presented the figures the correct way around above. Whilst East Anglia One North and East Anglia Two's lifespans are 25 years, data on counterfactuals of growth rate are only available in MacArthur Green (2019) for after 30 years.

159. It is not known what the growth rate of the colony will be over the next 25 years and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature.

160. As the Alde-Ore LBBG population is at best currently stable and the PVA undertaken for Norfolk Vanguard (MacArthur Green 2019) suggests a baseline growth rate of -2% for the density independent model we have considered these levels of growth rates per annum. We have also considered a range of 1-5% growth rates per annum for if the colony may potentially grow in the future, although at present there seems considerable uncertainty regarding whether this can be achieved.



161. If we assume a -2% per annum growth rate, a stable population or a 1% per annum growth rate then 55 additional mortalities per annum would result in the population declining below its current level and let alone be able to reach the target population of the conservation objective.
162. If we assume a 2% per annum growth rate then 55 additional mortalities per annum would result in the population being approximately 2,000 birds lower than without the additional mortality after 25 years and it would take over an additional 180 years to reach the target population compared to the no windfarm mortality scenario.
163. If the LBBG population were to grow at a rate of 3% per annum over the next 25 years, then additional mortality of 55 per annum would result in the population being approximately 2,000-2,500 birds lower than without the additional mortality after 25 years and it would take over an additional 40 years to reach the target population compared to the no windfarm mortality scenario.
164. There is no evidence to suggest that the future population trend will be significantly different from the current trend, which is most likely to be stable, in which case there is a risk that the population could decline due to predicted mortality levels. Furthermore, given that the population is likely to be hindered from restoration to target levels even when more optimistic assumptions about the population trend of the colony are made, Natural England also considers that it is not possible to rule out AEol even if the population starts to show modest growth.
165. **Therefore, as this feature has a restore conservation objective, and because there are indications that the population might even decline from current levels, Natural England advises that it is not possible to rule out an adverse effect on integrity (AEol) of the LBBG feature of the Alde-Ore Estuary SPA for from in-combination collision impacts with other plans and projects, for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, irrespective of whether Hornsea 4, DEP and SEP are included in the totals or not.**