THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

East Anglia ONE North Offshore Wind Farm

Appendix A19 to the Natural England Deadline 8 Submission

Natural England's Comments/Conclusions on Environmental Impact Assessment (EIA) Scale Impacts for EA1N and EA2 OWFs

For:

The construction and operation of East Anglia ONE North Offshore Wind Farm, a 800MW wind farm which could consist of up to 67 turbines, generators and associated infrastructure, located 36km from Lowestoft and 42km from Southwold.

Planning Inspectorate Reference: EN010077

25th March 2021

Natural England's Detailed Comments/Conclusions On Environmental Impact Assessment (EIA) Scale Impacts For East Anglia One North (EA1N) And East Anglia Two (EA2) Offshore Wind Farms

This document is a technical document submitted into the EA1N and EA2 Examinations to provide scientific justification for Natural England's advice provided on the significance of the potential impacts at the Environmental Impact Assessment (EIA) scale, as summarised within each section. 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.

1) SUMMARY OF NATURAL ENGLAND EIA SCALE ADVICE (ALONE & CUMULATIVE)

1. Since the submission of the applications for EA1N and EA2, the Applicants have updated the collision risk model (CRM) predictions for the two projects alone, based on an increase in draught height from a minimum of 22m above mean high water springs (MHWS) to a minimum of 24m above MHWS and for the reduced footprint at EA1N [REP1-047 for EA2 and REP4-042 for EA1N]. Whilst this has resulted in a reduction in the collision predictions from the EA1N project alone and from the EA2 project alone, the projects continue to make a meaningful contribution to cumulative effects on several seabirds at the EIA scale, particularly with respect to North Sea populations of great black-backed gull, gannet and kittiwake (see Table 1).

2. The operational displacement assessments for the projects alone have not been updated since submission and therefore, we have utilised the figures presented for each relevant species from the submission documents [APP-060 for each of EA1N and EA2].

3. It should be noted that presently Hornsea 3 only has updated collision prediction figures for the revised design parameters for Flamborough and Filey Coast SPA kittiwake in the information provided post examination, with no updated collision or displacement predictions provided for the revised design parameters or inclusion of the additional 3 months of baseline data for any of the other key species for cumulative/in-combination collision and displacement assessments (gannet, lesser black-backed gull, herring gull, great black-backed gull, guillemot and razorbill). As a result, uncertainty remains as to the appropriate figures to include for the Hornsea 3 project in cumulative (and in-combination) collision and displacement assessments. Due to **the associated level of uncertainty as regards the potential impacts of that project, Natural England is not in a position at this time to advise that a significant adverse impact for cumulative impacts at EIA**

scale can be ruled out for any relevant species when the Hornsea 3 project is included in the totals.

4. The figures included by the Applicants for Hornsea 4 come from the PEIR for that project, which currently represents the best available data to include for this project. However, as noted during the Norfolk Boreas examination, 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 a likelihood of being subject to change. **Therefore, the inevitable uncertainty around the Hornsea 4 figures along with that position set out above regarding inclusion of Hornsea 3 in the cumulative assessments means that again Natural England is not in a position to advise that a significant adverse impact for cumulative impacts at EIA scale can be ruled out for any relevant species when the Hornsea 3 and Hornsea 4 projects are included in the totals.**

5. In addition, the Norfolk Vanguard consent decision was overturned in February 2021. Natural England understands that Vattenfall intend to resubmit for new determination as soon as possible and it is highly probable that EA1N and EA2 will be in the planning system at the same time as Norfolk Vanguard.

6. In light of the issues set out above, we have therefore considered the cumulative totals for all projects excluding Hornsea 3 (H3), Hornsea 4 (H4) and Norfolk Vanguard (NVG) and for all projects including Hornsea 3, 4 and Norfolk Vanguard in our detailed advice on cumulative impacts set out in the sections below.

Table 1 Summary of conclusions for operational collision and displacement assessments of the EA1N and EA2 projects alone and cumulatively with other plans and projects for relevant species for EIA based on the Applicant's collision assessments in REP1-047 for EA2 and REP4-042 for EA1N and displacement assessments in APP-060, APP-471 and REP2-006

EIA species	EA1N Alone and EA2 Alone	EA1N and EA2 cumulatively with other plans & projects
Gannet: collision	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Gannet: displacement	No significant adverse impact	No significant adverse impact excl. H3, H4 & NVG

		Unable to rule out significant adverse impact incl. H3, H4 & NVG
Gannet: collision + displacement	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Kittiwake: collision	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Lesser black-backed gull: collision	No significant adverse impact	No significant adverse impact excl. H3, H4 & NVG Unable to rule out significant adverse impact incl. H3, H4 & NVG
Herring gull: collision	No significant adverse impact	No significant adverse impact excl. & incl. H3, H4 & NVG
Great black-backed gull: collision	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Red-throated diver: displacement	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Guillemot: displacement	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG
Razorbill: displacement	No significant adverse impact	Unable to rule out significant adverse impact excl. & incl. H3, H4 & NVG

2) EIA IMPACTS FROM THE EA1N AND EA2 PROJECTS ALONE

2.1 EIA impacts from operational collision risk from the EA1N and EA2 projects alone

7. Natural England has evaluated the updated collision risk modelling (CRM) outputs presented by the Applicants in REP1-047 for EA2, which accounts for the increase in draught height from 22m above MHWS to 24m above MHWS, and in REP4-042 for EA1N, which accounts for the revised footprint and increase in draught height, for each of the five key seabird species considered to be at risk of collision impacts from EA1N and EA2 at an EIA scale: gannet, kittiwake, lesser black-backed gull (LBBG), herring gull and great black-backed gull. We agree with the predicted collision figures presented by the Applicant in REP1-047 for EA2 and REP4-042 for EA1N for the central predicted figures (based on mean density) and for EA1N for the range of figures based on the 95% confidence intervals of the density data. No range of figures based on the 95% confidence intervals of the density data have been presented by the Applicant for EA2 for the increased draught height in REP1-047 – **these should be presented in order for the uncertainty/variability in the input data to be considered.**

8. As shown in Table 2 below, based on the updated CRM figures in REP1-047 and REP4-042, we agree with the Applicants that all the central CRM predictions (i.e. using mean density, mean avoidance rate, maximum likelihood flight height data and the standard nocturnal activity rates) equate to less than 1% baseline mortality of the largest Biologically Defined Minimum Population Scale (BDMPS) and biogeographic populations for all of the five key species (gannet, kittiwake, LBBG, herring gull and GBBG). This is also the case for the upper 95% confidence intervals of the bird density for all species for EA1N. **Therefore, based on these figures we advise that the collision risk from EA1N alone and EA2 alone would have no significant adverse impact at the EIA scale for all species.**

Table 2 Percentage of baseline mortality for predicted impact levels for EA1N and EA2 operational collision risk alone for EIA, using average across all age class mortality rates, as used by the Applicant in submission documents [APP-060]

	CRM prediction, project alone	Largest BDMPS (North Sea) individuals, Furness (2015)	% baseline mortality largest BDMPS	Biogeographic population individuals (Furness 2015)	% baseline mortality biogeographic
EA1N (CRM from REP4-042)					
Gannet	24 (8-45)	456,298	0.03 (0.01-0.05)	1,180,000	0.01 (0.004-0.02)
Kittiwake	52 (26-84)	829,937	0.04 (0.02-0.06)	5,100,000	0.01 (0.003-0.01)
LBBG	1 (0-5)	209,007	0.004 (0.00-0.02)	864,000	0.001 (0.00-0.005)
Herring gull	0 (0-0)	466,511	0.00 (0.00-0.00)	1,098,000	0.00 (0.00-0.00)
GBBG	5 (0-13)	91,399	0.03 (0.00-0.08)	235,000	0.01 (0.00-0.03)
EA2* (CRM from REP1-047)					
Gannet	40	456,298	0.05	1,180,000	0.02
Kittiwake	42	829,937	0.03	5,100,000	0.01
LBBG	5	209,007	0.02	864,000	0.005
Herring gull	0.2	466,511	0.00	1,098,000	0.0001
GBBG	7	91,399	0.04	235,000	0.02

* We note that no ranges of the predicted collision figures based on the 95% confidence intervals of the bird density data are presented for EA2 for the revised figures in light of the raised draught height in REP1-047. The ranges of the predicted impacts should be presented and considered in order to account for the uncertainty/variability in the input data.

2.2 EIA impacts from operational displacement from the EA1N and EA2 projects alone

9. We welcome that the Applicants have considered in REP2-035 the range of predicted displacement impacts based on the range of displacement and mortality rates. The ranges considered covers those recommended by Natural England (i.e. up to 100% displacement and 1-10% mortality for red-throated diver and 30-70% displacement and 1-10% mortality for auks).

Table 3 Percentage of baseline mortality for predicted impact levels for operational displacement for the EA1N and EA2 projects alone at EIA scale, using average across all age class mortality rates, as used by the Applicants

	Bird abundance	**Displacement prediction, alone (from Tables in APP-060 for each project)***	**Largest BDMPS individuals, Furness (2015)**	**% baseline mortality largest BDMPS**	**Biogeographic population individuals, Furness (2015)**	**% baseline mortality biogeographic**
Red-throated diver	EA1N	4-42	13,277	0.13-**1.39**	27,000	0.06-0.68
	EA2	2-27		0.07-0.89		0.03-0.44
Gannet	EA1N	3-5	456,298	0.003-0.006	1,180,000	0.001-0.002
	EA2	7-10		0.008-0.01		0.003-0.004
Razorbill	EA1N	2-49	591,874	0.002-0.05	1,707,000	0.001-0.02
	EA2	2-48		0.002-0.05		0.001-0.02
Guillemot	EA1N	18-424	1,617,306	0.01-0.19	4,125,000	0.003-0.07
	EA2	11-263		0.005-0.12		0.002-0.05

*Displacement predictions based on ranges of 90-100% displacement and 1-10% mortality for RTD, 60-80% displacement and 1% mortality for gannet, and 30-70% displacement and 1-10% mortality for razorbill and guillemot. Lower figure relates to the lower displacement and mortality rates, upper figure relates to the upper displacement and mortality rates

10. With regard to red-throated diver (RTD), the annual predicted impacts for operational displacement from EA1N alone exceeds 1% of baseline mortality of the largest BDMPS at the upper range of the Natural England advised rates of up to 100% displacement and 10% mortality – the figure equates to up to 1.39% of baseline mortality of the BDMPS using the mean peak abundance (Table 3 above). The Applicant considers that 10% mortality is unrealistic and notes that most of the annual mortality total at EA1N is predicted during the spring migration period, when birds would be passing through the site rather than resident in the area. We have given this issue consideration and consider that if there is turnover of lots of different birds, as suggested here for RTD passing through the EA1N site on spring migration, then Natural England agrees that it is then perhaps unrealistic to assume that 10% of the RTDs at this time would be likely to die as a result of displacement mortality when they are likely to be present at the site for a short time period. The spring contribution to the overall number of RTDs at risk of displacement annually from EA1N is over 80%. The annual number of RTDs predicted to die as a result of displacement from the EA1N array footprint exceeds 1% of baseline mortality of the largest BDMPS when the displacement rate is 100% and the mortality rate is at 8% and above. For the

biogeographic population, the annual number of RTDs predicted to die as a result of displacement from the EA1N array footprint exceeds 1% of baseline mortality when the displacement rate is 100% and the mortality rate is at 15% and above. Therefore, considering this for the specific timings of RTD peak abundance on the EA1N site, **we would agree with the Applicant that a significant adverse impact can be ruled out for operational displacement of RTD from EA1N alone**.

11. For EA2, the predicted impacts for RTD even at the Natural England worst case range of 100% displacement and 10% mortality do not exceed 1% of baseline mortality of the largest BDMPS for this species. Based on these figures, **we advise that operational displacement from EA2 alone would have no significant adverse impact at the EIA scale for RTD.**

12. From Table 3 above, the predicted impacts for gannet, razorbill and guillemot even at the Natural England worst case range of 70% displacement and 10% mortality do not exceed 1% of baseline mortality of the largest BDMPS for any of these species. Based on these figures, **we advise that operational displacement from EA1N alone and EA2 alone would have no significant adverse impact at the EIA scale for gannet, razorbill and guillemot.**

2.3 EIA Impacts from operational collision risk + displacement for gannet from the EA1N and EA2 projects alone

13. As noted in the 2017 SNCB interim advice on displacement (SNCBs 2017), the number of birds at risk of reduced individual fitness (i.e. mortality and productivity losses) as a result of displacement is based on the numbers of birds present within a development area and buffer both on the water and in flight. Assessment of the number of birds at risk of mortality as a result of collisions (e.g. with wind turbines) is based on the number of birds present within a development area that are in flight only. The mortality impacts estimated from CRM are assumed to be in addition to any mortality caused by displacement impacts (because the collision estimates take account of birds that avoid the wind farm). Productivity impacts due to displacement would be a further addition (but this is not currently quantitatively accounted for under existing methods/advice).

14. Therefore, at present, the SNCBs regard the **two impacts (collision and displacement) as additive and advise that they should be summed for species at risk from both impacts**, which in the case of EA1N and EA2 is gannet. In summing the predicted

mortalities that arise via these two mechanisms, there is a risk of some degree of double counting as a bird that collides with a turbine and dies cannot be displaced and a bird that dies as a result of displacement cannot collide with the turbine. Thus, it is acknowledged that this simplistic approach will therefore incorporate a degree of precaution. The level of precaution is difficult to gauge but will be highest when the number of birds recorded flying at turbine height (and therefore the predicted number of collisions) is greatest (SNCBs 2017).

15. The combined impact of collision plus displacement to gannet from EA1N alone equals:
    - 24 (range: 8-45) mortalities per annum from collisions plus up to 5 mortalities (no range of figures provided by Applicant based on 95% confidence intervals of abundance/density data) per annum from displacement = up to 29 mortalities.

16. This combined impact alone equates to 0.03% of baseline mortality of the largest BDMPS and to 0.01%of the biogeographic population. **Therefore, based on these figures we advise that the predicted impacts of operational collision combined with displacement from EA1N alone would have no significant adverse impact at the EIA scale for gannet.**

17. The combined impact of collision plus displacement to gannet from EA2 alone equals:
    - 40 (no range of figures provided by the Applicant) mortalities per annum from collisions plus up to 10 (again no range of figures provided by Applicant based on 95% confidence intervals of abundance/density data) mortalities per annum from displacement = up to 50 mortalities.

18. This combined impact alone equates to 0.06% of baseline mortality of the largest BDMPS and to 0.02% of the biogeographic population. **Therefore, based on these figures we advise that the predicted impacts of operational collision combined with displacement from EA2 alone would have no significant adverse impact at the EIA scale for gannet.**

3) EIA IMPACTS FROM EA1N AND EA2 CUMULATIVELY WITH OTHER PLANS ANS PROJECTS

3.1 EIA Impacts from operational collision risk from EA1N and EA2 cumulatively with other plans and projects

19. Table 4 shows the cumulative collision risk total predictions for all relevant projects excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and for all projects including Hornsea 3, Hornsea 4 and Norfolk Vanguard, based on the figures presented by the Applicants in REP4-042 for all species except herring, which is based on that presented in REP1-047, 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 4 Percentage of baseline mortality for cumulative CRM for EIA for both all projects (so includes figures for Hornsea 3, Hornsea 4 and Norfolk Vanguard) and also for all projects excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard. (Using average across all age class mortality rates, as used by the Applicants in APP-060)

	Cumulative collision prediction*		**Largest BDMPS (North Sea) individuals, Furness (2015)**	**% baseline mortality largest BDMPS**		**Biogeographic population individuals (Furness 2015)**	**% baseline mortality biogeographic**	
	Excl. H3, H4 & NVG	**ALL projects**		**Excl. H3, H4 & NVG**	**ALL projects**		**Excl. H3, H4 & NVG**	**ALL projects**
Gannet	2,889	3,031	456,298	3.31	3.48	1,180,000	1.28	1.34
Kittiwake	3,835	4,387	829,937	2.96	3.39	5,100,000	0.48	0.55
LBBG	509	540	209,007	1.93	2.05	864,000	0.47	0.50
Herring gull	740**	759**	466,511	0.92	0.95	1,098,000	0.39	0.40
GBBG	914	1,023	91,399	5.41	6.05	235,000	2.10	2.35

* Based on the Applicants' cumulative figures presented in REP4-042.

** Based on the Applicants' cumulative figures presented in REP1-047.

3.1.1 Gannet cumulative impacts

a) Operational collision risk:

20. The Applicants' cumulative collision totals for gannet of 2,889 birds excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 3,031 including all projects exceed 1% of baseline mortality of the North Sea BDMPS scale and the biogeographic population (Furness 2015) – the figure excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard equates to 3.31% of baseline mortality of the BDMPS and 1.28% of baseline mortality of the biogeographic

population, and the figure including all projects equates to 3.48% of the BDMPS and 1.34% of the biogeographic population baseline mortality (Table 5 above). This is significant and requires further consideration.

21. The Applicants have considered in their assessment in APP-060 outputs from the Population Viability Analysis (PVA) model for the British gannet population undertaken by WWT (2012). This PVA was run over 25 years and therefore does not cover impacts from the total lifespan of some projects e.g.35-year lifespan of the Hornsea 3 project. Additionally it has not been run using the 'matched runs/pairs' approach advised by Natural England and the counterfactual metrics of population size and growth rate (as recommended by Natural England) are not presented (these issues were all highlighted in our Relevant Representations at the Norfolk Vanguard and Norfolk Boreas examinations: see point 6.2 of key concerns in Appendix 1 of Natural England 2018 and point 8 of Appendix 1 of Natural England 2019). Therefore, ideally this PVA should have been updated by the Applicant to address these issues and to utilise the Natural England funded 'Seabird PVA Tool', as was done by the Norfolk Boreas Applicant. We also note that this PVA was undertaken using the estimated gannet population in 2004 (the most recent census available at that time), and the British gannet population has increased considerably since this time.

22. As the issues with the PVA used by the Applicant have not been raised by Natural England in the EA1N/EA2 examinations, we have therefore 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.

23. Using the PVA models undertaken by Boreas, if the additional mortality from the offshore wind farms is 3,000-3,100 per annum (closest PVA outputs to the cumulative collision mortality figures of 2,889 excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 3,031 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 0.77-0.80% using the density independent model and by 0.76-0.79% using the density dependent model (Table 5).

- 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 density independent model and 8.75-9.03% lower using the density dependent model. The population growth rate would be reduced by 0.30-0.31% using the density independent model and by 0.29-0.30% using the density dependent model (Table 5).

Table 5 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 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**
3,000	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 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**
3,000	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

24. 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).

25. 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 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 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.

26. Based on consideration of the PVA metrics 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 irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not**.

b) Operational Displacement

27. The Applicants have included an assessment of the number of gannets predicted to be at risk of cumulative displacement in Table A12.3.12 of APP-471 for EA1N and Table A12.3.13 of APP-471 for EA2. We note that this assessment does not include figures for Hornsea 4 and also includes figures for Thanet Extension. The assessment has not been updated by the Applicants since APP-470. Therefore, we have amended the figures presented by the Applicants to include Hornsea 4 and to remove Thanet Extension (as this project was not consented). This recalculation results in the total cumulative number of gannets estimated to be at risk of displacement for all projects (including from Hornsea 3, Hornsea 4 and Norfolk Vanguard) is 50,597 per annum.

28. <u>For the rates considered by the Applicants of 60-80% displacement and 1% mortality, the number of predicted additional cumulative mortalities **including** Hornsea 3, Hornsea 4 and</u>

Vanguard is between 304 (60% displacement and 1% mortality) and 405 (80% displacement and 1% mortality) gannets. This equates to 0.35-0.46% of baseline mortality for the largest BDMPS.

29. Given the uncertainty involved with the figures for both Hornsea 3 and Hornsea 4 and the current status of the Norfolk Vanguard project, the cumulative totals excluding these three projects is estimated to be 39,897 gannets at risk of displacement per annum.

30. For the rates considered by the Applicants of 60-80% displacement and 1% mortality, the number of predicted additional cumulative mortalities **excluding** Hornsea 3, Hornsea 4 and Norfolk Vanguard is between 239 (60% displacement and 1% mortality) and 319 (80% displacement and 1% mortality) gannets. This equates to 0.27-0.37% of baseline mortality for the largest BDMPS.

31. Based on the above, **we** therefore advise **no significant adverse impact to gannet from cumulative operational displacement at an EIA scale if the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are excluded from the cumulative totals.**

32. **However, due to Natural England's significant concerns regarding the associated level of uncertainty as regards the potential impacts of the Hornsea 3 project, together with the inevitable uncertainty associated with the figures for Hornsea 4 from the PEIR and are subject to change, along with the current status of the Norfolk Vanguard project, Natural England therefore is not in a position to advise that significant impact can be ruled out for gannet for cumulative displacement impacts when these projects are included in the cumulative totals.**

c) Operational collision risk plus displacement

33. As noted previously, 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). We welcome that the Applicants have undertaken this assessment for gannet cumulative impacts in APP-060. However, this assessment has not be updated since APP-060 and therefore does not account for the changes to the cumulative collision assessment as presented in REP4-042 and as noted above does not include figures for Hornsea 4 and still includes Thanet Extension. Therefore, we have updated the assessment to take account of this.

34. The combined cumulative impact **excluding** Hornsea 3, Hornsea 4 and Norfolk Vanguard of collision plus displacement to gannet equals:

    - 2,889 mortalities per annum from collisions plus up to 319 mortalities per annum from displacement = up to 3,208 mortalities.

35. This combined cumulative impact equates to 3.68% of baseline mortality of the largest BDMPS and to 1.42% of the biogeographic population.

36. The combined cumulative impact **including** all projects of collision plus displacement to gannet equals:

    - 3,031 mortalities per annum from collisions plus up to 405 mortalities per annum from displacement = up to 3,436 mortalities.

37. This combined cumulative impact equates to 3.94% of baseline mortality of the largest BDMPS and to 1.52% of the biogeographic population.

38. **These predicted levels of impacts are significant and require further consideration.**

39. 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.

40. Using the PVA models undertaken by 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 3,208 excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 3,436 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 0.87-0.90% using the density independent model and by 0.86-0.89% using the density dependent model (Table 6).
    - 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 6).

Table 6 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 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**
3,400	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 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**
3,400	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

41. 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).

42. 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 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 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.

43. Based on consideration of the PVA metrics 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 + displacement mortality at an EIA scale irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not**.

3.1.2 Kittiwake cumulative operational collision risk

44. The Applicants' cumulative collision totals for kittiwake of 3,835 birds excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 4,387 including all projects exceeds 1% of baseline mortality of the North Sea scale BDMPS – the figure excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard equates to 2.96% of baseline mortality, and the figure including all projects equates to 3.39% (Table 4 above). This is significant and requires further consideration.

45. The Applicants have considered in their assessments in APP-060 the kittiwake PVA constructed during the East Anglia 3 offshore wind farm examination for assessing the cumulative CRM impacts on the UK North Sea and Channel BDMPS population, available from Appendix 1 of EATL (2015). This PVA was run over 25 years and therefore does not cover impacts for all projects, e.g 30-year lifespan of the Norfolk Boreas project). Additionally, it has not been run using the 'matched runs/pairs' approach advised by Natural England and it appears that only the counterfactual of population size metric is available and that the counterfactual of growth rate metric is not presented (these issues were all highlighted in our Relevant Representations at the Norfolk Vanguard and Norfolk Boreas examinations: see point 6.2 of key concerns in Appendix 1 of Natural England 2018 and point 8 of Appendix 1 of Natural England 2019). **Therefore, ideally this PVA should have been updated by the Applicant to address these issues and to utilise**

the Natural England funded 'Seabird PVA Tool', as was done by the Norfolk Boreas Applicant.

46. As the issues with the PVA used by the Applicant have not been raised by Natural England in the EA1N/EA2 examinations, we have therefore utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) kittiwake 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.

47. Using the density independent PVA models undertaken by Norfolk Boreas in MacArthur Green (2019), if the additional mortality from the offshore wind farms is 3,900-4,400 per annum (closest PVA outputs to the cumulative collision mortality figures of 3,835 excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 4,387 including all projects) then:
    - The BDMPS population after 30 years will be 15.90-17.71% lower than it would have been in the absence of the additional mortality and the population growth rate would be reduced by 0.56-0.63% (Table 7).
    - The biogeographic population after 30 years will be 2.77-3.12% lower than it would have been in the absence of the additional mortality and the population growth rate would be reduced by 0.09-0.11% (Table 7).

Table 7 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

48. 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.

49. 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 irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not**.

3.1.3 Lesser black-backed gull (LBBG) cumulative operational collision risk

50. The Applicants' cumulative collision totals for LBBG of 509 birds excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 540 including all projects exceeds 1% of baseline mortality of the North Sea BDMPS scale (Furness 2015) – the figure excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard equates to 1.93% of baseline mortality, and the figure including all projects equates to 2.05% (Table 4 above). This is not insignificant and requires further consideration.

51. The Applicants have not considered any population modelling of LBBG in their assessment in APP-060. As this has not been raised as an issues by Natural England so far in the EA1N/EA2 examinations, we have therefore utilised the PVA metrics from the EIA scale (BDMPS) LBBG PVA 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.

52. 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 509 excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 582 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 8).

Table 8 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

53. 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.

54. Quite a high proportion of birds in the largest BDMPS of 209,007 will be UK breeding birds (Furness 2015).

55. 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 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.

56. 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 if the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are excluded from the cumulative total**.

57. **However, due to the associated level of uncertainty as regards the impact figures to include for Hornsea 3, together with the inevitable uncertainty associated with the figures for Hornsea 4 from the PEIR and are subject to change, and the current status of Norfolk Vanguard, 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 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals.**

3.1.4 Herring gull cumulative operational collision risk

58. The Applicant's cumulative collision totals for herring gull of 740 birds excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 759 including all projects equates to 0.92% (excluding Hornsea 3, Hornsea 4and Norfolk Vanguard) and to 0.95% (including all projects) of baseline mortality of the largest BDMPS and to 0.39% (excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard) and 0.40% (including all projects) of baseline mortality of the biogeographic population (Table 4 above).

59. On the basis that the EA1N contribution to the cumulative collision total is 0 (see Table 2). EA2 contributes and mean collision prediction on 0.2 collisions to the cumulative total. However, the range of predictions based on the 95% confidence intervals of the density data (to account for uncertainty/variability in the input data) have not been provided for the updated figures by the Applicant in REP1-047. Natural England considers that EA1N and EA2 are unlikely to make any contribution to the cumulative collision totals irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the total. **Therefore, we advise that no significant cumulative collision risk impact at the EIA scale for herring gull for EA1N irrespective of whether these projects are included or excluded from the cumulative total**.

60. 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, the Applicant's cumulative collision totals for including and excluding the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects equate to just under 1% of baseline mortality if the largest BDMPS and to less than 1% of baseline mortality of the biogeographic population.

3.1.5 Great black-backed gull (GBBG) cumulative operational collision risk

61. The Applicants' cumulative collision totals for GBBG of 914 birds excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 1,023 including all projects exceed 1% of baseline mortality of the North Sea BDMPS scale and the biogeographic population (Furness 2015) – the figure excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard equates to 5.41% of baseline mortality of the BDMPS and 2.10% of baseline mortality of the biogeographic population, and the figure including all projects equates to 6.05% of the BDMPS and 2.35% of the biogeographic population baseline mortality (Table 4 above). This is not insignificant and requires further consideration.

62. The Applicants have considered in their assessment in APP-060 the GBBG PVA constructed during the East Anglia 3 offshore wind farm examination for assessing the cumulative CRM impacts on the UK North Sea and Channel BDMPS population, available from Appendix 1 of EATL (2016). This PVA was run over 25 years and therefore does not cover impacts for some of the projects, e.g. 35-year lifespan of the Hornsea 3 project. Additionally, it has not been run using the 'matched runs/pairs' approach advised by Natural England and it appears that only the counterfactual of population size metric is available and that the counterfactual of growth rate metric is not presented (these issues were all highlighted in our Relevant Representations at the Norfolk Vanguard and Norfolk Boreas examinations: see point 6.2 of key concerns in Appendix 1 of Natural England 2018 and point 8 of Appendix 1 of Natural England 2019). Therefore, ideally this PVA should have been updated by the Applicant to address these issues and to utilise the Natural England funded 'Seabird PVA Tool', as was done by the Norfolk Boreas Applicant.

63. As the issues with the PVA used by the Applicant have not been raised by Natural England in the EA1N/EA2 examinations, we have therefore utilised the PVA metrics from the EIA scale (BDMPS and biogeographic scale) GBBG 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.

64. 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 914 excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard and of 1,023 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 9).
    - 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 9).

Table 9 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						
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**
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						
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**
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

65. 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.

66. 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 irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not**.

3.1.6 Red-throated diver (RTD) cumulative operational displacement

67. We welcome that the Applicants have undertaken a cumulative RTD operational displacement assessment using the ‘like for like’ approach using the SeaMast data (Bradbury et al. 2014), as was undertaken at Thanet Extension and hence also used at Norfolk Vanguard and Norfolk Boreas during the examinations for these projects.

68. Based on the cumulative figures presented by the Applicant in Table A12.3.8 of APP-471 of EA1N and A12.3.9 of APP-471 of EA2 we consider that the predicted figures are significant**. Therefore, we are unable to rule out a significant adverse impact on RTD from cumulative collision mortality at an EIA scale** (noting that no figures have been included for sites further offshore as SeaMast yielded no density estimates for such sites and the following projects were omitted from the cumulative totals: Dudgeon, Hornsea Project One, Hornsea Project Two, Hornsea Project Three, Hornsea Project Four, Dogger Bank Creyke Beck A and B, Dogger Bank Teesside A and B (now Sofia) and Triton Knoll).

3.1.7 Razorbill cumulative operational displacement

69. We welcome that the missing projects have been added into the updated cumulative assessment in REP2-006.

70. Based on the figures presented by the Applicant in Table 2 of REP2-006 the annual total cumulative number of razorbills to be at risk of displacement for all projects (including from Hornsea 3, Hornsea 4 and Norfolk Vanguard) is estimated to be 133,461 (note there is a minor error in the Applicants' calculated total in REP2-006 - the sum of the annual figures presented is 133,461 and not 133,458 as presented).

71. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **including** Hornsea 3, Hornsea 4 and Norfolk Vanguard is between 400 (30% displacement and 1% mortality) and 9,342 (70% displacement and 10% mortality) razorbills. This equates to 0.39-9.07% of baseline mortality for the largest BDMPS. (Table 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.

72. Given the uncertainty involved with the figures for both Hornsea 3 and Hornsea 4, and the current status of Norfolk Vanguard the annual cumulative total excluding these three projects is estimated to be 111,939 razorbills 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 3, Hornsea 4 and Norfolk Vanguard is between 336 (30% displacement and 1% mortality) and 7,836 (70% displacement and 10% mortality) razorbills. This equates to 0.33-7.61% of baseline mortality for the largest BDMPS (Table 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.

74. Table 10 below indicates that when considering the cumulative totals, either excluding or including Hornsea 3, Hornsea 4 and Norfolk Vanguard, 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 exceed for any displacement scenario (30-70%) at 1% mortality;
    - At 4%-10% mortality, 1% of baseline mortality is exceeded at all displacement rates from 30-70%.

Table 10 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 3, Hornsea 4 and Norfolk Vanguard. Shaded cells are those where 1% of baseline mortality is exceeded

INCLUDING HORNSEA 3, HORNSEA 4 & NORFOLK VANGUARD							
Displacement (%)	**% Baseline mortality of largest BDMPS***						
	Mortality rate (%)						
	1	**2**	**4**	**5**	**6**	**8**	**10**
30	0.39	0.78	1.56	1.94	2.33	3.11	3.89
40	0.52	1.04	2.07	2.59	3.11	4.15	5.18
50	0.65	1.30	2.59	3.24	3.89	5.18	6.48
60	0.78	1.56	3.11	3.89	4.67	6.22	7.78
70	0.91	1.81	3.63	4.54	5.44	7.26	9.07
EXCLUDING HORNSEA 3, HORNSEA 4 & NORFOLK VANGUARD							
Displacement (%)	**% Baseline mortality of largest BDMPS***						
	Mortality rate (%)						
	1	**2**	**4**	**5**	**6**	**8**	**10**
30	0.33	0.65	1.30	1.63	1.96	2.61	3.26
40	0.44	0.87	1.74	2.17	2.61	3.48	4.35
50	0.54	1.09	2.17	2.72	3.26	4.35	5.43
60	0.65	1.30	2.61	3.26	3.91	5.22	6.52
70	0.76	1.52	3.04	3.80	4.56	6.09	7.61

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

75. 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).

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 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.

77. Predicted cumulative mortality predictions exceed 1% of baseline mortality of the largest BDMPS at a 2% mortality rate and between 40 and 50% displacement. **Therefore, we advise that a significant adverse impact to razorbill from cumulative operational displacement cannot be ruled out at an EIA scale irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not**.

3.1.8 Guillemot cumulative operational displacement

78. We welcome that the missing projects have been added into the updated cumulative assessment in REP2-006.

79. Based on the figures presented by the Applicant in Table 1 of REP2-006 the annual total cumulative number of guillemots to be at risk of displacement for all projects (including from Hornsea 3, Hornsea 4 and Norfolk Vanguard) is estimated to be 427,697.

80. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **including** Hornsea 3, Hornsea 4 and Norfolk Vanguard is between 1,283 (30% displacement and 1% mortality) and 29,939 (70% displacement and 10% mortality) guillemots. This equates to 0.45-10.46% of baseline mortality for the largest BDMPS. (Table 11). 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.

81. Given the uncertainty involved with the figures for both Hornsea 3 and Hornsea 4, and the current status of Norfolk Vanguard the annual cumulative total excluding these three projects is estimated to be 301,253 guillemots at risk of displacement.

82. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional cumulative mortalities **excluding** Hornsea 3, Hornsea 4 and Norfolk Vanguard is between 904 (30% displacement and 1% mortality) and 21,088 (70% displacement and 10% mortality) guillemots. This equates to 0.32-7.37% of baseline mortality for the largest BDMPS (Table 11). 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.

83. Table 11 below indicates that when considering the cumulative totals, including or excluding Hornsea 3, Hornsea 4 and Norfolk Vanguard 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 3, Hornsea 4 and Vanguard 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 3, Hornsea 4 and Norfolk Vanguard 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 3, Hornsea 4 and Norfolk Vanguard.

Table 11 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 calculated cumulative totals excluding and including Hornsea 3, Hornsea 4 and Norfolk Vanguard. Shaded cells are those where 1% of baseline mortality is exceeded

INCLUDING HORNSEA 3, HORNSEA 4 & NORFOLK VANGUARD							
Displacement (%)	**% Baseline mortality of largest BDMPS***						
	Mortality rate (%)						
	1	**2**	**4**	**5**	**6**	**8**	**10**
30	0.45	0.90	1.79	2.24	2.69	3.59	4.48
40	0.60	1.20	2.39	2.99	3.59	4.78	5.98
50	0.75	1.49	2.99	3.73	4.48	5.98	7.47
60	0.90	1.79	3.59	4.48	5.38	7.17	8.96
70	1.05	2.09	4.18	5.23	6.27	8.37	10.46
EXCLUDING HORNSEA 3, HORNSEA 4 & NORFOLK VANGUARD							
Displacement (%)	**% Baseline mortality of largest BDMPS***						
	Mortality rate (%)						
	1	**2**	**4**	**5**	**6**	**8**	**10**
30	0.32	0.63	1.26	1.58	1.89	2.53	3.16
40	0.42	0.84	1.68	2.10	2.53	3.37	4.21
50	0.53	1.05	2.10	2.63	3.16	4.21	5.26
60	0.63	1.26	2.53	3.16	3.79	5.05	6.31
70	0.74	1.47	2.95	3.68	4.42	5.89	7.37

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

84. 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).

85. 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 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.

86. Predicted cumulative mortality predictions exceed 1% of baseline mortality of the largest BDMPS at a 2% mortality rate and when displacement rates exceed between 30 and 50% displacement depending on whether Hornsea 3, Hornsea 4 and Norfolk Vanguard 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 irrespective of whether the Hornsea 3, Hornsea 4 and Norfolk Vanguard projects are included in the cumulative totals or not.**

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