Norfolk Vanguard Offshore Wind Farm

In Principle Habitats Regulations Derogation Provision of Evidence

Appendix 1 Flamborough and Filey Coast SPA In Principle Compensation

Applicant: Norfolk Vanguard Limited
Document Reference: 8.26
ExA; IROPI; 11.D13.3.App1
Revision: Version 3
Date: November 2021
Author: MacArthur Green

Photo: Kentish Flats Offshore Wind Farm

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
28/02/2020	01F	Final for submission 28 February 2020	MT	VR	RS
23/07/2021	02D	Draft for Internal Review	MT	VR	JL
02/08/2021	02F	Final for submission 02 August 2021	MT	VR	JL
03/10/2021	03D	Draft for Internal Review	MT	VR	VR
18/11/2021	03F	Final for submission 18 November 2021	MT	VR	VR

Royal HaskoningDHV
Enhancing Society Together

VATTENFALL

Table of Contents

1 INTRODUCTION

1.1 Background

1. This document is an update of version 2 submitted on the 2nd August 2021 (8.26, ExA; IROPI; 11.D11.2.App3).

2. In response to a request for further information from the Secretary of State (SoS) received by Norfolk Vanguard Limited ('the Applicant') on the 5th July 2021, this document provides updates to the proposed in-principle compensation originally submitted by the Applicant in February 2020 in response to a request for Information from the Secretary of State to the Applicant on the 6th December 2019. It is also based on a similar document submitted to the Secretary of State in response to a separate request for information for the Norfolk Boreas project (on the 25th June 2021).

3. It should be noted that while this document is specifically related to the Norfolk Vanguard project, the information presented in this document is considered to be appropriate to both the Norfolk Vanguard and Norfolk Boreas projects, since the same compensation is proposed for both and, due to the large degree of over-compensation inherent in the proposed measure, it could readily offset the potential impacts predicted for both projects. Vattenfall, who is separately pursuing consent for the Norfolk Boreas project, has been in discussion with stakeholders about these proposals in relation to both the Norfolk Boreas and Norfolk Vanguard projects, which has led to them being further developed and refined. As a consequence and where appropriate, references are made herein to those discussions conducted as part of the Norfolk Boreas application process.

4. The additional information requested by the SoS was:

20. The Applicant is also requested to provide details of the following:

- *Any modifications to the Norfolk Vanguard project, that were not included at the time of the application or during the Examination, which could avoid or reduce adverse effects on the integrity of the site for the kittiwake, razorbill, and guillemot features; and*
- *Compensation strategies for kittiwake, razorbill, and guillemot, produced in consultation with Natural England, other interested parties and, if an action is required on its part, Defra. The strategies should include, but not be limited to, the following information:*
    - *A description of the compensatory strategies proposed, accompanied by an explanation of how they will effectively compensate for the negative effects*

of the Norfolk Vanguard project on the species, and how they will ensure that the overall coherence of the National Site Network is protected.
- *Confirmation of the selected site(s) for compensation strategies and details of how the site(s) will be acquired/leased. For kittiwake, this would include viable options for offshore artificial nest site creation.*
- *An implementation timetable for when the compensation measures will be delivered and achieve their objectives in relation to the first operation of the windfarm.*
- *Details of any proposed routine maintenance and species population monitoring during the project lifetime, together with the funding mechanisms for their delivery.*

5. These points have been addressed in the relevant sections of this updated document.

6. In response to submissions made by Natural England and the Royal Society for the Protection of Birds (RSPB) during the Norfolk Vanguard Examination, the Applicant proposed further mitigation measures above those set out in the Norfolk Vanguard DCO Application in order to give further confidence that there will not be any adverse effects from Norfolk Vanguard Wind Farm ('the project') on kittiwake at Flamborough and Filey Coast (FFC) Special Protection Area (SPA).

7. This mitigation is detailed in full in the following document which was submitted in response to the SoS's request for further information dated 6th December 2019:

- Norfolk Vanguard Offshore Wind Farm Additional Mitigation Appendix 1 Updated Collision Risk Modelling (ExA; Mit; 11.D10.2.App1, 28 Feb 2020)

8. The additional mitigation resulted in the Norfolk Vanguard collision risk for kittiwake being reduced by up to 50% compared with those figures presented for the final wind farm design submitted as part of the Application (APP-217).

9. As stated in the original submission (APP-217), and subsequently during the Examination, the Applicant considers there to be no risk of an Adverse Effect on Integrity (AEoI) for this site as a result of the project alone and in-combination with other plans and projects, based on assessment of the original design. Following the additional mitigation for collisions risks (ExA; Mit; 11.D10.2.App1), the Applicant firmly maintains that there is no AEoI for this site as a result of the project alone and in-combination with other plans and projects. This position was supported by the SoS in the Norfolk Vanguard consent decision (1st July 2020) which concluded there would be no AEoI on the FFC SPA.

10. However, the DCO was then quashed in February 2021 and as part of the redetermination the SoS has "decided to revisit the conclusions of the Habitats Regulations Assessment in relation to certain protected sites". Accordingly, in the letter of the 5th July 2021 to the Applicant, the SoS requested further consideration of these matters. Hence this document outlines in-principle compensatory measures that could be developed should the Secretary of State (SoS) conclude AEoI on the qualifying kittiwake, guillemot or razorbill features of the FFC SPA in relation to the Norfolk Vanguard project. Separately, Appendix 2 outlines in-principle compensatory measures that could be developed should the SoS conclude AEoI on the qualifying lesser black-backed gull feature of the AOE SPA.

11. Following the considerable reductions in the predicted impacts from the project as a result of additional mitigation, the Applicant firmly maintains the position presented in the Application (APP-217), and updated in this document, that in respect of the FFC SPA, an AEoI as a result of the project alone and in-combination with other plans and projects can be ruled out beyond reasonable scientific doubt. However, with due regard to the SoS's request to Norfolk Boreas Limited, and more recent request with respect to the Applicant (see above), this document provides the Applicant's submission in relation to in principle compensatory measures for the qualifying kittiwake, guillemot and razorbill features of the FFC SPA.

12. Natural England, in their submission to the East Anglia ONE North and East Anglia TWO examinations at deadline 12[1], conclude that displacement of guillemot and razorbill from the FFC SPA would not give rise to in-combination AEoI as a result of Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North, East Anglia TWO and Hornsea Project Three. As there is currently only preliminary assessment information available for Hornsea Project Four, Dudgeon Extension and Sheringham Extension, Natural England have not been able to conclude that these projects will not give rise to an in-combination impact due to the uncertainty regarding their figures. However, for the purposes of the Norfolk Vanguard project it is now clear that the Applicant and Natural England are in agreement that there is currently no risk of AEoI for guillemot and razorbill from the FFC SPA for the project alone or in-combination for all projects which have submitted final applications (i.e. up to and including East Anglia ONE North and East Anglia TWO). Nonetheless, since the SoS has specifically requested presentation of in-principle compensation for these species these have been provided in this document.

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-005512-Natural%20England%20-%20Appendix%20A16c%20-%20NE%20Comments%20on%20Cumulative%20and%20In-Combination%20Collision%20Risk%20[REP11-027]%20Deadline%2012.pdf

1.2 Purpose of this Document

1.2.1 Context

13. The Applicant does not believe that any compensatory measures will need to be progressed due to the delivery of specific mitigation measures committed to by the Applicant which provide certainty that AEoI on the FFC SPA can be avoided. Therefore, the provision of evidence regarding compensation measures is provided 'in-principle', and is made entirely without prejudice to the Applicant's position that there will be no AEoI on the FFC SPA.

14. This document therefore provides a review of a range of potential measures that could be adopted to compensate for the potential effects on collision risk for kittiwake, guillemot and razorbill at the FFC SPA. This range of compensation measures has been discussed with Natural England and the Marine Management Organisation (MMO) (as detailed in section 1.2.2 below) and their feedback incorporated where appropriate.

15. In addition, the advantages and inherent compensation which renewable energy provides for the features of the Natura 2000 network should not be forgotten; with climate change representing the key pressure for a wide range of features. For example, the RSPB identifies climate warming as a major threat to kittiwakes. They state "*higher kittiwake breeding success was associated with lower sea surface temperatures during the breeding season*"… "*climate change therefore poses a longer-term threat to kittiwakes*" and "*if they are to have any hope, it's critically important that we act on climate change*".[2] The recent EU funded Strategic Environmental Impact Assessment North Seas Energy (SEANSE) project has assessed the impact of climate change on key bird species (Rijkswaterstaat Zee & Delta, 2020) and concluded that changes in prey availability due to climate change is the current pressure which appears to have the largest impact on guillemot and kittiwake populations at the wider North Sea level (note that razorbill was not included in the review, but the same factors are expected to apply). This is likely to be responsible for a substantially greater effect than impacts resulting from any other activity (including collision risk). Hence, the benefits of the project would clearly outweigh the harm, although it is recognised that these are extremely challenging to quantify and, therefore, these benefits are the focus of the Imperative Reasons of Overriding Public Interest (IROPI) case (discussed in the In Principle Habitats Regulations

[redacted]

Derogation Provision of Evidence document reference ExA; IROPI; 11.D10.3 submitted on 28th Feb 2020).

1.2.2 Consultation on in-principle compensatory measures

16. In relation to compensatory measures, draft in principle compensatory measures were provided to Natural England and the MMO on 17 January 2020 in order to seek guidance on the effectiveness of the potential compensatory measures identified; in particular whether they would be sufficient to ensure that the overall coherence of the Natura 2000 network is protected.

17. Written feedback was provided from Natural England on 4 February 2020 and this was then taken into account in the previous version of this document.

18. Vattenfall Wind Power Ltd is the parent company for the Applicant and also the applicant for the Norfolk Boreas project, and the projects are being developed as sister projects. Therefore the extensive consultation with Natural England and the MMO undertaken during the Norfolk Boreas Examination in relation to possible compensation measures has also informed the updates to this document. A record of this consultation is provided in the Norfolk Boreas Appendix 4 Consultation Overview (Norfolk Boreas examination library reference [REP11-015]).

19. Following the request to Norfolk Boreas Limited for further information from the SoS on the 28 April 2021, the Norfolk Boreas applicant undertook further consultation, which is also of relevance to the Norfolk Vanguard project and has informed the updates to this document.

20. Following the close of the Norfolk Vanguard and Norfolk Boreas Examinations, the Applicant has continued to engage with Natural England on the proposed in-principle compensation measures to ensure that should compensatory measures be required there will be a minimal delay in their implementation and has also held meetings with Defra and Scottish Power Renewables.

21. A summary of recent consultation with respect to the FFC SPA is provided in Table 1.1.

Table 1.1 Summary of Recent Consultation in respect of the FFC SPA

Consultee	Consultation Type	Comment or summary of response	Applicants response
Natural England Defra ScottishPower Renewables	Meetings on: 31st March 2021 20th April and 15 May 2021	Initial and follow-up discussions on developing compensation collaboratively and/or strategically in relation to ornithology. Presented designs of the proposed kittiwake artificial colony structures	The Applicant is fully supportive of these efforts and is continuing to engage with these discussions and/or take the lead as required.

Consultee	Consultation Type	Comment or summary of response	Applicants response
		and a timetable for deployment at a preferred location	
Natural England	2nd June 2021	Comments on Norfolk Boreas Limited's draft response to the Secretary of State's request for additional information.	Advice received was incorporated the updated version of this document.
Natural England	8th June 2021	Meeting to discuss Natural England's advice on the draft response to the Secretary of State's request for additional information	The opportunity to further explore issues and concerns was welcomed, and has informed this submission.
Natural England ScottishPower Renewables	9th June 2021	Meeting to discuss opportunities for ScottishPower Renewables and Vattenfall Wind Power Ltd to collaborate to deliver compensation where the same in principle compensation measures have been proposed for the Norfolk Vanguard, Norfolk Boreas and East Anglia ONE North and East Anglia TWO projects	The continued constructive discussions were welcomed.
Natural England	23rd June	Comments on Norfolk Boreas Limited's draft response to the Secretary of State's request for additional information.	Advice received was incorporated into the updated version of this document.

1.2.3 This document

22. Following this introduction, section 2 of this document provides a description of the FFC SPA. Section 3 quantifies the predicted effect of the project on the FFC SPA. Section 4 considers the guidance on compensation and sets out in principle compensation measures for Norfolk Vanguard and the FFC SPA, including how these measures may be secured.

2 FFC SPA

2.1 Overview

23. Flamborough and Filey Coast SPA covers an area of 7,858ha and is located on the Yorkshire coast between Bridlington and Scarborough, approximately 200km from the proposed Norfolk Vanguard offshore wind farm at its closest point. The SPA is in two sections: the southern section extends north from South Landing around Flamborough Head to Speeton; the northern section covers the peninsula of Filey Brigg before extending north west to Cunstone Nab. The seaward boundary extends 2km throughout the two sections of the site into the marine environment, running parallel to the landward boundaries to include the adjacent coastal waters. The SPA includes the RSPB reserve at Bempton Cliffs, the Yorkshire Wildlife Trust

Flamborough Cliffs Nature Reserve and the East Riding of Yorkshire Council Flamborough Head Local Nature Reserve.

24. The site description indicates that the Flamborough and Filey Coast SPA qualifies under Article 4.2 of the Birds Directive (2009/147/EC) by supporting over 1% of the biogeographical populations of four regularly occurring migratory species and a breeding seabird assemblage of European importance: kittiwake 44,520 pairs (89,040 breeding adults, 4 year average 2008-2011); gannet 8,469 pairs (16,938 breeding adults, 2008-2012); guillemot 41,607 pairs (83,214 breeding adults, 2008-2011) and razorbill 10,570 pairs (21,140 breeding adults, 2008-2011). In addition, the SPA supports a breeding seabird assemblage of 216,730 individuals (average 2008-2012).

25. The Flamborough and Filey Coast SPA replaced the Flamborough Head and Bempton Cliffs SPA. The trend in the kittiwake population for this site has been subject to discussion and disagreement between seabird experts (e.g. John Coulson) and the Statutory Nature Conservation Bodies (SNCBs). At the time of citation, the Flamborough Head and Bempton Cliffs SPA was thought to support 83,370 breeding pairs of kittiwakes (2.6% of the breeding Eastern Atlantic population) (count as of 1987). However, there were 37,617 kittiwake pairs or 75,234 breeding adults recorded in 2008 (JNCC Seabird Colony Register). The citation (JNCC 2011b) notes that the SPA designations were reviewed in 2000, at which point kittiwakes were the only notified feature of the site. There is some uncertainty as to whether there were ever as many as 83,370 pairs of kittiwakes at this site; this number has been challenged repeatedly by the world's leading expert on kittiwake biology (Coulson, 2011), most recently by noting that this colony should have been increasing in numbers based on monitoring data on its productivity. The apparent decline from 83,370 pairs in 1987 to 37,617 pairs in 2008 does not correspond with population trajectories elsewhere based on the influence of productivity on population change (Coulson 2017). Indeed, recent counts by the RSPB show a small increase in kittiwake breeding numbers in the years since 2008 (RSPB data), as predicted by Coulson (2017).

26. Historical published counts of guillemots (NB these are the number of individuals recorded on land and have not been adjusted to estimate pairs) at Flamborough Head and Bempton Cliffs SPA include 12,570 in 1969, 32,578 in 1987, 47,215 in 2000, 59,817 in 2008, and 84,647 in 2017 according to Lloyd et al. (2019). The counts from 1987, 2000, 2008 and 2017 are also listed in JNCC (2020). In the larger area of the whole FFC SPA there were 90,861 guillemots in 2017 (Lloyd et al. 2019), so the majority of this species are to be found within the original Flamborough Head and Bempton Cliffs SPA, with an additional 6,214 individuals (an additional 7%) in 2017 in

the part of the FFC SPA that is outwith Flamborough Head and Bempton Cliffs SPA boundaries. There has been a clear and strong increase in numbers of guillemots at the FFC SPA, which has averaged 4% per year over the last 50 years.

27. Historical published counts of razorbills (NB these are the number of individuals recorded on land and have not been adjusted to estimate pairs) at Flamborough Head and Bempton Cliffs SPA include 1,724 in 1969, 7,688 in 1987, 8,463 in 2000, 14,956 in 2008, and 27,967 in 2017 according to Lloyd et al. (2019). The counts from 1987, 2000, 2008 and 2017 are also listed in JNCC (2020). In the larger area of the whole FFC SPA there were 30,228 razorbills in 2017 (Lloyd et al. 2019), so the majority of this species are to be found within the original Flamborough Head and Bempton Cliffs SPA, with an additional 2,261 individuals (an additional 7%) in 2017 in the part of the FFC SPA that is outwith Flamborough Head and Bempton Cliffs SPA boundaries. There has been a clear and strong increase in numbers of guillemots at the FFC SPA, which has averaged 6% per year over the last 50 years.

2.2 Conservation Objectives

28. The Conservation Objectives for the site are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Birds Directive, by maintaining or restoring:

- the extent and distribution of the habitats of the qualifying features;
- the structure and function of the habitats of the qualifying features;
- the supporting processes on which the habitats of the qualifying features rely;
- the populations of each of the qualifying features; and
- the distribution of the qualifying features within the site.

29. Natural England has stated the target is to restore the size of the breeding populations to levels which are above 83,700 breeding pairs (kittiwake), 41,607 pairs (guillemot) and 10,570 pairs (razorbill), whilst avoiding deterioration from their current levels, as indicated by the latest mean peak counts or equivalent.

3 QUANTIFICATION OF EFFECTS ON THE FFC SPA

3.1 Summary of Revised Kittiwake Collision Risk Modelling

3.1.1 Norfolk Vanguard alone

30. At the close of the Norfolk Vanguard examination the wind farm design comprised 180 x 10MW turbines with a minimum draught height (the gap between the lower rotor tip and the sea level at Mean High Water Springs, MHWS) of 27m, which was a

refinement from the DCO submission which was based on 200 x 9MW turbines with a draught height of 22m (from MHWS).

31. Following the close of examination, the Applicant undertook further investigations into the design envelope and committed to additional design restrictions in order to further reduce the predicted collision risks. Additional mitigation proposed by the Applicant was detailed in full in document reference ExA; Mit; 11.D10.2 ('Additional Mitigation') submitted on 28th February 2020. In summary this includes the following measures:

- Reduced maximum number of turbines from 180 to 158 by increasing the minimum turbine size from 10MW to 11.55MW; and
- Increased draught height:
    - Minimum draught height increased from 22m to 35m (above MHWS) for turbine models of up to and including 14.6MW capacity; and
    - Minimum draught height increased from 22m to 30m (above MHWS) for turbine models of 14.7MW and above.

32. At these two draught heights (30m and 35m) the worst case turbine options (with respect to collision risk) are the 14.7MW and 11.55MW respectively, and of these two the overall worst case collision predictions are obtained for the 14.7MW turbine model.

33. Using Natural England's preferred Collision Risk Model (CRM) parameters, the annual kittiwake mortality apportioned to the Flamborough and Filey Coast SPA has reduced from 42.2 individuals to 21 (this update has been agreed by Natural England), while using the Applicant's preferred parameters the reduction is from 9.3 to 4.6 individuals (the Applicant has derived these parameters from a robust analysis of available evidence).

34. Thus, the worst case scenario of a 14.7MW turbine with a 30m draught height has predicted collision risks which are over 50% lower for kittiwake compared with the estimate submitted at the close of the project examination for the 10MW turbine at a draught height of 27m [APP-217].

35. Natural England has agreed with the Applicant that impacts for the project alone do not cause any adverse effects on integrity (AEoI) on any SPA population, and therefore the request for compensation is not with respect to Norfolk Vanguard alone.

36. In the letter from the SoS (5th July 2021) the following request for further details was made:

Any modifications to the Norfolk Vanguard project, that were not included at the time of the application or during the Examination, which could avoid or reduce adverse effects on the integrity of the site for the kittiwake, razorbill, and guillemot features

37. While the Applicant has been undertaking work to further develop the project design, these have not affected the worst case collision impacts as defined at the close of the Examination, therefore the project alone impacts remain as set out in the previous submission (ExA; Mit; 11.D10.2 ('Additional Mitigation') submitted on 28th February 2020).

3.1.2 In combination

38. The in-combination total kittiwake collisions assigned to the Flamborough and Filey Coast SPA from all wind farms predicted to have connectivity are provided in Table 10.2. This is an update of the tables submitted during the Examination, taking into account the following changes to other wind farms included in this assessment:

- Removal of the Thanet Extension wind farm following the Secretary of State's decision to refuse development consent on 1st June 2020;
- Inclusion of the Hornsea Project Three wind farm figures in the cumulative and in-combination totals (previously the totals were presented both with and without this project), although since the Hornsea Project Three kittiwake mortalities apportioned to the FFC SPA are required to be compensated for, these have been omitted from the in-combination total;
- Updated figures for East Anglia ONE North and East Anglia TWO following submission of revised estimates for those wind farms made during those projects' examination[3]; and
- Addition of preliminary collision estimates for the Dudgeon Extension and Sheringham Extension wind farms.[4]

39. Using the Applicant's estimate for Norfolk Vanguard of 4.6, the updated total in-combination kittiwake collision risk for the Flamborough and Filey Coast SPA population is estimated to be 516. This includes the estimates from the Preliminary Environmental Impact Reports for Hornsea Project Four and the Dudgeon and

---

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-002594-ExAAS7D1V1EA1NEA2OffshoreOrnithologyCumulativeandInCombinationCollisionUpdate_378218_1.pdf; https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-003429-ExA.AS-7.D4.V1%20EA1N&EA2%20Deadline%204%20Offshore%20Ornithology%20Cumulative%20and%20In-Combination%20Collision%20Risk%20Update.pdf

[redacted]

Sheringham Extensions, but does not include Hornsea Project Three (which will be fully compensated for). Using Natural England's estimate for Norfolk Vanguard, this total increases to 532. If the above named projects, for which only preliminary estimates are available, are omitted the in-combination total is reduced to 357.

40. Therefore, Norfolk Vanguard's contribution to the higher total, using Natural England's figures, is 3.9% (=21/532) and using the Applicant's figures is 0.9% (=4.6/516). For the lower total, omitting the PEIR projects, the Norfolk Boreas contribution is between 5.8% (Natural England figures) and 1.3% (the Applicant's figures).

41. The changes to the in-combination totals presented in the current version of this document do not affect the Applicant's conclusions on the magnitude and significance of any ornithological impacts, as discussed below.

42. The Norfolk Boreas Applicant presented analysis of the potential impact of the in-combination mortality which clearly concluded there will be no adverse effect on the integrity of the FFC SPA due to in-combination kittiwake mortality (see Norfolk Boreas Offshore Ornithology Assessment Update [REP2-035] and the Norfolk Boreas Assessment Update Cumulative and In-combination Collision Risk Modelling [REP6-024]).

43. The project impacts are now reduced to very small levels and the contributions of the project to in-combination impacts are also very small. Indeed, as presented in Table 10.2, the Norfolk Vanguard predicted mortality of kittiwake from the Flamborough and Filey Coast SPA (using Natural England's precautionary figure of 21) is lower than those for several consented offshore wind farms including Hornsea Project One, Dogger Bank Creyke Beck A and B, Dogger Bank Teesside A and B and Triton Knoll.

44. Furthermore, the impacts from the project are more than offset by the reductions in in-combination totals currently locked up in the available headroom, created by the difference between assessed, consented and as built schemes (see for example Norfolk Boreas REP6-021 for further details).

45. On this basis, the Applicant firmly maintains the position presented in the original application, during the Examination, in the additional information submitted on 28th February 2020 and as supplemented in this submission, that in respect of these designated sites, an in-combination AEoI for the project with other plans and projects can be ruled out beyond reasonable scientific doubt for all relevant designated sites.

46. The contribution to the in-combination total from Norfolk Vanguard must also be taken into consideration with respect to the scale and timescale for delivery of any compensation measures (if required).

3.2 Summary of Guillemot Displacement Assessment

3.2.1 Norfolk Vanguard alone

47. The annual number of guillemots at risk of displacement from Norfolk Vanguard, apportioned to the FFC SPA, was 210 individuals (95% confidence intervals 114-331). Of these, Natural England advice is that between 30% and 70% would be predicted to be displaced and of those displaced, a mortality rate of between 1% and 10% should be applied. Thus, between 0.6 (30% displaced, 1% mortality; 95% confidence intervals 0.3 – 1.0) and 15 (70% displaced, 10% mortality; 95% confidence intervals 8 – 23) individuals could be affected by the project.

48. Natural England has agreed with the Applicant that impacts for the project alone do not cause any adverse effects on integrity (AEoI) on any SPA population, and therefore there is no requirement to consider compensation with respect to Norfolk Vanguard alone.

49. In the letter from the SoS (5th July 2021) the following request for further details was made:

Any modifications to the Norfolk Vanguard project, that were not included at the time of the application or during the Examination, which could avoid or reduce adverse effects on the integrity of the site for the kittiwake, razorbill, and guillemot features

50. While the Applicant has been undertaking work to further develop the project design, these have not affected the worst case displacement impacts as defined at the close of the Examination, therefore the project alone impacts remain as set out in the final assessments.

3.2.2 In combination

51. The in-combination total guillemot displacement mortality assigned to the Flamborough and Filey Coast SPA from all wind farms predicted to have connectivity are provided in Table 10.4. This updates the tables submitted during the Examination (REP8-069), taking into account the following changes to other wind farms included in this assessment:

- Removal of the Thanet Extension wind farm following the Secretary of State's decision to refuse development consent on 1st June 2020;

- Inclusion of the Hornsea Project Three wind farm figures in the cumulative and in-combination totals (previously the totals were presented both with and without this project);
- Updated figures for East Anglia ONE North and East Anglia TWO following submission of revised estimates for those wind farms made during those projects' examination[5]; and
- Addition of preliminary displacement estimates for the Hornsea Project Four, Dudgeon Extension and Sheringham Extension wind farms.[6]

52. The range of in-combination mortalities for the FFC SPA, including Hornsea Project Four and Dudgeon and Sheringham Extensions, is between 131 (30% displaced, 1% mortality) and 3,056 (70% displaced, 10% mortality). With Hornsea Project Four and Dudgeon and Sheringham Extensions omitted the mortalities are between 75 and 1,748, respectively. Thus, the Norfolk Vanguard contribution is between 0.5% and 0.8% of the total predicted mortality, including and excluding Hornsea Project Four and Dudgeon and Sheringham Extensions, respectively.

53. The changes to the in-combination totals presented in this document do not affect the Applicant's conclusions on the magnitude and significance of any ornithological impacts, as discussed below.

54. The Applicant has presented further analysis of the potential impact of the in-combination mortality which clearly concludes there will be no adverse effect on the integrity of the FFC SPA due to in-combination guillemot mortality (see Offshore Ornithology Auk Displacement Assessment Update [REP8-069]).

55. On this basis, the Applicant firmly maintains the position presented in the original application and during the Examination, as supplemented in this submission, that in respect of these designated sites, an in-combination AEoI for the project with other plans and projects can be ruled out beyond reasonable scientific doubt for all relevant designated sites. As noted above (section 1.1), Natural England, in their submission to the East Anglia ONE North and East Anglia TWO examinations at deadline 12[1], have also concluded that displacement of guillemot from the FFC SPA would not give rise to in-combination AEoI as a result of projects for which

[5] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-002594-ExAAS7D1V1EA1NEA2OffshoreOrnithologyCumulativeandInCombinationCollisionUpdate_378218_1.pdf; https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-003429-ExA.AS-7.D4.V1%20EA1N&EA2%20Deadline%204%20Offshore%20Ornithology%20Cumulative%20and%20In-Combination%20Collision%20Risk%20Update.pdf

[redacted]

applications have been submitted (i.e. including Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North, East Anglia TWO and Hornsea Project Three).

56. The contribution to the in-combination total from Norfolk Vanguard must also be taken into consideration with respect to the scale and timescale for delivery of any compensation measures (if required).

3.3 Summary of Razorbill Displacement Assessment

3.3.1 Norfolk Vanguard alone

57. The annual number of razorbills at risk of displacement from Norfolk Vanguard, apportioned to the FFC SPA, was 84 individuals (95% confidence intervals 34 - 141). Of these, Natural England advice is that between 30% and 70% would be predicted to be displaced and of those displaced, a mortality rate of between 1% and 10% should be applied. Thus, between 0.3 (30% displaced, 1% mortality; 95% confidence intervals 0.1 – 0.4) and 6 (70% displaced, 10% mortality; 95% confidence intervals 2.4 – 9.9) individuals could be affected by the project.

58. Natural England has agreed with the Applicant that impacts for the project alone do not cause any adverse effects on integrity (AEoI) on any SPA population, and therefore there is no requirement to consider compensation with respect to Norfolk Vanguard alone.

59. In the letter from the SoS (5th July 2021) the following request for further details was made:

Any modifications to the Norfolk Vanguard project, that were not included at the time of the application or during the Examination, which could avoid or reduce adverse effects on the integrity of the site for the kittiwake, razorbill, and guillemot features

60. While the Applicant has been undertaking work to further develop the project design, these have not affected the worst case displacement impacts as defined at the close of the Examination, therefore the project alone impacts remain as set out in the final assessments.

3.3.2 In combination

61. The in-combination total razorbill displacement mortality assigned to the Flamborough and Filey Coast SPA from all wind farms predicted to have connectivity are provided in Table 10.5. This is an update of the tables submitted during the Examination (REP8-069), taking into account the following changes to other wind farms included in this assessment:

- Removal of the Thanet Extension wind farm following the Secretary of State's decision to refuse development consent on 1st June 2020;
- Inclusion of the Hornsea Project Three wind farm figures in the cumulative and in-combination totals (previously the totals were presented both with and without this project);
- Updated figures for East Anglia ONE North and East Anglia TWO following submission of revised estimates for those wind farms made during those projects' examination[7]; and
- Addition of preliminary displacement estimates for the Hornsea Project Four, Dudgeon Extension and Sheringham Extension wind farms.[8]

62. The range of in-combination mortalities for the FFC SPA, including Hornsea Project Four and Dudgeon and Sheringham Extensions, is between 22 (30% displaced, 1% mortality) and 508 (70% displaced, 10% mortality). With Hornsea Project Four and Dudgeon and Sheringham Extensions omitted the mortalities are between 19 and 435, respectively. Thus, the Norfolk Vanguard contribution is between 1.1% and 1.3% of the total predicted mortality, including and excluding Hornsea Project Four and Dudgeon and Sheringham Extensions, respectively.

63. The changes to the in-combination totals presented in this document do not affect the Applicant's conclusions on the magnitude and significance of any ornithological impacts, as discussed below.

64. The Applicant has presented further analysis of the potential impact of the in-combination mortality which clearly concludes there will be no adverse effect on the integrity of the FFC SPA due to in-combination razorbill mortality (see Offshore Ornithology Auk Displacement Assessment Update [REP8-069]).

65. On this basis, the Applicant firmly maintains the position presented in the original application and during the Examination, as supplemented in this submission, that in respect of these designated sites, an in-combination AEoI for the project with other plans and projects can be ruled out beyond reasonable scientific doubt for all relevant designated sites. As noted above (section 1.1), Natural England, in their submission to the East Anglia ONE North and East Anglia TWO examinations at deadline 12[1], have also concluded that displacement of razorbill from the FFC SPA

---

[7] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-002594-ExAAS7D1V1EA1NEA2OffshoreOrnithologyCumulativeandInCombinationCollisionUpdate_378218_1.pdf; https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-003429-ExA.AS-7.D4.V1%20EA1N&EA2%20Deadline%204%20Offshore%20Ornithology%20Cumulative%20and%20In-Combination%20Collision%20Risk%20Update.pdf

[redacted]

would not give rise to in-combination AEoI as a result of projects for which applications have been submitted (i.e. including Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North, East Anglia TWO and Hornsea Project Three).

66. The contribution to the in-combination total from Norfolk Vanguard must also be taken into consideration with respect to the scale and timescale for delivery of any compensation measures (if required).

4 COMPENSATION - KITTIWAKE

4.1 Guidance

67. If the conclusion of the Competent Authority is that, following conclusion of the Appropriate Assessment, an AEoI on a Natura 2000 site(s) cannot be ruled out, that there are no alternative solutions and that there are IROPI, then Article 6(4) of the Habitats and Birds Directives "*requires that all necessary compensatory measures are taken to ensure the overall coherence of the network of European sites as a whole is protected.*"

68. Defra (2012) and EC (2012 and 2018) explain that for SPAs, the overall coherence of the Natura 2000 Network can be maintained by:

- compensation that fulfils the same purposes that motivated the site's designation;
- compensation that fulfils the same function along the same migration path; and,
- the compensation site(s) are accessible with certainty by the birds usually occurring on the site affected by the project.

69. The guidance provides an element of flexibility, recognising that compensation of a 'like for like' habitat and/or in the same designated site may not be practicable.

70. Compensation should not be used to address issues that are causing designated habitats or species to be in an unfavourable condition. This is the responsibility of the UK Government.

71. Ideally, compensation should be functioning before the effect takes place, although it is recognised that this may not always be possible, as stated in the EC (2012) guidance: "*in principle, the result of implementing compensation has normally to be operational at the time when the damage is effective on the site concerned. Under certain circumstances where this cannot be fully fulfilled, overcompensation would be required for the interim losses*."

72. In line with the guidance, indicative compensation options for collision risk to kittiwake at the FFC SPA are summarised in Table 4.1 and could include:

- Prey enhancement;
- Predator control / mortality reduction; and
- Productivity improvement.

4.2 Review of Potential Compensation Measures – Measures suggested in the Defra report

73. In a report to Defra, Furness et al. (2013) suggested possible measures that could improve the conservation status of UK seabird populations. These are summarised for kittiwake in Table 4.1.

Table 4.1 Measures listed in the Defra report (Furness et al. 2013) to improve conservation status of kittiwake at colonies throughout the UK

Type of measure	Suggested method plus in parentheses comments on suitability in relation to the key SPA population
Prey enhancement	Closure of sandeel and sprat fisheries close to SPA colonies; (sandeels are the key breeding season prey of kittiwakes at FFC, but sprats do not occur in diet of North Sea kittiwakes (but are taken by kittiwakes breeding in the Irish Sea)).
	Purchase of sandeel fishery quota (as above sandeels are the key breeding season prey of kittiwakes at FFC).
Predator control / mortality reduction	Eradicate American mink (not a pressure at FFC).
	Eradicate feral cats (not a pressure at FFC).
	Eradicate rats (not a pressure at FFC).
	Exclusion of foxes from colonies (not a pressure at FFC).
	Exclusion of great skuas from around colonies (not a pressure at FFC).
Productivity improvement	Artificial structures to support colonies (not appropriate at FFC but could be effective at sites in southern North Sea close to sandeel feeding grounds and distant from FFC).

74. Only some of the measures presented in Table 4.1 would be appropriate for the focal SPA populations of Flamborough and Filey Coast SPA for reasons summarised in Table 4.1 and detailed further in the following sections. In addition, knowledge of seabird ecology has advanced in the six years since publication of the Defra report so the suitability of these measures requires further consideration in relation to new evidence.

4.3 Prey enhancement

75. Two mechanisms seem suitable to achieve this long-term, strategic compensation, as described below; closure of a defined area for sandeel fishing and purchase of sandeel fishery quota.

4.3.1 Closure of sandeel fishing to benefit kittiwakes at Flamborough and Filey Coast SPA

4.3.1.1 Overview

76. In particular, since 2013, understanding of the impact of sandeel fishing on the stock of sandeels most relevant to the kittiwakes at Flamborough and Filey Coast SPA has improved considerably. There is now a clearer understanding of the impact of fishing effort on sandeel stock size and on the impact of sandeel stock size on breeding success of kittiwakes at FFC SPA. That has identified that changes in fishery management to reduce fishing mortality imposed on the stock would permit this stock to recover from heavy exploitation. This would increase breeding success of kittiwakes at FFC SPA.

77. During the breeding season, kittiwakes breeding at colonies around the North Sea feed mainly on sandeels (Furness and Tasker 2000, Coulson 2011). Sandeel abundance strongly influences breeding success of kittiwakes, and breeding success strongly influences whether kittiwake colonies increase or decrease in breeding numbers (Coulson 2011, 2017). In Shetland, kittiwake breeding success, and breeding numbers, crashed after the collapse of the Shetland sandeel stock (Furness and Tasker 2000). Kittiwake breeding success has also been affected at the Isle of May, off east Scotland, when the sandeel stock in that area (which is distinct from the sandeel stocks at Shetland or in the southern North Sea; Frederiksen et al. 2005; ICES 2019) was heavily fished (Frederiksen et al. 2004). Sandeels (specifically *Ammodytes marinus*) are the target of what has been the largest single-species fishery in the North Sea over recent decades. Kittiwakes at Flamborough and Filey Coast SPA forage over a large area from that colony, and their foraging area includes some of the most important sandbanks supporting high densities of sandeels and the sandeel fishery (Carroll et al. 2017). There is strong evidence, summarised below, that the sandeel fishery has caused depletion of sandeel biomass in this region (Lindegren et al. 2018), and that reduced abundance of sandeels as a result of the high fishing effort on sandeels has led to reduced breeding success of kittiwakes at Flamborough and Filey Coast SPA (Carroll et al. 2017). Reducing the level of fishing effort on sandeels, or closing the fishery in waters close to the colony, would, therefore, represent mechanisms to improve breeding success of kittiwakes at that colony by making it possible for the biomass of the sandeel stock to recover from the high fishing mortality that has been imposed in recent decades. Such reduction would be anticipated to lead to rapid recovery of sandeel abundance. Sandeel is a short-lived fish which starts to breed when only 1 or 2 years old, with high reproductive potential, and since kittiwakes will feed on all age classes of sandeels but especially on 1 and 2 year old sandeels, the increase in sandeel abundance

would be likely to influence kittiwake breeding success with a time lag of only 1 or 2 years.

78. There is very clear evidence that reduction in the abundance of sandeels can cause a reduction in breeding success of kittiwakes, and that large reductions in sandeel abundance result in breeding failure of kittiwakes and population decline (Furness and Tasker 2000, Oro and Furness 2002, Frederiksen et al. 2004, Furness 2007, Carroll et al. 2017). It is however more difficult to demonstrate the benefits of closing a fishery on sandeel abundance because closure of a fishery is usually accompanied by ending of the monitoring of sandeel abundance. At Shetland, the local sandeel fishery closed in 1990, and immediately after the fishery was closed, sandeel recruitment was particularly high in 1991, but it is not clear that this was a consequence of the closure of the fishery. Subsequently, sandeel abundance at Shetland has not been monitored in any detail, but there has been little evidence of any further recovery of sandeel abundance at Shetland, possibly due to increases in abundance of adult herring which feed on the scarce larval sandeels (Frederiksen et al. 2007), and climate change reducing the productivity of the small numbers of sandeels remaining in the area (Wright et al. 2018).

79. Frederiksen et al. (2004) showed that breeding success of kittiwakes at the Isle of May (part of Forth Islands SPA) was on average 0.5 chicks per pair lower during years when sandeel fishing occurred in the area than it was in years with no sandeel fishing. A decision was taken to close an area to sandeel fishing (the ‘sandeel box’ off the east of Scotland) because of persistent low breeding success of kittiwakes indicative of the poor condition of the sandeel stock in the area. The consequence of that closure was monitored. Closure of the fishery resulted in an increase in sandeel stock biomass (Greenstreet et al. 2006) and an increase in kittiwake breeding success at colonies within the closed area compared to those outside (Daunt et al. 2008, Frederiksen et al. 2008), providing experimental evidence for the mitigation of fishery impact by closing the fishery. Recovery of sandeel abundance in the closed area has led to the sandeel fishing industry seeking the opportunity to resume fishing within the closed area, but until now the regulator has retained this closed box, although fishing for sandeels has occurred right up to the offshore (eastern) edge of the closed box.

80. Closure of the sandeel fishery off east Scotland also altered the age structure of the sandeel population. When the stock was heavily fished, very few sandeels lived beyond two years old, resulting in high variability on stock abundance from year to year depending on the highly variable level of production of young fish. When the fishery was closed, sandeels tended to live longer, with large cohorts remaining in the stock for up to six years (Peter Wright, pers. comm.). The longer life expectancy

of sandeels when not subject to fishing not only increases mean biomass of the stock, but also reduces variability in abundance driven by variable recruitment. This in turn will also be beneficial to kittiwake breeding success, by ensuring that even if recruitment is poor, the biomass of the stock is buffered by presence of older age classes of fish.

81. Breeding success of the Flamborough and Filey Coast SPA kittiwake population was 1.2 chicks/pair in 1986-1990, but fell to about 1 chick/pair in 1990-2010 and to 0.8 chicks/pair in 2010-2014, with that reduction largely being attributable to high fishing mortality of sandeels especially at Dogger Bank but also generally in the southern North Sea, resulting in a reduction in sandeel abundance (Carroll et al. 2017). The productivity of kittiwakes at Flamborough and Filey Coast SPA is significantly correlated with sandeel stock biomass. The relationship found by Carroll et al. (2017) for kittiwakes at Flamborough and Filey Coast SPA in relation to sandeel stock in International Council for the Exploration of the Sea (ICES) North Sea sandeel management Area 1 ('Dogger Bank' and neighbouring areas) is similar to that previously identified elsewhere: kittiwake breeding success and adult survival at Shetland was closely related to changes in sandeel stock biomass in that area (Furness and Tasker 2000, Oro and Furness 2002, Furness 2007), and kittiwake breeding success at the Isle of May was strongly influenced by effects of sea surface temperature and sandeel fishing on the sandeel stock off the Firth of Forth, east Scotland (Frederiksen et al. 2004).

82. Lindegren et al. (2018) carried out a hindcast analysis of the Dogger Bank sandeel stock to assess the consequence of the high fishing mortality. They estimated that sandeel spawning stock biomass would have been about twice as large now as it is, if the fishery had maintained fishing mortality (F) at F=0.4 rather than at the levels of F=0.8 to 1.2 as seen during 1999-2009 in the history of this fishery. Indeed, the stock would be even larger now if there had been no fishery harvesting sandeels, although Lindegren et al. (2018) did not report on that scenario. However, their results further support the conclusion that the high fishing mortality imposed on the sandeel stock has been a major influence on the abundance of the sandeel, and hence on the breeding success of kittiwakes. Lindegren et al. (2018) also identified influences of sea temperature and copepod abundance on the abundance of sandeels, and suggested that long term trends in those drivers may inhibit recovery of sandeels if fishing pressure was reduced.

83. At present, the sandeel stock remains considerably below its long term average abundance, and is subject to a fishing mortality around F=0.6 (ICES 2018), a figure above the level tested in the scenario of Lindegren et al. (2018), and a figure which their scenario modelling clearly demonstrates has a negative impact on sandeel

abundance. Indeed, at present the spawning stock biomass in this area is at an unusually low level of 97,636 tonnes in 2019, which is less than 10% of its highest historical level and is slightly below the limiting spawning stock biomass at which ICES should recommend closure of the fishery (Blim of 110,000 tonnes SSB) because there is an increased risk of recruitment failure in this stock (ICES 2019).

84. Cury et al. (2011) used empirical evidence from several seabird-fishery interactions around the world to suggest that management should aim to keep food fish stocks such as sandeels above a threshold of one-third of their historical maximum biomass in order to achieve good productivity among dependent seabird populations. The southern North Sea sandeel stock has fallen far below that rule of thumb management objective. This suggests that the continuation of sandeel fishery is likely to continue to cause mortality of many thousands of kittiwake chicks per year compared to a scenario with no fishing of the sandeel stock. It also identifies that the single most effective practical management action to assist the kittiwake population would be closure of the sandeel fishery (Carroll et al. 2017, Lindegren et al. 2018, Wright et al. 2018).

85. Mortality of chicks has less impact on the kittiwake population than the same mortality of adults. On the basis of the demographic parameters of kittiwakes in the North Sea (adult survival 0.854, juvenile survival 0.79, age of first breeding 4 years; Horswill and Robinson 2015), 4,000 fledglings would be expected to give rise to about 2,000 adults per year surviving to recruit into colonies at 4 years of age. If sandeel fishing reduced productivity by 20,000 chicks per year which appears to be approximately the scale of the impact indicated by the data for this region, that would be equivalent to nearly 10,000 adults per year surviving to recruit into colonies at 4 years of age.

4.3.1.2 Delivery Mechanism

86. Closure of a defined area for sandeel fishing was achieved off the east coast of Scotland, and has been successful in recovering sandeel abundance and kittiwake breeding success (although these have also been affected over the years by climate change). This is an example of where the EU Common Fisheries Policy (as discussed further below) has previously been used as a management measure; ICES advised closure of the area off east Scotland and the EU took that advice. Rather than complete closure of the fishery, it is also possible to promote a closed box under the Common Fisheries Policy.

87. ICES promotes 'ecosystem-based management' of fish stocks. However, their management of the sandeel stock has recently been criticised as not being 'ecosystem-based' because it sets a quota only on the basis of sustaining the sandeel

stock and not on the basis of the needs of higher trophic level predators (such as kittiwakes) (Hill et al. 2019). ICES should therefore be highly receptive to the need to better manage that sandeel stock to avoid adverse impacts on kittiwakes and other top predators.

88. The Common Fisheries Policy recognises that conservation measures which affect fishing interests may need to be adopted to comply with obligations in relation to environmental legislation[9]. Member States are allowed to adopt measures which do not affect other Member States under their own legislation, e.g. through byelaws under Section 129 (promoted by the MMO) and Section 155 (promoted by Inshore Fisheries Conservation Authorities) of the MCAA 2009. However, where conservation objectives would affect other Member States which have a direct management interest in the fishery, a joint recommendation must be made to the European Commission (EC) to adopt those measures.

89. Following EU Exit in December 2020, the UK is no longer part of the Common Fisheries Policy. Instead, the Fisheries Act 2020 establishes the legal framework for managing fishing in the UK. It contains objectives for managing fisheries under which a Joint Fisheries Statement is currently being prepared, which will set out fisheries policy in the UK to achieve the stated objectives. There are still a number of controls used to manage fisheries in a sustainable way and this includes through byelaws promoted under the MCAA 2009 (as referred to above) which have been amended under the Fisheries Act 2020, so that powers now extend to make byelaws beyond territorial waters and outside of Marine Protected Areas.

90. However, the purpose of promoting byelaws relates to conserving marine flora or fauna, or marine habitats or habitat types. EC Guidance[10] states that compensatory measures should be additional to the actions that are considered normal practice under the Habitats and Birds Directives or obligations laid down in EU law, including the standard measures required for designation, protection and management of Natura 2000 sites.

91. Whilst this compensatory measure would be analogous to the examples above, and could even be achieved simply by extending the existing closed area box southward to beyond FFC SPA, at present, no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK

[9] Articles 11 and 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy
[10] Managing Natura 2000 sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC – C(2018) 7621

Government in allocating appropriate powers to a relevant management body and, potentially, through the delivery of legislation to secure the necessary powers.

4.3.1.3 Spatial Scale

92. To compensate for an average of 21 and a worst case of 60 kittiwakes from FFC SPA estimated to be killed by collisions each year at Norfolk Vanguard (applying Natural England's preferred methods which the Applicant considers include a very large degree of precaution), it would be necessary to increase fledgling production at FFC SPA by at least 120 fledglings per year (as about half of those will survive to reach breeding age). Since there are over 40,000 pairs of kittiwakes at FFC SPA, that compensation can be achieved by increasing breeding success by 0.003 chicks per nest on average (i.e. 1 extra chick for every 333 pairs). The change in breeding success at this very large colony required in order to compensate for loss of a maximum of 60 birds per year is extremely small. The analysis by Carroll et al. (2017) suggests that if fishing mortality on the southern North Sea sandeel stock was reduced by 50%, kittiwake productivity would increase by at least 0.2 chicks per nest on average. That would be 67 times the compensation level required to offset any potential impact of Norfolk Vanguard.

93. It can therefore be concluded that reducing fishing mortality on sandeels may be an effective long-term, strategic compensation, but it would be very difficult to precisely achieve the small amount of proportionate compensation for Norfolk Vanguard and it would also be very difficult to measure the effect of the very small change required to compensate for loss of up to 60 birds.

94. In view of the large numbers of kittiwake chicks dying at Flamborough and Filey Coast SPA as a consequence of reduced abundance of sandeels due to fishing impacts, there is evidently scope for compensation through either reducing fishing effort directed at sandeels, or through closing areas within the main foraging range of this kittiwake population to sandeel fishing.

4.3.1.4 Timescale

95. There is some evidence to suggest that recovery of sandeel stocks may be slow, or incomplete, as a consequence of other ecological factors (for example the effects of climate change on zooplankton on which sandeels feed, such as large copepods, and the recovery to high abundance of predatory fish such as cod, hake, haddock and whiting that eat sandeels) and impacts of climate change (Lindegren et al. 2018). Therefore, any compensation (in terms of improved stock biomass) on these grounds should aim to exceed the minimum suggested by the statistical relationship between sandeel total stock biomass and kittiwake productivity.

96. This therefore represents a long-term, strategic opportunity for compensation for all relevant offshore wind farms with a cumulative/in-combination impact on North Sea kittiwake populations, as an increase in breeding success equivalent to the loss of 10,000 adult kittiwakes per year could be achieved by closing areas of sandeel fishery in UK waters, and this is considerably greater than the worst case cumulative impact estimated for all UK offshore wind developments on kittiwake in the North Sea.

4.3.1.5 Monitoring

97. The breeding success of kittiwakes at FFC SPA is already monitored, so the consequence of adjusting sandeel fishing effort would be visible from the long-term data on kittiwake breeding success. Breeding success is also already monitored at other colonies that are distant from the southern North Sea sandeel stock and the productivity of those colonies would provide some baseline data against which to compare FFC SPA productivity. However, there would be no ideal ‘control’ for this manipulation. Similarly, sandeel stock biomass is assessed annually by ICES. There is no ‘control’ site in that case either, but population modelling (Lindegren et al. 2018) provides strong evidence of the changes resulting from adjustment of fishing effort. By such mechanisms it would therefore be possible to monitor the effectiveness of this compensation.

4.3.1.6 Feasibility

98. As noted above, at present no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate rights to a relevant management body and, potentially, through the delivery of legislation to secure the necessary rights. The feasibility of this measure is, therefore, currently uncertain and so the Applicant would not propose to progress this option.

99. However, if initiatives are developed by the relevant authorities in the future with a view to enabling fishery management to be undertaken as strategic compensation then Vattenfall would be willing to participate in their delivery, on the basis that these were within acceptable timeframes for the project.

4.3.2 Prey enhancement - Purchase of sandeel fishery quota

4.3.2.1 Overview

100. A second, long-term strategic option would be for developers to purchase quota for sandeel, in order to reduce the catch taken by the fishery.

4.3.2.2 Delivery mechanism

101. The fishery quota is held entirely by Danish fisheries interests, so purchase of quota may or may not be possible. However, the ability of the Applicant to purchase fishing quotas would be dependent on fishermen with appropriate quotas being willing to sell.

4.3.2.3 Spatial scale

102. The extent to which fishing effort needs to be reduced to compensate for loss of an average of 21 or a worst case of 60 kittiwakes is very small. Coulson (2011) reported that to raise a chick to the point of fledging, each chick was fed around 3kg of fish in total. The North Sea sandeel fishery total annual landings is currently around 500,000 tonnes. Therefore, allowing for the fact that approximately half of fledged chicks reach adult recruitment age, the amount of sandeel prey required to raise 120 chicks to fledging is approximately 360kg, which is an extremely small proportion of the total take (less than 0.00007%).

4.3.2.4 Timescale

103. The timescale would be dependent on the agreement reached with a seller if one could be found, but potentially this could be achieved prior to operation of the wind farm and would then be maintained for the duration of the wind farm's operational life.

4.3.2.5 Feasibility

104. Due to the uncertainty associated with the acceptability and deliverability of this compensatory measure, the Applicant would not propose to progress this option.

105. As for fisheries management, if initiatives are developed by the relevant authorities in the future with a view to enabling fishery quotas to be purchased as means to deliver strategic compensation, then Vattenfall would be willing to participate in their delivery, on the basis that these were within acceptable timeframes for the project.

4.4 Predator control / mortality reduction

4.4.1 Overview

106. Kittiwakes normally nest on narrow ledges of steep cliffs. Their nest sites are usually on the lower part of the cliff, often overhanging the sea. Coulson (2011) states 'predation by mammals on kittiwakes is extremely rare'. Furness et al. (2013) reviewed JNCC Annual Reports of Seabird numbers and breeding success in Britain

and Ireland (1986-2006) to extract information on causes of reduced breeding success at kittiwake colonies. Factors identified by JNCC were food shortage (43 cases), great skua predation (6 cases), extreme weather events (5 cases), gull predation (3 cases), mink predation (2 cases), peregrine predation (1 case), feral cat predation (1 case), fox predation (1 case), rat predation (1 case). The cases of predation by great skuas and gulls were mostly in Orkney and Shetland, where breeding success was low due to food shortage so adults left nests unattended. The few cases of predation by mammals were at St Abb's Head (mink in 1999 and 2001), at an artificial colony on Lowestoft pier (fox in 2006), and at the Isles of Scilly (feral cat in 1998, rat in 1994).

107. Brown rats were eradicated from St Agnes and Gugh islands in the Isles of Scilly in 2013-14 (Heaney 2018). There were immediate signs of recovery and recolonization by seabirds that had been affected by rats. However, kittiwake breeding numbers on St Agnes have decreased since the eradication of rats; none bred there in 2017 or 2018. Kittiwake breeding numbers on Gugh fell to zero before the eradication of rats; 30 pairs bred there in 2017 and 35 pairs in 2018, but they fledged only nine chicks in 2017 and none in 2018. Overall across the Isles of Scilly, kittiwake breeding numbers fell from around 70 pairs in 2010-2015 to only 30 and 35 pairs in 2017 and 2018. It was suggested that rats had an adverse effect on kittiwake breeding success in the Isles of Scilly in 1994 (Walsh et al. 1995). However, changes in kittiwake numbers and breeding success since eradication of rats from St Agnes and Gugh were not considered to be related in any way to absence of rats, but rather to be a response to a shortage of food for kittiwakes in the waters around the Isles of Scilly (Heaney 2018). Isles of Scilly are in the south-west of England, in a different marine ecosystem from the southern North Sea, and therefore the shortage of food inferred by Heaney (2018) in the area off Isles of Scilly does not indicate anything about food availability for kittiwakes in the southern North Sea.

4.4.2 Feasibility

108. Mammal predators were not recorded by JNCC at Flamborough & Filey kittiwake colonies in any year. Based on the national picture described above, and on the apparent absence of mammal predator impacts on kittiwakes at Flamborough & Filey it is unlikely that predator control would significantly increase breeding success of kittiwakes at Flamborough and Filey Coast SPA, because this colony is on large cliffs that give birds good protection from mammalian predators and disturbance.

109. Due to the highly doubtful benefit associated with this compensatory measure, the Applicant would not propose to progress this option.

4.5 Productivity Improvement - Construction of artificial nest sites

4.5.1 Update in response to SoS request for additional information

110. The following sections (from section 4.5.2) of this document are an update to the original version of this report [ExA; IROPI; 11.D10.3 submitted 28th February 2020], incorporating information presented in submissions made to the Norfolk Boreas Examination [Norfolk Boreas examination library reference: REP16-003], which addressed Natural England comments (Norfolk Boreas examination library reference: REP15-009; and also comments provided to Norfolk Boreas Limited by Natural England through their Discretionary Advice Service) and providing further updates on the work the Applicant has undertaken since the close of the Examination. This summarises the detailed and robust evidence base the Applicant has produced in support of the proposal to construct an artificial nest site which would deliver the necessary level of compensation (plus over-compensation to allow for any residual uncertainties in the assessment and the compensation), to offset the collision impacts at the Norfolk Vanguard wind farm. Furthermore, by providing a surplus of nesting space the structure will ensure over-compensation for predicted collision mortality at Norfolk Vanguard will be achieved by a ratio of at least 3:1.

111. The Applicant and Norfolk Boreas Limited have continued to engage with Natural England and the Port of Lowestoft to further develop these proposals (Norfolk Boreas document reference: [REP16-003], included a letter of comfort from the Lowestoft Port Authority confirming their willingness to assist Norfolk Boreas, should this compensation be required, to develop the compensation in the Port of Lowestoft). Since this submission discussions with ABP have been progressed by the Applicant with Norfolk Boreas. As a consequence, some of the original aspects of the proposed compensation have been revised and others (such as offshore structures) are no longer being considered. Therefore, where appropriate the following sections have been updated in the current version (V3) of this compensation submission to reflect the current proposals.

112. With respect to the potential for providing an artificial site on an offshore structure (discussed in ExA; IROPI; 11.D10.3 submitted 28th February 2020), for reasons including feasibility, health and safety and cost, particularly when compared with onshore options, these have not been developed further and the Applicant has no current plans to do so.

4.5.2 Overview

113. Provision of artificial nest sites for kittiwakes has good potential to provide a compensation mechanism. There is strong evidence that kittiwakes in the southern

North Sea are limited by nesting habitat (Coulson 2011). The natural habitat for kittiwakes to nest is sea cliffs with narrow ledges, where the birds can place their nests on the cliff in a way that prevents other seabird species from taking over the nest sites (because other species require broader ledges than kittiwakes), and which makes their nest site relatively safe from predators. There is a lack of suitable cliffs (cliffs of solid rock with narrow ledges) for kittiwakes along much of the south-eastern coast of England. Seabird 2000 (Mitchell et al. 2004) found no kittiwakes breeding in Norfolk or Essex, and only 369 pairs in Suffolk (those birds all nesting on man-made artificial structures, and not in natural habitat). In contrast, the cliffs of Flamborough and Filey Coast in Humberside hold over 40,000 pairs of kittiwakes, the largest colony of the species in the UK (Mitchell et al. 2004). Exceptionally large colonies occur only where there is little or no suitable nesting habitat elsewhere within the foraging range of seabirds from that colony (Furness and Birkhead 1984). This implies that provision of artificial nest sites in south-east England would be likely to attract kittiwakes to nest at sites where competition for resources would be less than at the exceptionally large colony of Flamborough and Filey Coast SPA.

114. Where a kittiwake colony is large there is strong evidence of density-dependent competition; for example, breeding adults have to travel further from the colony to seek food for their chicks (Wakefield et al. 2017). Breeding success, and possibly adult survival, may decrease as a result of density-dependent competition. Creating small new colonies in locations away from high levels of intra-specific competition (i.e. not at Flamborough and Filey Coast SPA, but at sites well away from that large colony) would be likely to increase breeding success of birds in new artificial colonies relative to that achieved in larger colonies, and providing breeding success averaged more than 0.8 chicks per nest these new colonies in artificial nest habitat would contribute to supporting the kittiwake regional population (Coulson 2017). This could boost productivity of the regional population from which the FFC SPA is likely to draw its recruits.

115. Artificial nest sites used by kittiwakes exist in many places where there is a shortage of natural nesting habitat. In southeast England, kittiwakes have nested on the pavilion on the pier at Lowestoft (Brown and Grice 2005). When that pavilion was demolished in 1989-90 the kittiwakes subsequently took to nesting on a specially provided concrete wall, with numbers on the wall increasing to 259 pairs in 1995, more than double the number that had previously nested on the pavilion (Brown and Grice 2005). Kittiwakes have used the outfall structures of Sizewell nuclear power station as another nesting site in Suffolk where there are no natural cliff sites available. Kittiwakes nested in large numbers on several buildings beside the River Tyne over many decades, where they were the subject of detailed research (Coulson 2011). When individual buildings on which these birds nested were demolished,

birds moved to use other buildings. There is a long-established kittiwake colony on the walls of the castle overhanging Dunbar harbour, where kittiwakes nest within a few metres of a busy fishing harbour. Kittiwakes have attempted to nest on a number of operational North Sea oil and gas platforms in UK waters, but have generally been discouraged from doing so on operational platforms for human health and safety reasons. Nevertheless, two pairs bred successfully on a gas platform off the Lancashire coast in 1998 and 1999 (Brown and Grice 2005), and kittiwakes have nested on several platforms in the Norwegian Sea and in the Barents Sea, where they have been tolerated by the oil company and workers. Indeed, at an oil production platform in north Norway where about 200 pairs of kittiwakes are now nesting on the platform, a new research study has just been started by Norwegian ornithologists, equipping breeding kittiwakes with GPS tags to track their foraging trips from this platform in order to compare their breeding success and time budgets at this artificial colony with the performance of kittiwakes at coastal natural colonies; initial results suggest that the breeding success is higher on this platform because there is no predation or disturbance and the birds are close to preferred foraging grounds (Signe Dalsgaard, pers. comm.). Kittiwakes also nest on many coastal artificial structures such as wooden buildings or sheds at harbours in Norway and elsewhere across their range. For example, kittiwakes have nested for many decades on the wooden window ledges of warehouses on the rather flat island of Utsira, which lacks natural cliff habitat (Tveit et al. 2004). In Norway, breeding success of kittiwakes is higher at these 'urban' sites than at natural colonies because those birds are less at risk of predation and disturbance by natural avian predators such as ravens and white-tailed eagles (Signe Dalsgaard, pers. comm.).

116. Breeding success of kittiwakes on artificial structures can be just as high as at more natural sites in the UK too. Research on the kittiwakes nesting on buildings on the River Tyne showed that survival rates of adults and breeding success were higher than for some natural colonies because nest sites on the building were less vulnerable to predation or to disturbance by other species (Coulson 2011).

4.5.3 Delivery mechanism

117. The absence of suitable natural sites for kittiwakes to breed in the southern North Sea clearly limits their breeding numbers in that area. Despite the lack of nesting habitat, there are potentially good food supplies for kittiwakes in the southern North Sea (depending on how the sandeel stock is managed). Dogger Bank has the potential to hold a very large stock of sandeels, the main food of kittiwakes during the breeding season. Provision of artificial nesting structures for kittiwakes in the southern North Sea could allow kittiwakes to breed in places close to this high quality food resource, that is not possible at present because there are few suitable

structures in areas away from human disturbance and mammal predators. Provision of suitable artificial nest sites in this region would not only be highly likely to attract kittiwakes, it would also be highly likely to support higher than normal breeding success where kittiwakes could nest, undisturbed and safe from predators and close to their preferred food supply.

118. The proposed approach would increase production of kittiwake chicks by providing novel nesting opportunities in the southern North Sea. Some of the extra chicks arising from such nest sites may not survive to replace breeding adults that may be lost from the population through collisions with offshore wind turbines, so the increase in numbers of chicks produced would need to take account of the demography of the species, and therefore the chances of surviving through to adulthood. The survival rate of kittiwakes through their first year of life averages 79% while survival in subsequent years averages 85.4% (Horswill and Robinson 2015). Kittiwakes reach breeding age on average at four years of age (Horswill and Robinson 2015). This means that each kittiwake chick fledged has about a 50% chance of reaching the age of recruitment into the breeding population. Collision mortality is likely to affect all age classes of kittiwakes, and not just adults. However, it would be appropriate to aim for compensation that exceeded likely losses due to collision mortality. To achieve that, numbers of kittiwake chicks fledging from new artificial nest sites should be at least double the numbers thought likely to be killed by collisions.

119. A simple wall adjacent to the sea may be adequate, as shown at Lowestoft, in Dunbar and on the River Tyne, so constructing a suitable wall at the coast may be sufficient. There is, for example, a colony of about 700 pairs of kittiwakes on an artificial cliff constructed onshore adjacent to a road accessing the fish processing factory beside the harbour at Vanse in Norway.

120. As noted above, the Applicant does not intend to pursue construction of an offshore structure due to the additional challenges this represents. However it is worth noting that such an approach could provide greater benefits to kittiwakes if it was close to their preferred foraging area. One option that could be considered might be to use existing gas platforms that are due to be decommissioned, or offshore electrical platforms, as it is likely that kittiwakes would take to nesting on these structures if allowed to do so. There may be options to enhance the structure for kittiwakes, for example by providing narrow horizontal ledges, since kittiwakes would not normally choose to nest on large horizontal platforms where large gulls could land and walk up to a kittiwake nest. Large surfaces on platforms are likely to attract roosting herring gulls, lesser black-backed gulls and great black-backed gulls, all of which are predators on kittiwake eggs and chicks, so structures on a gas platform may require

extensive modifications to make them suitable for kittiwakes and unsuitable for large gulls.

121. Compensation in the form of creating new nesting sites for kittiwakes would not be carried out at FFC SPA, as any effort to increase breeding numbers there would increase competition for food around that exceptionally large colony. However, creating new nesting sites (colonies) elsewhere in the southeast of England would benefit the regional population (the vast majority of which breeds at FFC SPA).

122. The Applicant has been in discussion with Natural England and other relevant stakeholders in the process of site selection and has taken into account factors including current understanding on prey distributions, kittiwake foraging activity and the location of existing kittiwake colonies.

123. Since the end of the Examination the Applicant has continued discussions with the Port of Lowestoft with respect to possible locations for a nest structure within the port. The Applicant is currently in discussions with Associated British Ports (ABP) with a view to securing the land on which one or more structures would be located. In addition, other potential locations also remain under consideration and negotiations are continuing to be progressed with landowners in respect of those sites. Given the stage of engagement reached to date with landowners, the Applicant is highly confident that necessary land rights to deliver the compensation proposals can be obtained voluntarily and through agreement.

124. The Applicant will continue to engage with Natural England (and the Local Planning Authority) as necessary on the final location to be taken forward and acknowledges the need to consider the suitability of the location to successfully deliver compensation both currently and in the future (e.g. in light of any future developments in the vicinity of the final location). In addition, consultation would be undertaken with the LPA to ensure that there are no other constraints which would delay the issue of necessary consents or permissions to enable the structures to be constructed.

125. Since the close of the examination the Applicant has also commissioned production of concept designs for scalable and modular structures that could be installed either on an existing structure or as standalone features. Two designs are being progressed, a wall based structure and a tower based structure, both being modular in concept and therefore readily scalable. The designs also incorporate adaptive elements, so should monitoring indicate the need to extend, move or reorient the structures to improve breeding success then the designs specifically allow for this to be undertaken. With two alternative design options the Applicant has ensured there is flexibility in location options.

126. The intention is that a wall-based design could be positioned adjacent to an existing linear structure within a port such as Lowestoft, therefore offering enhanced shelter for the nest sites. The Tower structure is free standing and therefore offers greater flexibility of location. Both concepts have been designed on the basis that:

- Access to the nests will be required from within (or behind) the structure for low disturbance maintenance and monitoring;
- Anti-predation (mammals) measures include:
  - Shelves at least 2m above ground level to prevent access (e.g. by foxes); and
  - A perimeter fence at least 2m high, with overhang and continuation underground.
- Anti-predation measures (avian) include:
  - Narrow ledges to prevent large gulls landing on them; and
  - Inclusion of a large overhanging ledge at the top of the structure (i.e. to prevent large gull access to nests).
- The design of the structures has been informed by the specifications and dimensions of artificial locations which have previously been colonised and will ensure that the optimal designs are used for the following aspects:
  - Depth of ledge;
  - Exposure to the weather (e.g. wind, rain, sun, etc.);
  - Free draining; and
  - Distance between nest areas.
- The structures have been designed to be independent of their foundations therefore allowing the flexibility in location and the opportunity to move the structure if required.

127. The Applicant is in the process of progressing detailed design which, once completed, will allow procurement of the manufacture and installation of the structures to commence. As part of the detailed design phase the Applicant is also progressing the design of:

- Demountable timber ledges to be placed on an existing structure on site; and
- Converted shipping containers to be placed on site.

128. This will allow the Applicant to be adaptive in its management of the artificial colony to further increase its success. Each structure will have a design life of at least 50 years.

129. The Applicant has commissioned a study of kittiwake breeding success at existing artificial colonies at Dunbar, along the River Tyne and at Lowestoft which is currently

underway (2021 breeding season). This survey will enable identification of the most important attributes of nest sites for successful breeding. The results will be shared with Natural England and will be used to finalise the physical design characteristics of the artificial nest structure (e.g. aspect, platform width, etc.). This will ensure that the final designs of the artificial colonies reflect the best scientific evidence with respect to identifying the features of greatest importance in determining successful reproduction.

130. The preliminary designs have been shared with Natural England and their feedback, together with the results of the surveys will be used to refine the final structures.

131. As a result of the ongoing development work being undertaken by the Applicant, should compensation be required, it is anticipated that one or more structures could be installed by February 2022, allowing birds to begin using them from the 2022 breeding season. On the basis of the project's current estimated development timeline, this will permit three breeding seasons for the colonies to produce chicks before offshore construction starts, with the first cohort reaching breeding age (4 years), in the same year the wind farm becomes operational. There will therefore be no lag between the occurrence of the predicted collision mortality of FFC SPA birds at the wind farm and the availability of adult birds produced by the artificial colonies to recruit to the SPA thereby compensating for these losses from the population. It is also worth noting that, although the intention is to meet the timetable outlined above, since the measures have been designed to over-compensate for the project's impacts, should there be a short delay (e.g. one to two years) due to unforeseen factors, it is anticipated that any shortfall will be quickly made up within a small number of breeding seasons.

132. The time taken to 'pay back' a mortality debt depends on several factors which are difficult to predict (e.g. rate of colony growth, and starting size), however under even very modest assumptions of how many birds would initially colonise the structures (e.g. 50 pairs in year 1) and how quickly this number would increase (e.g. by 20% per year) and a low excess productivity rate (0.6 chicks per pair available to recruit to FFC SPA), it can be seen that the colonies' cumulative production of adults (i.e. allowing for a four year lag between chick production and reaching maturity) overtakes the project's cumulative mortality (i.e. the sum of mortality at Norfolk Vanguard over time) within 12 to 13 years (Figure 1).

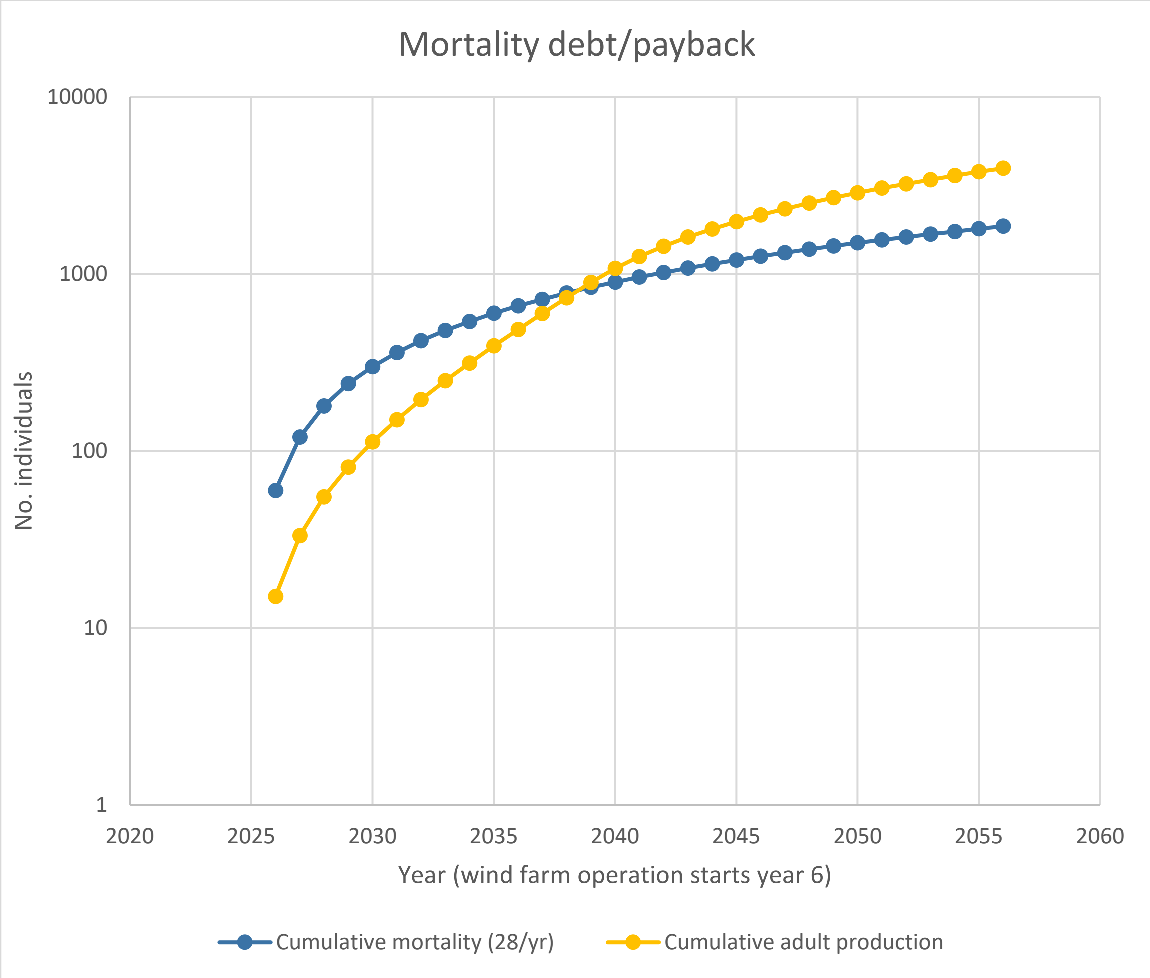

Figure 1. Plot of accumulated kittiwake mortality at rate of 60 birds/year (blue line) and cumulative production of 4+ year old adults from the new colony (orange line), under assumption of initial colony of 50 pairs, colony growth of 20%/year and excess productivity of 0.6 birds per pair. Point at which lines cross the compensation exceeds mortality.

133. Table 1 of Appendix 1 shows modelled outputs of the time taken to repay 'mortality debt at differing rates of colony growth and productivity. It can be seen that if the starting population is kept at 50 pairs (as in Figure 1) but excess productivity is increased to 0.8, the payback duration is reduced to 11 years. Alternatively, if the number of initial pairs is increased to 100 but the excess productivity kept at 0.6 then the time to pay back the mortality debt reduces to seven years, and if the starting number of pairs is 100 with an excess productivity of 0.8 then the time to payback is reduced to five years. Thus the size of starting colony appears to have the greatest effect on the time taken for compensation to exceed mortality. Given these predictions there is little to indicate that the compensation needs to be fully operational four years prior to wind farm operation, since even under precautionary assumptions about rates of colony growth and productivity, the proposed compensation would quickly achieve its aims. If the colonies perform at a similar

level as recorded at other locations (e.g. see section 4.5.5) then it is very likely there will be a delay of no more than one to two years between mortality at the wind farm and the availability of adult recruits for the SPA, and this remains the case even if installation of the structure should be delayed, such that the current four year lead in time is reduced (although it should be noted that the Applicant is pursuing a timetable which will meet the four year lead in time).

134. Associated British Ports have recently announced plans for port improvements in the Lowestoft Outer Harbour as part of the Lowestoft Eastern Energy Facility (LEEF). Subject to the final locations chosen for nesting structures, if deemed appropriate or necessary to avoid any potential disturbance to birds colonising or already established on the structures, appropriate mitigation for the variable magnitudes of potential disturbance would be implemented. This could for example, take the form of a 50m construction buffer (to be monitored and potentially refined as necessary), implemented during the breeding season (defined as March to July, inclusive) at any locations where structures are sited near to construction activities associated with the LEEF development. Other means to minimise visual and noise disturbance will also be considered, such as acoustic screening, sheeting, etc. Given the availability of measures to mitigate impacts from construction of the LEEF development, this is not considered to be a barrier to early implementation of the nesting structures which could be delivered as compensation at the Port of Lowestoft.

135. Kittiwake have nested in and around the port for several decades, including in close proximity to areas of significant activity. For example, the existing kittiwake wall near the main entrance to the port, is located 50m away from an area that was used for the construction of large offshore structures (e.g. rigs). This site was regularly used for breeding by over 100 pairs during the period when such construction was ongoing, and with no apparent evidence the birds were disturbed. Kittiwakes also breed at other locations in and around the port, indeed the main area of nesting is currently within the busy commercial port in the Waveney Dock. Other nesting occurs in close proximity to anthropogenic activity, including on house window ledges on the main A47 road which runs behind the port. Therefore, it seems apparent that this species is not sensitive to such disturbance and port redevelopment work is very unlikely to result in reduced uptake of the proposed breeding structures, nor reduced breeding success.

136. There are piling activities currently underway within and around the Port of Lowestoft as part of the Lowestoft Flood Risk Management Project (LFRMP). These are taking place as close as 70m from existing nests located within the harbour. Surveys of the breeding birds in Lowestoft conducted during the current (2021) breeding season have observed no apparent changes in abundance or differences in

nesting success of birds close to the piling works compared with nests located further away.

137. Kittiwakes are often found nesting close to areas with high levels of visual and noise disturbance, such as on the Newcastle Tyne Bridge structure, Claremont Pier at Lowestoft, on top of a range of public buildings (hotels, churches etc.) and near to busy roads. Other nesting in Lowestoft regularly occurs in close proximity to anthropogenic activity. They are, therefore, considered to have a high tolerance and low sensitivity to visual and noise stimuli. Overall, based on this evidence, it is considered unlikely that the piling activities associated with the LEEF Project will result in a significant adverse effect on nesting Kittiwakes.

138. The Applicant is aware that other developers may also be interested in the potential for locating structures suitable for kittiwake breeding, or enhancing any existing structures designed for that purpose, in the Lowestoft Port. This includes possible replacement for the Sizewell Rigs County Wildlife Site (CWS) 30km to the south which are due to be removed as part of the decommissioning of the Sizewell A power plant. However, the Applicant does not consider this to be a source of conflict or competition with respect to its proposed compensation, since considerations of the port infrastructure and discussions with the Port Authority have revealed there are several possible locations in Lowestoft Port where new artificial colony structures could be constructed. Furthermore, the existing Lowestoft Port kittiwake wall (itself a CWS) has fallen into disuse by breeding kittiwakes due to the limited protection it provides to predation. With modest changes this could be reinstated and would provide, for example, a suitable location for a nesting structure in addition to the other possible sites within the location of the port. While this would be beneficial for kittiwakes in the region generally, this would not be regarded as additional provision within the Applicant's compensation proposals.

139. The Applicant has been in discussion with ScottishPower Renewables in relation to providing combined compensation with that which may be requested for their proposed East Anglia ONE North and East Anglia TWO wind farms. The two developers have agreed to work collaboratively to ensure that any kittiwake nesting structures provided will be large enough to accommodate sufficient pairs to deliver over-compensation for the predicted mortality for all of these wind farms. This collaborative approach applies irrespective of whether compensation is required for Norfolk Vanguard, Norfolk Boreas or both projects.

4.5.4 Spatial Scale

140. Using Natural England's preferred collision estimation methods, the average annual mortality of breeding adults from the FFC SPA would be 21, however Natural

England has also advised allowance should be made for uncertainties in the collision modelling parameters by allowing for annual collisions at the upper 95% confidence interval figure of 60. It should be noted that uncertainty does not automatically mean impacts could be higher. Lower collision figures are equally plausible, and this includes the evidence based estimate of 5 individuals which the Applicant considers to be more appropriate. Nevertheless, the following calculations have used the upper collision estimate and incorporate additional compensation (over-compensation) in acknowledgement of Natural England's advice. Thus, over-compensating for the upper 95% confidence interval collision figure (60) results in an even greater degree of over-compensation for the mean (21; i.e. nearly three times as much) and more again in relation to the Applicant's evidence-based estimate of 5 (i.e. 12 times as much).

141. The Applicant had previously proposed to build a structure capable of supporting up to 200 pairs which was considered capable of over-compensating for the predicted Norfolk Vanguard collision mortality (ExA; IROPI; 11.D10.3), which equated to an over-compensation ratio of approximately 1:1.7 compared to the upper 95% mortality. Since then Natural England guidance is that the target for over-compensation should be a ratio of 3:1. Therefore the calculated number of pairs required to achieve 2:1 and 3:1 are presented in Table 4.2.

Table 4.2 Calculation of the number of nests required to compensate for collisions at Norfolk Vanguard. Note that the number of nests have been rounded up slightly.

Step	Aspect	Applicant's evidence based mean estimate	Natural England's precautionary mean estimate	Natural England's precautionary upper 95% c.i. estimate
1	Estimated productivity at artificial site		1.2	
2	Productivity at Flamborough and Filey Coast SPA		0.6	
3	Available recruits - surplus (step 1 minus step 2)		0.6	
4	Predicted adult mortality at Norfolk Boreas	5	21	60
5	Survival to maturity		0.49	
6	No. chicks required to produce required no. of adults (step 4/step 5)	10	43	122
7	No. nests required to obtain surplus production adults (step 6/step 3)	17	71	204
8	No. nests required at 2:1 compensation ratio (step 7 x 2)	34	142	408
9	No. nests required at 3:1 compensation ratio (step 7 x 3)	51	213	612

142. As noted above, achieving 3:1 for 60 collisions ensures a ratio of 9:1 for a mean of 21 collisions and 36:1 for 5 collisions. Therefore, the 3:1 ratio should be considered as the smallest degree of over-compensation that this provision would achieve.

143. These calculations explicitly allow for the proportion of birds expected to recruit to the colony they hatch in and the proportion (c. 0.6) which are available to recruit elsewhere (i.e. FFC SPA) and the rate of survival from fledging to breeding age (c. 49%).

144. Furthermore, the collision assessment incorporates several sources of precaution which further indicate that provision for 600 nests will offer a very large degree of over-compensation. For example, as discussed above, the precautionary mean collision estimate of kittiwake from the Flamborough and Filey Coast SPA at Norfolk Vanguard is 21 (ExA; Mit; 11.D10.2). The estimate of 21 is derived with the following precautionary collision modelling parameters:

- An avoidance rate of 98.9%, while evidence indicates that 99% is more appropriate (using the lower avoidance rate inflates the collision estimate by 10%);
- A nocturnal activity rate of 50%, while evidence indicates this is more than double the realistic levels for this species (using the higher nocturnal activity rate inflates the estimate by around 14%);
- A flight speed of 13.1m/s, while evidence indicates a value of around 10m/s is more appropriate (using the higher speed inflates the estimate by around 15%); and,
- Assumption that 86% of the birds on Norfolk Vanguard between March and August originate from the SPA, while the Applicant's evidence-based estimate is 26% between April and August (using the higher rate inflates the estimate by 55%).

145. These aspects taken together mean that the average value of 21 collisions apportioned to the FFC SPA (and upper 95% confidence interval of 60) would be reduced to 6 and the upper confidence interval to 18. On this basis, 3:1 compensation for mortality of 60 individuals represents 10:1 for the equivalent upper estimate of 18 collisions, and 18:1 for the mean of 4 collisions. It is clear therefore, that the compensation proposals include a very considerable degree of over-compensation which would be *at least* 3:1 and almost certainly an order of magnitude higher. The SoS can have high confidence that, if this compensation is required, there are both proven means to achieve this and that the predicted mortality due to Norfolk Vanguard could be readily compensated.

146. A colony of 300 pairs of kittiwakes would easily fit onto a structure such as a wall of 30m length and 12m height, or onto panels attached to a steel lattice structure (e.g. all sides totalling 30m in length, because kittiwakes could nest on each side of such a structure). Therefore, two such structures would provide the required level of nesting capacity assumed under the most precautionary 3:1 ratio. On natural sites, kittiwakes prefer to nest on the lower parts of cliffs, relatively close to the water, rather than high up. However, they avoid areas where waves or sea spray may hit their nests so it would be necessary for the nesting areas to be mounted sufficiently high on the structures to be out of the range of sea spray.

147. Depending on the locations of the artificial sites and their proximity to wind farms, there may be a risk that birds in the new colonies are at risk of collisions themselves, thereby potentially reducing the number of birds available to recruit to the FFC SPA. This may reduce the number of adults at the colonies, although given the much lower kittiwake population density in Norfolk and Suffolk and hence lower competition for prey, it is likely that breeding birds here forage much closer to their nests and are thus at low risk of encountering wind farms. In addition, prior to recruiting to a colony as breeding age birds, sub-adult kittiwakes disperse widely within the North Atlantic and typically only return to regions near breeding colonies in their third summer (Coulson 2011), therefore the risks to young birds are also small.

148. Although an artificial colony close to an important feeding area, such as Dogger Bank, and sited on an offshore structure would potentially represent an optimal solution, this approach has not been pursued by the Applicant due to the potential logistical and safety challenges of installing and maintaining such a structure and undertaking the monitoring to determine the success achieved. Therefore, construction of two or more wall structures (or similar), sited in appropriate coastal locations, such as Lowestoft Port, is the Applicant’s preferred option (although other additional locations are also under consideration).

4.5.5 Timescale

149. Kittiwakes have been quick to use artificial structures when made available (for example in the Tyne they were encouraged to move from a building where they nested that was to be demolished and were given a new structure to move to), but if a site is created in an area away from existing colonies, the colonisation of the structure could be facilitated by placing some model kittiwakes on model nests and using playback of the sounds from an established kittiwake colony to attract potential recruits to the new site. Speed of colonisation of new sites may vary according to the status of the kittiwake population; novel sites are adopted faster where a population is growing rather than declining. However, experience from

previous projects establishing artificial nest sites for kittiwakes has been that these have generally been occupied within the first three or four years after being made available. For example, a new oil platform recently set up in north Norway was colonised within four years by breeding kittiwakes, despite the fact that numbers breeding in natural sites in that region were declining (Signe Dalsgaard, pers. comm.).

150. Nonetheless, some structures provided for kittiwake to nest on have not been successful (see Ørsted 2020 for examples). These have primarily been situations where a purpose-built structure has been provided with the intention of attracting birds away from their current nest sites (e.g. on buildings) due to concerns about noise and health and safety (e.g. build-up of guano). Kittiwakes are known to have high site fidelity (i.e. they favour returning to the same sites each year), so the lower success rate seen in these efforts, where their existing nest sites are still accessible, is not surprising. However, these examples are not considered to be directly applicable to the Applicant's proposals, since the aim of these is to provide additional nesting capacity, not to attract birds which already have established nest sites. Thus, the new colonies will be expected to grow initially by attracting young birds settling at a breeding site for the first time. Given the number of locations around the port area used by the birds it is considered highly likely that such recruits are present and these birds will quickly initiate colonisation of the structures. These examples also highlight the importance of understanding the aspects which make a structure attractive to kittiwakes. The survey of artificial sites being conducted by the Applicant in the 2021 breeding season is collecting these data, which will be used to finalise the designs to ensure that the levels of occupancy and productivity are maximised.

151. The most appropriate data with which to estimate colonisation rate would be for structures built specifically for kittiwakes, which limits the sample size. The wall at Lowestoft Port was colonized in the year it was constructed (but was subsequently abandoned apparently due to increasing predator impact there, although this was relatively recently), as was the alternative structure when the North Shields warehouse was demolished. Similarly the Gateshead tower was colonised as soon as the Baltic Flour Mill was netted off to prevent kittiwakes from nesting (and is still in use even though the netting has been removed from Baltic Flour Mill and over 190 pairs of kittiwakes have recolonized the mill as soon as that became available again).

152. Turner (2010) reported that the number of pairs on the kittiwake tower constructed at Gateshead grew from 18 pairs in 1998 to 131 in 2000, an increase by a factor of 2.7 per year. The numbers using the north tower of the Tyne Bride grew at a similar rate, from 2 pairs in 1997 to 134 in 2001 (a factor of 2.9 per year). Thus it seems

reasonable to assume that suitable structures will achieve high levels of usage within a very few years.

153. According to Coulson (2011) the first record of kittiwakes nesting on an artificial structure was in 1931 when a few pairs nested on Granton pier (Edinburgh) for two years (they then abandoned). Then in 1934 a colony was formed on a warehouse at Dunbar. That warehouse was demolished in the 1960s and those birds immediately colonized the castle walls at Dunbar harbour. The North Shields warehouse was colonized in 1949 and then progressively spread to other sites along the Tyne. Coulson (2011) says that the colonies on the Customs Shed at Newcastle and the Coop flour silos were demolished a few years after kittiwakes started to nest on those. Birds moved immediately onto the Baltic Flour Mill. When the Baltic Flour Mill (during winter) was netted off some birds nested the following spring on the new Gateshead tower, but some missed one season and colonized the tower a year later. The majority moved to other structures rather than the purpose-built tower. Some colonized the Akzo Nobel warehouse which now has over 200 pairs on it (but had none previously).

154. At Hartlepool, kittiwakes colonized a warehouse in 1960, and when that was demolished moved onto a nearby wooden pier.

155. Based on the available evidence it is apparent that birds move almost immediately from sites that are demolished to alternative sites nearby. While this is not quite the same as colonizing a novel site where no existing site is being demolished, it does provide some evidence that kittiwakes can be quick to respond to new nesting opportunities.

4.5.6 Proposed routine maintenance and species population monitoring during the project lifetime and funding mechanisms for delivery

4.5.6.1 Maintenance

156. It is not anticipated that the nesting structures will require much routine maintenance, however they will be inspected on a regular basis. This is expected to take the form of a scheduled inspection once per year, conducted during the nonbreeding season, both to reduce disturbance and also to permit closer access to the structure. These will pay particular attention to the integrity of the structure and the nesting shelves. The structures will also be checked less formally during the monitoring of the performance of the birds breeding at the colonies which will be conducted during each breeding season. Any requirement for repair work which is identified by these inspections will be undertaken in a timely manner, and in a manner which minimises undue disturbance to the birds. Thus, all work will be

undertaken outside the breeding season unless there is a clear requirement for more urgent intervention.

157. In all cases of maintenance, but particularly if there is a need to work on the structures during the breeding season, this will be discussed with Natural England in advance in order to agree the most appropriate approach to minimise disturbance.

158. Inspection of any anti-predator aspects of the structures (e.g. fencing and overhanging ledges) will also be conducted as part of the inspections and maintenance, and repairs undertaken to ensure they continue to perform as intended.

4.5.6.2 Monitoring

159. It will be crucial to undertake monitoring of the artificial nest sites during the lifetime of the wind farm in order to determine if the compensation measure is working as intended. As a minimum this will include, on an annual basis, counts of the number of birds in attendance (i.e. breeding adults and any nonbreeding birds, such as immatures, also present), the number of apparently occupied nests (AON, the standard measure of kittiwake breeding colony size), the reproductive success (depending on access and visibility this may include estimates of the number of eggs and chicks in visible nests and subsequently the number of juveniles which fledge). The structural designs include allowance for access to nests from behind for research and monitoring purposes (i.e. through pre-installed doors or hatches). This will permit closer monitoring of chicks (e.g. weighing) and also to allow leg rings to be fitted. As well as standard metal rings, these can include colour-rings which could permit subsequent identification of individuals or the colony of origin without the need for recapture (i.e. unlike metal rings which cannot be read accurately from distance). After a period of a few years resighting of ringed birds can also be used to estimate survival rates, which will provide further information on the status and success of the colony. Although observing birds closely at FFC SPA is difficult, the presence of colour ringed birds from Lowestoft will provide direct evidence that the compensation is delivering. Therefore the Applicant will also support ring re-sighting efforts at FFC SPA.

160. It will also be appropriate to monitor the status of the existing kittiwake breeding locations in Lowestoft (i.e. on buildings in the town and around the port). This will allow comparison between the size and reproductive success at these sites with that at the new colony and in later years, determine if colour-ringed birds fledged from the new site recruit to these other local colonies. Similar monitoring, including ringing, has been undertaken in Lowestoft for several years by local interest groups, so it will be sensible to build on this and ensure future monitoring complements this

work and also avoids the risk that the additional work conflicts with that of the local workers. Anticipated costs for the annual monitoring of the new colonies would be minimal, based on a few days per year of observations to estimate colony size and breeding success, analysis and reporting (section 4.5.6.3).

161. Proposed monitoring will be discussed and agreed with Natural England and the results will be shared on an at least annual basis. Through this forum, any adaption of the structures to improve performance will also be discussed and agreed (i.e. adaptive management). If feasible (e.g. dependent on access to the structure and the visibility of the birds on the nests) diet analysis of the prey items fed to chicks will also be considered.

162. Monitoring at FFC SPA, similar to that already performed by the RSPB, would also be undertaken by the Applicant in order to consider if the new sites had caused a redistribution of the population rather than an expansion. However, it should be noted that given the size of the SPA colony (c. 50,000 pairs), it is unlikely that variations at the scale of 600 pairs (the proposed total population of the new colonies) would be detectable.

163. If monitoring establishes there is a need to undertake additional measures to achieve compensation, options for modifying the existing measures have been exhausted and fishery management measures (section 4.3) have been progressed to the stage that this has become a feasible option for wind farm developers, the Applicant is willing to engage in discussions for how this could be achieved.

4.5.6.3 Funding

164. As described above the proposed FFC SPA compensation will involve the installation and maintenance of artificial nesting structures for kittiwake. Estimated costs for each phase of the compensation are provided in Table 4.3.

Table 4.3 Indicative costs for proposed FFC SPA compensation.

Compensation Option	Cost Estimate subcategories	Norfolk Boreas cost estimate
Artificial nesting structures	Development Expenditure	£60,000
	Capital Expenditure	£130,500
	Operational Expenditure	£1,575,000
	Decommissioning Expenditure	£150,000
Total estimated cost		**£1,915,500**

165. Having regard to the estimated costs for delivery of the compensation measures set out above (as well as other compensation measures which may be required for the FFC SPA, and those measures which may be required for compensation in relation to the Alde-Ore Estuary Special Protection Area and the Haisborough, Hammond and

Winterton Special Area of Conservation), the Applicant considers that delivery of the measures, in line with the timescales proposed in the implementation programme, is financially feasible. Therefore, in the event that it is necessary to deliver these (and/or other) compensation measures, the Applicant is confident that the commercial viability of the project would not be prejudiced.

166. The Applicant provided a Funding Statement [APP-009] with the Application, which explains that the Applicant will have the ability to procure the financial resources necessary to fund the works to be authorised by the Order, subject to final Board authority. The Applicant's parent company (Vattenfall Wind Power Ltd), which is part of the wider Vattenfall Group (Europe's fifth largest generator of electricity and the largest generator of heat), have the experience and reputation to enable funds to be procured and this applies equally in respect of the funds to deliver the compensation measures. The Applicant will secure funding for the project after certainty is obtained on development consent, the tender process is complete for the major construction contracts, and the investment case has been satisfied. Once these criteria are met the Applicant will take a final investment decision (FID) which will irrevocably commit funding for the project. Should funding for any compensation measures be required as part of the project then these costs will be factored into any FID.

167. In summary, the Applicant, its parent company (Vattenfall Wind Power Ltd), and the wider Vattenfall Group have substantial net assets (as outlined in the accounts shown at Annex 1 and Annex 2 of the Funding Statement, [APP-009]) as well as a positive track record in the field of renewable energy development. The Applicant and the parent company are therefore able to provide the required funding for the project, which would include funding to guarantee the success of any compensation measures required.

4.5.7 Feasibility

168. The Applicant considers that provision of artificial nest sites to enhance kittiwake productivity is a feasible measure. The Applicant has continued to progress the deliverability of these measures since Examination, and further details on the anticipated timetable for implementation of the measures (if required) are provided in section 4.6. The cost of this measure (if required) is capable of being funded by the Applicant, as explained above.

4.6 Proposed Approach to Delivery of Compensation (if required)

169. If compensation is deemed to be required following the Appropriate Assessment, the Applicant proposes that provision of artificial nest sites would be the most

appropriate measure to deliver compensation prior to the construction of Norfolk Vanguard.

4.6.1 Stakeholder engagement

170. During the course of the Norfolk Vanguard and Norfolk Boreas examinations the Applicant held several meetings with Natural England to discuss compensation measures. In response to Natural England's advice and comments the Applicant has provided additional information which has considerably bolstered the evidential basis underpinning the proposals. Since the close of the examination the Applicant has continued to develop the artificial colony proposals and to engage with Natural England, both to keep them informed of progress and to provide an opportunity for their input. The Applicant intends to continue to engage with Natural England throughout the remainder of this process, and will offer to extend this engagement to other relevant organisations such as the Royal Society for the Protection of Birds (RSPB) and the relevant Local Planning Authorities (LPAs), within whose administrative area the compensation measures would be located. During these consultations Natural England has already provided constructive feedback on the preliminary designs for the proposed structures which have been incorporated into design revisions, and further comments on these will be sought as the plans are refined.

4.6.2 Implementation timetable

171. If required by the SoS following the Appropriate Assessment, the Applicant proposes the following measures would be undertaken (see also Table 4.4 GANTT chart of the timeline for implementing kittiwake compensation using artificial breeding structures.):

- Concept designs for two possible structure options to be completed by end of June 2021;
- Study of breeding success to be completed by August 2021;
- Screening and early consultation with the Local Planning Authority;
- Detailed designs for the two structure options to be completed once breeding success survey has been completed;
- Results of survey and detailed designs to be shared with stakeholders in August 2021;
- Detailed designs updated following stakeholder input;
- Identification of precise locations to site structures and engagement on location suitability both currently and in the future;
- Planning Application submitted end of October 2021;
- Procurement of structures to be completed end of November 2021;

- Planning approved mid-January 2022;
- Manufacturing of structures complete by the end of January 2022;
- Installation complete by the middle of February 2022;
- Ready for colonisation by the end of February 2022;
- Monitoring success of the colonies and any adaptive management as required throughout the lifetime of the project;
- Start of offshore construction of Norfolk Vanguard April 2025;
- First cohort from the colonies reaches breeding age and is available to recruit to the breeding population (e.g. to FFC SPA) in spring 2026; and,
- First generation Q2 2026.

172. The Applicant is already progressing the above steps in case, and without prejudice to, the SoS's decision on whether this compensation is required for the Norfolk Vanguard wind farm, since, as can be seen, there will be a need for the structures to be installed and available for colonisation in the 2022 breeding season. Thus delays in initiating this process would prevent this being achieved.

Table 4.4 GANTT chart of the timeline for implementing kittiwake compensation using artificial breeding structures.

	2021							2022		2022 to 2024			2025				2026			
Stage	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Concept designs for two possible structures																				
Study of breeding success																				
Detailed designs for the two structures																				
Identification of precise locations and stakeholder engagement on locations																				
Screening and early consultation with local Planning Authorities																				
Results of survey and detailed designs to be shared with stakeholders																				
Detailed designs updated following stakeholder input and final designs complete																				
Planning Applications submitted																				
Planning determination period																				
Procurement of structures complete																				
Manufacturing of structures																				
Construction and snagging																				
First cohort of chicks reach breeding age																				
Monitoring of colony success, adaptive management and maintenance																				
Start of Norfolk Vanguard offshore construction																				
Start of first generation at Norfolk Vanguard																				

4.6.2.1 DCO Condition

173. The Applicant has provided (in a document titled Extract of Schedule 17 to the draft DCO Compensation to protect the coherence of the Natura 2000 Network) proposed wording for a condition which could be inserted into the Norfolk Vanguard DCO should the SoS decide that compensation is required. Natural England and the MMO have been consulted on the proposed wording and are in agreement with much of the principle of the wording, however agreement has not been reached on the timing of delivery of the compensation measures and on the inclusion of strict timeframes for consultation of the compensation strategy, which the Applicant does not consider necessary to include on the face of the DCO given the ongoing and iterative engagement.

4.6.3 Proposed content of kittiwake compensation plan

174. Following advice from Natural England the kittiwake compensation plan will provide the following:

- What, where, when: clear and detailed statements regarding the locations and designs of the proposal.
- Why and how: ecological evidence to demonstrate compensation for the impacted site feature is deliverable in the proposed locations.
- Demonstration that deliverability is secured.
- Demonstration of the policy/legislative mechanism for delivering the compensation (where relevant).
- Set out clear aims and objectives of the compensation.
- Include proposals for adaptive management.
- Governance proposals for the post-consent phase (where relevant).
- Timescales for implementation including how these timescales relate to the ecological impacts from the development.
- Commitments to monitoring specified success criteria.
- Proposals for reporting on monitoring.
- Proposals for management of the compensation area to support the continued success of the compensation measures (where relevant).

4.7 Summary

175. Table 4.5 provides a summary of the compensatory measures that have been reviewed by the Applicant following consultation with Natural England and the MMO.

176. While there is a range of potential measures to compensate collision risk to kittiwake at the FFC SPA, the Applicant considers that construction of artificial nest sites is the most deliverable within the timescales required for Norfolk Vanguard.

177. It is noted that compensation would only be required should the Secretary of State conclude that an AEoI on the kittiwake feature of the FFC SPA cannot be ruled out and there is agreement on the Assessment of Alternative Solutions and IROPI case presented in the Applicant’s Habitats Regulations Derogation Provision of Evidence (ExA; IROPI; 11.D10.3).

178. However, it is the Applicant's firm conclusion that there is no AEoI for FFC SPA as a result of the project alone and in-combination with other plans and projects.

Table 4.5 Summary of In Principle Compensation Measures

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
Prey enhancement	Partial or complete closure of sandeel fishery in the North Sea would improve fish stocks and evidence strongly indicates this would have a very large beneficial effect on FFC SPA kittiwake productivity (and also for other species which feed on sandeel).	✓ Define a closed area	✓ For practical reasons this would need to be an area much in excess of that required to compensate for the loss of 21 kittiwakes attributed to Norfolk Vanguard. For example, reducing fishery mortality by 50% (approximately equivalent to closing half the current area) has been estimated to provide 67 times as much improvement in productivity as required to compensate for Norfolk Vanguard. On this basis the Applicant considers this option is more suitable as a long-term strategic measure covering the potential impacts for multiple wind farms.	✓ Long-term, likely requiring >5 years for effects to become apparent at the colony.	? Currently no authority has the jurisdiction to deliver fisheries management areas for the purposes of compensation. The feasibility of this measure therefore requires government intervention.	x Due to the uncertainty in deliverability of this compensatory measure in the timescales required for the project, the Applicant would not propose to progress this option.
		✓ Purchase part of the existing fishery quota.	✓ Small scale required to compensate for loss of 21 kittiwakes due to Norfolk Vanguard (it is estimated that to increase the number of fledged chicks to	✓ Potentially could be put in place prior to wind farm operation. Increased prey stock would	? This is only feasible if a current owner of part of the sandeel quota was willing to sell. This is highly uncertain.	x Due to the uncertainty in deliverability and acceptability of this compensatory measure the

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
			compensate this level of mortality the amount of additional sandeel prey required is equivalent to less than 0.00007% of the current fishery landings).	potentially be available within 2-3 years.		Applicant would not propose to progress this option.
Predator control	Kittiwakes are not generally considered to be subject to high levels of mammalian predation so benefits of mammal predator control are likely to be negligible. While a small amount of predation by large gulls and skuas is known to occur, these species are also protected so control would not be appropriate.	x Not considered feasible or beneficial.	x Not considered feasible or beneficial.	x Not considered feasible or beneficial.	x Not considered feasible or beneficial.	x Due to the highly doubtful benefit associated with this compensatory measure, the Applicant would not propose to progress this option.
Productivity Improvement - Construction of artificial nest sites	Kittiwakes readily make use of artificial breeding sites. A small area of wall, measuring 30m by 12m (or equivalent) would provide ledges of sufficient length to accommodate 300 pairs. Two colonies of this size could produce around nine times as many adult recruits as the 21 mortalities to be lost at Norfolk Vanguard.	✓ Two walls constructed in coastal locations, such as Port of Lowestoft. Either standalone structures, attached to existing structures or purpose-built towers (e.g. with panels on 3 sides) are under consideration.	✓ The structures would need to be no more than 30m long and 12m high (or equivalent). Two of these would support a population of 600 pairs.	✓ Colonisation would be expected to occur naturally within a period of months if the structure is located near existing kittiwake nest sites.	✓ Construction of artificial nest sites can be achieved 4 years prior to wind farm operation and therefore is deliverable within the timescales required for Norfolk Vanguard.	✓

5 COMPENSATION - GUILLEMOT

5.1 Guidance

179. If the conclusion of the Competent Authority is that, following conclusion of the Appropriate Assessment, an AEoI on a Natura 2000 site(s) cannot be ruled out, that there are no alternative solutions and that there are IROPI, then Article 6(4) of the Habitats and Birds Directives "*requires that all necessary compensatory measures are taken to ensure the overall coherence of the network of European sites as a whole is protected.*"

180. Defra (2012) and EC (2012 and 2018) explain that for SPAs, the overall coherence of the Natura 2000 Network can be maintained by:

- compensation that fulfils the same purposes that motivated the site's designation;
- compensation that fulfils the same function along the same migration path; and,
- the compensation site(s) are accessible with certainty by the birds usually occurring on the site affected by the project.

181. The guidance provides an element of flexibility, recognising that compensation of a 'like for like' habitat and/or in the same designated site may not be practicable.

182. Compensation should not be used to address issues that are causing designated habitats or species to be in an unfavourable condition. This is the responsibility of the UK Government.

183. Ideally, compensation should be functioning before the effect takes place, although it is recognised that this may not always be possible, as stated in the EC (2012) guidance: "*in principle, the result of implementing compensation has normally to be operational at the time when the damage is effective on the site concerned. Under certain circumstances where this cannot be fully fulfilled, overcompensation would be required for the interim losses*."

184. During the Examination there was no request from Natural England to provide in-principle compensation proposals for guillemot from the FFC SPA to offset the predicted displacement from the project. The Applicant considers this to be a reflection of the low project alone impact (which Natural England agreed would not give rise to an AEoI alone, and was only unable to rule this out in-combination due to uncertainty in the appropriate figures to use for the Hornsea Project Three wind farm; final statement of common ground, [REP9-046]).

185. Natural England, in their submission to the East Anglia ONE North and East Anglia TWO examinations at deadline 12[1], concluded that displacement of guillemot from the FFC SPA would not give rise to in-combination AEoI for all wind farms considered (which of the recent applications included Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North, East Anglia TWO and Hornsea Project Three. As Hornsea Project Four was only submitted on 19 September 2021 with the assessment documents published on 8 October 2021, and there is currently only preliminary assessment information available for Dudgeon Extension and Sheringham Extension, Natural England have not been able to conclude that these projects will not give rise to an in-combination impact due to the uncertainty regarding their figures. Therefore, since both the Applicant and Natural England agree there is currently no risk of AEoI for guillemot from the FFC SPA, it follows that there is no requirement for compensation of the project impacts. Nonetheless, since the SoS has specifically requested presentation of in-principle compensation for these species these have been provided in this document.

186. In a submission to the Norfolk Vanguard Examination, Natural England has also stated that the mortality rate for displaced birds would be unlikely to be at the top of the range advised (of 1-10%; [REP9-057]).

187. To further clarify what mortality rate Natural England appear to have applied in this assessment, the Applicant has reviewed Natural England's submission on this matter ([REP9-057]). To avoid any risk that Natural England's position is misrepresented the complete section of relevant text is provided below:

However, 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 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. We do not expect the mortality to exceed a level where the population growth rate would decline by more than approximately 0.4% per annum.

188. From the PVA outputs which accompanied this statement (Table 4 of Norfolk Vanguard [REP9-057]) it can be seen that population growth rate declines below 0.4% were obtained for combinations of displacement and mortality rates

(respectively) of up to 70% and 2% or 30% and 5% (both with and without Hornsea Project Three included, note that Hornsea Project Four had not reached PEIR stage).

189. Thus, Natural England considered the percentage at risk of displacement could be as high as 70%, with a consequent mortality for these displaced birds of 2%. Applying 70% displaced and 2% mortality, the in-combination totals at risk of displacement mortality are reduced from the worst case prediction discussed in section 3.2.2 by 80%, from 3,056 to 611 (note this has been estimated with the inclusion of Hornsea Project Four and Dudgeon and Sheringham Extensions). It should also be noted that Natural England has stressed to the Applicant that these estimates should not be applied to future projects.

190. A review of evidence on displacement of guillemots (MacArthur Green 2019) found that a precautionary rate of displacement for this species was 50% and that consequent mortality of 1% would also be precautionary. This would give an in-combination maximum mortality of 218 individuals from the FFC SPA.

191. Therefore, the Applicant considers that applying either the evidence based rates (50% and 1%) or the methods applied by Natural England (Norfolk Boreas examination library reference [REP4-040]; (60-70% and 1-2%), the magnitude of potential in-combination impact is very small (between 218 and 611) and therefore the risk of an in-combination AEoI for guillemot can be ruled out. It therefore follows that there is no requirement for compensation.

192. Counts of the SPA undertaken in 2017 recorded 90,861 individuals (following standard adjustment this is equivalent to 60,877 pairs), an overall increase of 46% since 2011 (Aitken et al., 2017) and an annual growth rate over this period of 6.9%. This can also be considered against Natural England’s interpretation of the PVA, which considered that a reduction in the annual growth rate of no more than 0.5% was expected. Against an annual growth 13 times higher (6.9% compared to 0.5%), and even if this declines to some extent in the future (as perhaps is indicated by the recent trend in productivity rates at the SPA), it is clear that the effect on the population would be negligible and there is no risk of an in-combination AEoI.

193. This robust, evidence based conclusion notwithstanding, the Applicant has presented a proposal for compensation if this should be required.

194. In line with the guidance, indicative compensation options for displacement risk to guillemot at the FFC SPA are summarised in Table 5.1 and could include:

- Prey enhancement;
- Predator control / mortality reduction; and
- Prevention of oil spills.

5.2 Review of Potential Compensation Measures – Measures suggested in the Defra report

195. In a report to Defra, Furness et al. (2013) suggested possible measures that could improve the conservation status of UK seabird populations. These are summarised for guillemot in Table 5.1.

Table 5.1 Measures listed in the Defra report (Furness et al. 2013) to improve conservation status of guillemot at colonies throughout the UK

Type of measure	Suggested method plus in parentheses comments on suitability in relation to the key SPA population
Prey enhancement	Closure of sandeel and sprat fisheries close to SPA colonies (sandeels are the key breeding season prey of guillemots at FFC)
	Closure of sandeel and sprat fisheries in wintering areas
Predator control / mortality reduction	Eradicate rats (not a pressure at FFC).
Prevent oil spills	Prevent illegal discharges, greater efforts to detect and prosecute transgression (these methods have largely already been adopted in UK waters)

196. Only some of the measures presented in Table 5.1 would be appropriate for the focal SPA populations of Flamborough and Filey Coast SPA for reasons summarised in Table 5.1 and detailed further in the following sections. In addition, knowledge of seabird ecology has advanced in the six years since publication of the Defra report so the suitability of these measures requires further consideration in relation to new evidence.

197. Furness et al. (2013) considered that there was strong evidence that preventing oil spills would benefit this species, but also acknowledged that considerable efforts are already made to avoid oil spills so it was not obvious what further steps could be taken. For these reasons prevention of oil spills is given no further consideration here.

5.3 Prey enhancement

198. Two mechanisms seem suitable to achieve this long-term, strategic compensation, as described below; closure of a defined area for sandeel fishing and purchase of sandeel fishery quota.

5.3.1 Closure of sandeel fishing to benefit guillemots at FFC SPA

5.3.1.1 Overview

199. Studies have highlighted the importance of maintaining sufficient prey densities in the vicinity of guillemot breeding colonies, suggesting that fine-scale spatial fisheries

management is necessary to maintain high seabird breeding success (Chimienti et al. 2017, Hentati-Sundberg et al. 2020). Hentati-Sundberg et al. (2020) concluded that densities of forage fish corresponding to the fisheries management target for conserving seabirds proposed by Cury et al. (2011), equating to 1/3 of historical maximum prey biomass, was sufficient to maintain populations.

200. Guillemot breeding success and population sizes in Newfoundland were related to forage fish availability, although the species was able to work harder when densities were lower, thereby buffering demographics variations in stock levels (Montevecchi et al. 2019). However, Montevecchi et al. (2019) concluded that the reduction in capelin abundance had taken the common guillemots very close to their limit of buffering capacity. A similar conclusion was reached by Kadin et al. (2016), who found that guillemots adjusted their foraging effort to compensate, but only within limits, for reduced quality of prey brought to chicks. Storey et al. (2017) showed that guillemot body mass and chick-feeding rates were higher in good years than in poor years and heavier guillemots were more likely to fledge a chick than lighter birds. Wanless et al. (2018) also showed that guillemots at the Isle of May were better able to switch from a diet of sandeels to a diet of sprats than were other seabird species.

201. Schaefer et al. (2020) demonstrated that forage fish aggregations are the main driver of guillemot spatial aggregations in winter and individual guillemots appear to return to the same wintering areas in successive years, which has the advantage of improving familiarity with the local resources, but can be a limitation when the environment changes (Merkel et al. 2020). Therefore, guillemots may not be able to adjust their migration strategies in the face of changes in their chosen wintering area, such as depletion of forage fish stocks or impacts of climate change on forage fish distribution.

202. There is evidence that guillemot mortality peaks during winter, and therefore that winter may represent a bottleneck of high energy demand and low availability of food, as well as a time of exposure to extreme weather (Louzao et al. 2019). On the basis of diving activity, recorded using Time Depth Recorder (TDR) tags, Dunn et al. (2019) concluded that guillemots managed their energy expenditure throughout the year, despite the potential constraints of reduced daylength and low sea surface temperatures in winter, with no peaks of energy expenditure in winter (in fact energy expenditure was highest immediately before and during the breeding season). Since guillemots are often also present at colonies outside the breeding season it seems probable that local forage fish abundance is not limiting at these locations. Colony attendance in winter is also related to wind speed (Sinclair 2018), thus increasingly stormy conditions may lead to higher winter colony attendance levels.

203. Evidence that sandeel stock biomass affects guillemot breeding success is relatively weak, however guillemot return rates to the Isle of May suggests quite a strong effect of sandeel abundance on guillemot survival (Furness and Tasker 2000).

5.3.1.2 Delivery Mechanism

204. Closure of a defined area for sandeel fishing was achieved off the east coast of Scotland, and has been successful in recovering sandeel abundance and kittiwake breeding success (although these have also been affected over the years by climate change). This is an example of where the EU Common Fisheries Policy (as discussed further below) has previously been used as a management measure; ICES advised closure of the area off east Scotland and the EU took that advice. Rather than complete closure of the fishery, it is also possible to promote a closed box under the Common Fisheries Policy.

205. ICES promotes 'ecosystem-based management' of fish stocks. However, their management of the sandeel stock has recently been criticised as not being 'ecosystem-based' because it sets a quota only on the basis of sustaining the sandeel stock and not on the basis of the needs of higher trophic level predators (such as kittiwakes) (Hill et al. 2019). ICES should therefore be highly receptive to the need to better manage that sandeel stock to avoid adverse impacts on guillemots and other top predators.

206. The Common Fisheries Policy recognises that conservation measures which affect fishing interests may need to be adopted to comply with obligations in relation to environmental legislation[11]. Member States are allowed to adopt measures which do not affect other Member States under their own legislation, e.g. through byelaws under Section 129 (promoted by the MMO) and Section 155 (promoted by Inshore Fisheries Conservation Authorities) of the MCAA 2009. However, where conservation objectives would affect other Member States which have a direct management interest in the fishery, a joint recommendation must be made to the European Commission (EC) to adopt those measures.

207. Following EU Exit in December 2020, the UK is no longer part of the Common Fisheries Policy. Instead, the Fisheries Act 2020 establishes the legal framework for managing fishing in the UK. It contains objectives for managing fisheries under which a Joint Fisheries Statement is currently being prepared, which will set out fisheries policy in the UK to achieve the stated objectives. There are still a number of controls used to manage fisheries in a sustainable way and this includes through byelaws promoted under the MCAA 2009 (as referred to above) which have been amended

[11] Articles 11 and 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy

under the Fisheries Act 2020, so that powers now extend to make byelaws beyond territorial waters and outside of Marine Protected Areas.

208. However, the purpose of promoting byelaws relates to conserving marine flora or fauna, or marine habitats or habitat types. EC Guidance[12] states that compensatory measures should be additional to the actions that are considered normal practice under the Habitats and Birds Directives or obligations laid down in EU law, including the standard measures required for designation, protection and management of Natura 2000 sites.

209. Whilst this compensatory measure would be analogous to the examples above, and could even be achieved simply by extending the existing closed area box southward to beyond FFC SPA, at present, no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate powers to a relevant management body and, potentially, through the delivery of legislation to secure the necessary powers.

5.3.1.3 Spatial Scale

210. The worst case mortality of guillemots from the FFC SPA predicted as a result of displacement from Norfolk Vanguard was 15 individuals (for the worst case rates of 70% displacement and 10% mortality). However, it should be noted that the mortality rate Natural England applied in their assessment [REP9-057] equated to 1/5th of this (i.e. 2% mortality compared with 10%). Application of the lower mortality rate reduces the mortality to 3 individuals. Thus, to compensate for the worst case of 15 individuals it would be necessary to increase fledgling production at FFC SPA by at least 30 fledglings per year (as approximately half the birds fledged are typically expected to reach breeding age). Since there are over 40,000 pairs of guillemots at the FFC SPA, that compensation can be achieved by increasing breeding success by a maximum of 0.00075 chicks per nest on average (or one additional chick for every 1,333 pairs). The change in breeding success at this very large colony required in order to compensate for loss of a maximum of 15 birds per year is extremely small.

211. It can therefore be concluded that reducing fishing mortality on sandeels may be an effective long-term, strategic compensation, but it would be very difficult to precisely achieve the small amount of proportionate compensation for Norfolk Vanguard and it would also be very difficult to measure the effect of the very small change required to compensate for loss of 15 birds.

---

[12] Managing Natura 2000 sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC – C(2018) 7621

212. Nonetheless, there is scope for compensation through either reducing fishing effort directed at sandeels, or through closing areas within the main foraging range of this guillemot population to sandeel fishing.

5.3.1.4 Timescale

213. There is some evidence to suggest that recovery of sandeel stocks may be slow, or incomplete, as a consequence of other ecological factors (for example the effects of climate change on zooplankton on which sandeels feed, such as large copepods, and the recovery to high abundance of predatory fish such as cod, hake, haddock and whiting that eat sandeels) and impacts of climate change (Lindegren et al. 2018).

214. This therefore represents a long-term, strategic opportunity for compensation for all relevant offshore wind farms with a cumulative/in-combination impact on North Sea guillemot populations, since fishery closures would deliver considerably larger benefits to the population than the worst case cumulative impact estimated for all UK offshore wind developments in the North Sea.

5.3.1.5 Monitoring

215. The breeding success of guillemots at FFC SPA is already monitored, so the consequence of adjusting sandeel fishing effort would be visible from the long-term data on guillemot breeding success. Breeding success is also already monitored at other colonies that are distant from the southern North Sea sandeel stock and the productivity of those colonies would provide some baseline data against which to compare FFC SPA productivity. However, there would be no ideal 'control' for this manipulation. Similarly, sandeel stock biomass is assessed annually by ICES. There is no 'control' site in that case either, but population modelling (Lindegren et al. 2018) provides strong evidence of the changes resulting from adjustment of fishing effort. By such mechanisms it would therefore be possible to monitor the effectiveness of this compensation.

5.3.1.6 Feasibility

216. As noted above, at present no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate rights to a relevant management body and, potentially, through the delivery of legislation to secure the necessary rights. The feasibility of this measure is, therefore, currently uncertain and so the Applicant would not propose to progress this option.

217. However, if initiatives are developed by the relevant authorities in the future with a view to enabling fishery management to be undertaken as strategic compensation then Vattenfall would be willing to participate in their delivery, on the basis that these were within acceptable timeframes for the project.

5.4 Rat eradication

5.4.1 Overview

218. The guillemot breeding sites at FFC SPA are predominantly on cliff ledges which are inaccessible to rats. Therefore rats are not expected to be a significant predator of guillemot eggs and chicks at FFC SPA. However, there is potential for rat eradication to be undertaken at other guillemot colonies, both SPAs and otherwise. Seabird populations comprise inter-connected, meta-populations, with many birds recruiting to breed at other colonies than the one they hatched in. Therefore improving reproductive success at other colonies benefits the population as a whole, including those sites designated for their conservation.

219. Rats were eradicated from Lundy (between 2002 and 2004), following which there was a rapid increase in guillemot breeding numbers from 2,348 to 6,198 individuals. Increases occurred both at parts of the island already in use by the species and also across parts of the island which were previously little used, presumably due to the presence of rats. Thus, productivity increases were attributed to the removal of the pressure of predation by rats (Booker et al. 2019). The Lundy case study provides strong evidence that rat eradication from island colonies can benefit guillemots, but the degree of success is very likely to depend on the amount of ground nesting habitat and whether or not guillemot numbers can increase into such habitat or are constrained by other factors such as food availability.

5.4.2 Delivery

220. Rat eradication from offshore islands to benefit breeding birds has been undertaken on numerous islands worldwide. The methods used and the success achieved vary depending on the island characteristics. Options range from placing baits by hand (e.g. as undertaken at Canna) to the use of helicopters to distribute bait over wide areas (e.g. Campbell Island, New Zealand), and combinations of the above. Therefore, following identification of a suitable island for an eradication campaign it would then be necessary to determine the most appropriate delivery mechanism.

5.4.3 Spatial scale

221. It is critical to ensure complete eradication in the first instance, that efforts are then taken to minimise the risk of recolonisation and that careful monitoring is

undertaken in order to quickly identify recolonisation events in a timely manner. Thus, it is important to distribute bait throughout the site in question (to ensure no survivors) and to take steps to prevent accidental reintroduction (e.g. use of sealed containers for transporting supplies to the island). A grid of traps around potential ‘entry’ points can also be maintained and checked regularly. In some cases (e.g. islands close to the mainland) where there may be a risk of rats swimming to the island themselves, traps can also be set up along the nearest points of the mainland to suppress the population of potential invading rats.

222. Selection of a suitable island for an eradication programme would need to consider factors such as whether rats are thought to be limiting the guillemot population (i.e. do the birds nest in places that rats can access, or are the birds excluded from areas due to the presence of rats), accessibility, bait delivery method, likelihood of reintroduction and whether the island has human inhabitants (and how this would affect the programme). Selection of the colony would be based on criteria, developed by Ratcliffe et al., (2009) and Stanbury et al. (2017), to rank locations in terms of the cost-effectiveness and consideration of the risk of re-invasion by rats (and other introduced mammalian predators). The list of islands identified by Stanbury et al. (2017) which have rats present is provided in Table 5.2, of which 12 have breeding guillemot which could potentially benefit from a rat eradication programme.

Table 5.2 Rank order of islands identified by Stanbury et al (2017) for which rat eradication would offer benefits to breeding seabirds. Note that only those islands which had rats listed are shown here, but the original ranking scores have been retained. Key to conservation status: UNc = unfavourable no change ; UD = unfavourable declining; FM = favourable maintained.

Rank order	Name, location	SPA for guillemot?	Most recent guillemot count (individuals) in JNCC SMP database, year of count and conservation status on NatureScot SiteLink
4b	Rousay, Orkney	Yes	6,500 (2016); UD
4c	Rathlin Island, Northern Ireland	Yes	130,445 (2011)
7a	Colonsay and Oronsay, Inner Hebrides	Yes	18,724 (2018); FM
7b	Unst, Shetland	Yes	6,109 (2016); UD
10	Rum, Small Isles	Yes	2,454 (2000); UNc
12b	Inchkeith, Forth Estuary	No	278 (2020)
14	Hoy, Orkney	Yes	12,198 (2017); UNc
15	Flotta, Orkney	No	64 (2019)
16a	Tiree, Inner Hebrides	No	3,610 (2018)
18a	Stronsay, Orkney	No	750 (2018)
18b	Eilean Mhuire, Shiant Islands	Yes	5,624 (2015); UNc
25	Herm, Channel Islands	No	135 (2015)

223. If guillemot compensation is required by the SoS, and it is agreed that a rat eradication programme is the appropriate means to achieve this, the list of islands in Table 5.2 would be used as the starting point for more detailed consideration leading to the identification of the most suitable location(s).

5.4.4 Temporal scale

224. Eradication programmes are typically conducted intensively over a relatively short space of time (weeks/months) as this improves success rates (by preventing animals from moving around and avoiding baited areas) and also minimises the risk that the rat population will have time to recover. Once completed, apart from ongoing measures to prevent reintroduction, no additional funding would be required. Seabird species often show recoveries in numbers and breeding success within a short period of time (e.g. within 1 to 2 years), although this would be very dependent on the specific situation. Therefore if this compensation is required by the SoS, the target will be to commence the programme at least two years prior to wind farm operation.

5.4.5 Monitoring

225. Monitoring for both the presence of rats and the status of the target seabird populations would be essential. Regularly checked traps is the simplest means to check for the presence of rats, while annual counts of the guillemot population and monitoring of sample plots to estimate productivity rates would reveal how successful the measure had been. A relatively modest increase in productivity would be required to offset the predicted mortality at the project. In most seabirds around 50% of fledged chicks reach breeding adult age. Therefore an additional 30 fledged chicks would provide the 15 breeding adults at risk of mortality under the worst case scenario (70% displaced, 10% mortality).

5.4.6 Feasibility

226. Rat eradications are an established method for improving the conservation status of breeding seabird populations. However, since this is not an option for the FFC SPA itself it would need to be conducted at another location, as discussed above.

5.5 Proposed Approach to Delivery of Compensation (if required)

227. If compensation is deemed to be required by the SoS following the Appropriate Assessment, the Applicant proposes that undertaking a rat eradication programme at a suitable location would be the most appropriate measure to deliver compensation prior to the construction of Norfolk Vanguard.

5.5.1 Implementation timetable

228. If guillemot compensation is deemed to be required by the SoS following the Appropriate Assessment, the Applicant proposes the following measures would be undertaken:

- The first step would be to identify suitable guillemot colonies for further consideration, using the criteria noted above and guided by ornithological experts with experience in this topic (Q3-4 2021);
- Following identification of a short list of suitable locations, the Applicant would liaise with the relevant landowners and appropriate authorities to determine the permitting requirements (e.g. licences) and land access (Q4 2021);
- A report detailing the short-listing process and outcomes would be shared with Natural England for discussion, following which a final decision on the site to be taken forward would be made (Q4 2021);
- If required, a Habitats Regulations Assessment would be undertaken detailing the potential for adverse effects and how these would be avoided, with similar assessment and reporting undertaken if the site is designated under other legislation (e.g. SSSI) (Q3-4 2021);
- A steering group would be appointed (comprising representation from relevant stakeholders, e.g. Natural England, landowners, etc.) to oversee the planning, implementation, monitoring and reporting of the compensation measures (Q1-2 2022);
- Baseline monitoring of the guillemot population and breeding success would be initiated (if not already conducted) to provide a yardstick against which post-eradication monitoring would be measured (Q2-3 2022, and ongoing);
- A delivery plan, which would include contingencies for reasonably foreseeable issues which might reduce the success achieved, would be developed and submitted to the SoS for approval (Q3 2022).
- Eradication would be planned for the next suitable nonbreeding period, expected to be winter 2023-2024, with contingency for the following winter (2024-2025) depending on practical considerations such as bait deployment method, island size, necessary licensing, etc.
- The success of the eradication measures would be monitored using traps, while the outcomes for the guillemot population would be determined through population counts and productivity estimation. If the monitoring indicates a need for additional actions, then these would be taken as per the contingency planning, or developed in conjunction with the steering group as necessary.
- Monitoring on an annual basis and, if necessary, repeat eradication efforts would continue, until the wind farm has been decommissioned or a

determination is made by the SoS, following consultation with the relevant statutory nature conservation body, that compensation is no longer required.

Table 5.3 GANTT chart of the timeline for implementing guillemot compensation through rate eradication.

	2021		2022				2023				2024				2025				2026			
Stage	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Long-list of sites																						
Landowner liaison and licensing review																						
Discussions with NE and final decision on site																						
Steps to obtain necessary consents and authorisations																						
Steering group appointed																						
Baseline monitoring																						
Delivery plan submitted to SoS																						
Eradication programme (inc. contingency)																						
Monitoring (start)																						
Start of Norfolk Vanguard offshore construction																						
Start of first generation at Norfolk Vanguard																						

5.5.2 Proposed routine maintenance and species population monitoring during the project lifetime and funding mechanisms for delivery

5.5.2.1 Maintenance

229. As discussed above, there is no specific maintenance requirement following the rat eradication programme, with the exception of ensuring that the mechanisms used to check for the presence of rats (traps, baits, etc.) are maintained in a serviceable condition and checked on a regular basis. Depending on the island selected for rat eradication it may be feasible for other measures to be taken (e.g. use of sealed containers for goods brought to the island to prevent rat stowaways, which will need to be checked and repaired or replaced as necessary to ensure they remain fit for the intended purpose).

5.5.2.2 Monitoring

230. As discussed above, the guillemot population will be monitored before and after the eradication programme, to obtain population counts and if possible, estimates of breeding success (the latter is dependent on the accessibility or visibility of the breeding sites). Standard seabird census methods will be used (e.g. Walsh et al. 1995). This will allow estimation of the success of the eradication scheme to be determined. This monitoring would initially be undertaken each year, however the requirement to continue this for the lifetime of the wind farm would be discussed with Natural England (e.g. after 3-5 years a lower frequency may be appropriate, such as every 5 or 10 years).

5.5.2.3 Funding

231. The cost of rat eradication is very dependent on the size of island and its topography. Recent UK examples are set out below, however, in each case there were a considerable number of volunteer days, of which it is not clear how many have been included in the quoted costs. Therefore, these costs should be considered as an estimate only:

    i. Canna, Inner Hebrides. The cost was estimated to be approximately £725,000[13], however this estimate does not include a cost breakdown and it is considered that a large amount of unpaid (volunteer) time was used in this project. As no estimate of days is provided for this project (Bell et al. 2011) it is not possible to estimate the staff cost equivalent.

[redacted]

ii. Lundy, Bristol Channel. The cost for this is quoted as £76,500 (Lock 2006), however a total of 2,700 days is also given, of which it is unclear how many were included in the cost estimate. If it is assumed that all the time was volunteered, the time cost for employees would be in the region of £400,000.

iii. The Shiants, Outer Hebrides. These islands were cleared of rats by the RSPB, at a quoted cost of 'more than £1 million'[14], however this project involved approximately 600 days of apparent volunteer effort (Main et al. 2019), which is estimated to be the equivalent of approximately £100,000 of employee time.

232. Estimated costs for each phase of the compensation are provided in Table 5.4.

Table 5.4 Indicative costs for proposed FFC SPA compensation.

Compensation Option	Cost Estimate subcategories	Norfolk Boreas cost estimate
Island rat eradication	Development Expenditure	£150,000
	Capital Expenditure	£850,000
	Operational Expenditure	£1,150,000
	Decommissioning Expenditure	NA
Total estimated cost		**£2,150,000**

233. Having regard to the estimated costs for delivery of the compensation measures set out above (as well as other compensation measures which may be required for the FFC SPA, and those measures which may be required for compensation in relation to the Alde-Ore Estuary Special Protection Area and the Haisborough, Hammond and Winterton Special Area of Conservation), the Applicant considers that delivery of the measures, in line with the timescales proposed in the implementation programme, is financially feasible. Therefore, in the event that it is necessary to deliver these (and/or other) compensation measures, the Applicant is confident that the commercial viability of the project would not be prejudiced.

234. The Applicant provided a Funding Statement [APP-009] with the Application, which explains that the Applicant will have the ability to procure the financial resources necessary to fund the works to be authorised by the Order, subject to final Board authority. The Applicant's parent company (Vattenfall Wind Power Ltd), which is part of the wider Vattenfall Group (Europe's fifth largest generator of electricity and the largest generator of heat), have the experience and reputation to enable funds to be procured and this applies equally in respect of the funds to deliver the compensation measures. The Applicant will secure funding for the project after certainty is obtained on development consent, the tender process is complete for

14 [redacted]

the major construction contracts, and the investment case has been satisfied. Once these criteria are met the Applicant will take a final investment decision (FID) which will irrevocably commit funding for the project. Should funding for any compensation measures be required as part of the project then these costs will be factored into any FID.

235. In summary, the Applicant, its parent company, and the wider Vattenfall Group have substantial net assets (as outlined in the accounts shown at Annex 1 and Annex 2 of the Funding Statement, [APP-009]) as well as a positive track record in the field of renewable energy development. The Applicant and the parent company are therefore able to provide the required funding for the project, which would include funding to guarantee the success of any compensation measures required.

5.6 Guillemot and razorbill – potential compensation synergies

236. The same in-principle compensation has been proposed for guillemot and razorbill (hereafter referred to as auks), since these species have similar ecologies, distributions and conservation threats. Thus, should this compensation be undertaken for one species it will in fact deliver for all those present on the island which are subject to predation by rats (i.e. not just auks). Similarly, as discussed above, the compensation would deliver a large degree of over-compensation for the predicted impact magnitudes for the Norfolk Boreas wind farm (an absolute worst case maximum of 15 guillemots and 6 razorbills), and therefore such measures would in fact provide compensation for impacts from more than one project.

Therefore, there is considerable scope for an island rat eradication project to provide compensation for several wind farms and hence this should be considered from a strategic perspective. This is further supported by the fact that the nature of this compensation is 'all or nothing' (to all intents, an island is either cleared of rats or it is not), and it is highly probable that for any individual wind farm there would be a very considerable degree of over-compensation derived from such a scheme. The Applicant would be very willing to undertake the proposed compensation (rat eradication) as part of a joint measure with other developers, should this be an appropriate option.

5.7 DCO Condition

237. The Applicant has provided (in a document titled Extract of Schedule 17 to the draft DCO Compensation to protect the coherence of the Natura 2000 Network) proposed wording for a condition which could be inserted into the Norfolk Vanguard DCO should the SoS decide that compensation is required. Natural England and the MMO have been consulted on the proposed wording and are in agreement with much of the principle of the wording, however agreement has not been reached on the

timing of delivery of the compensation measures and on the inclusion of strict timeframes for consultation of the compensation strategy, which the Applicant does not consider necessary to include on the face of the DCO given the ongoing and iterative engagement.

5.8 Proposed content of guillemot compensation plan

238. Following advice from Natural England the guillemot compensation plan will provide the following:

- What, where, when: clear and detailed statements regarding the location and design of the proposal.
- Why and how: ecological evidence to demonstrate compensation for the impacted site feature is deliverable in the proposed locations.
- Demonstration that deliverability is secured.
- Demonstration of the policy/legislative mechanism for delivering the compensation (where relevant).
- Set out clear aims and objectives of the compensation.
- Include proposals for adaptive management.
- Governance proposals for the post-consent phase (where relevant).
- Timescales for implementation including how these timescales relate to the ecological impacts from the development.
- Commitments to monitoring specified success criteria.
- Proposals for reporting on monitoring.
- Proposals for management of the compensation area to support the continued success of the compensation measures (where relevant).

5.9 Summary

239. The most deliverable option for compensating displacement risk for guillemot from the FFC SPA is through rat eradication at another location where this would be anticipated to improve the population status and breeding success of the wider guillemot population and thereby increase the pool of birds available to recruit to the FFC SPA.

240. It is noted that compensation would only be required should the Secretary of State conclude that an AEoI on the guillemot feature of the FFC SPA cannot be ruled out and there is agreement on the Assessment of Alternative Solutions and IROPI case presented in the Applicant’s Habitats Regulations Derogation Provision of Evidence (document reference ExA; IROPI; 11.D10.3).

241. However, it is the Applicant's firm conclusion that there is no AEoI for FFC SPA as a result of the project alone and in-combination with other plans and projects.

6 COMPENSATION - RAZORBILL

6.1 Guidance

242. If the conclusion of the Competent Authority is that, following conclusion of the Appropriate Assessment, an AEoI on a Natura 2000 site(s) cannot be ruled out, that there are no alternative solutions and that there are IROPI, then Article 6(4) of the Habitats and Birds Directives "*requires that all necessary compensatory measures are taken to ensure the overall coherence of the network of European sites as a whole is protected.*"

243. Defra (2012) and EC (2012 and 2018) explain that for SPAs, the overall coherence of the Natura 2000 Network can be maintained by:

- compensation that fulfils the same purposes that motivated the site's designation;
- compensation that fulfils the same function along the same migration path; and,
- the compensation site(s) are accessible with certainty by the birds usually occurring on the site affected by the project.

244. The guidance provides an element of flexibility, recognising that compensation of a 'like for like' habitat and/or in the same designated site may not be practicable.

245. Compensation should not be used to address issues that are causing designated habitats or species to be in an unfavourable condition. This is the responsibility of the UK Government.

246. Ideally, compensation should be functioning before the effect takes place, although it is recognised that this may not always be possible, as stated in the EC (2012) guidance: "*in principle, the result of implementing compensation has normally to be operational at the time when the damage is effective on the site concerned. Under certain circumstances where this cannot be fully fulfilled, overcompensation would be required for the interim losses*."

247. During the Examination there was no request from Natural England to provide in-principle compensation proposals for razorbill from the FFC SPA to offset the predicted displacement from the project. The Applicant considers this to be a reflection of the low project alone impact (which Natural England agreed would not give rise to an AEoI alone, and was only unable to rule this out in-combination due to uncertainty in the appropriate figures to use for the Hornsea Project Three and Four wind farms; final statement of common ground, [REP9-046]).

248. Natural England, in their submission to the East Anglia ONE North and East Anglia TWO examinations at deadline 12[1], concluded that displacement of razorbill from the FFC SPA would not give rise to in-combination AEoI for all wind farms considered (which of the recent applications included Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North, East Anglia TWO and Hornsea Project Three. As Hornsea Project Four was only submitted on 19 September 2021 with the assessment documents published on 8 October 2021, and there is currently only preliminary assessment information available for Dudgeon Extension and Sheringham Extension, Natural England have not been able to conclude that these projects will not give rise to an in-combination impact due to the uncertainty regarding their figures. Therefore, since both the Applicant and Natural England agree there is currently no risk of AEoI for razorbill from the FFC SPA, it follows that there is no requirement for compensation of the project impacts. Nonetheless, since the SoS has specifically requested presentation of in-principle compensation for these species these have been provided in this document.

249. In a submission to the Norfolk Vanguard Examination, Natural England has also stated that the mortality rate for displaced birds would be unlikely to be at the top of the range advised (of 1-10%; [REP9-057]).

250. To further clarify what mortality rate Natural England have applied in this assessment, the Applicant has reviewed Natural England's interpretation of the PVA for razorbill [REP9-057]. To avoid any risk that Natural England's position is misrepresented the complete section of relevant text is provided below:

> *However, 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 anticipate razorbill mortality rates to be at the top of the range considered. We do not expect the mortality to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.*

251. From the PVA outputs which accompanied this statement (Table 2 of Norfolk Vanguard [REP9-057]) it can be seen that population growth rate declines did not exceed 0.5% for respective displacement and mortality combinations of up to 70%

and 2% and 30% and 5% (both with and without Hornsea Project Three included, note that Hornsea Project Four had not reached PEIR stage).

252. Thus, Natural England considered the percentage at risk of displacement could be as high as 70%, with a consequent mortality for these displaced birds of 2%. Applying 70% displaced and 2% mortality, the in-combination totals at risk of displacement mortality are reduced from the worst case prediction discussed in section 3.3.2 by 80%, from 508 to 102 (note this includes Hornsea Project Four and Dudgeon and Sheringham Extensions). It should also be noted that Natural England has stressed to the Applicant that these estimates should not be applied to future projects.

253. A review of evidence on displacement of razorbills (MacArthur Green 2019) found that a precautionary rate of displacement for this species was 50% and that consequent mortality of 1% would also be precautionary. This would give an in-combination mortality of 36 individuals from the FFC SPA.

254. Therefore, the Applicant considers that applying either the evidence based rates (50% and 1%) or the methods applied by Natural England in (Norfolk Boreas examination reference [REP4-040]; 60-70% and 1-2%), the magnitude of potential in-combination impact is very small (between 36 and 102) and therefore the risk of an in-combination AEoI for razorbill can be ruled out. It therefore follows that there is no requirement for compensation.

255. Counts of the SPA undertaken in 2017 recorded 30,228 individuals (following standard adjustment this is equivalent to 20,253 pairs), an increase of 43% since 2011 (Aitken et al. 2017), and an annual growth rate of 6.9%. This can also be considered against Natural England's interpretation of the PVA, which considered that a reduction in the annual growth rate of no more than 0.5% was expected. Against an annual growth 13 times higher (6.9% compared to 0.5%). and even if this declines to some extent in the future (as perhaps is indicated by the recent trend in productivity rates at the SPA), it is clear that the effect on the population would therefore be negligible and there is no risk of an AEoI.

256. This robust, evidence based conclusion notwithstanding, the Applicant has presented a proposal for compensation if this should be required.

257. In line with the guidance, indicative compensation options for displacement risk to razorbill at the FFC SPA are summarised in Table 6.1 and could include:

- Prey enhancement;
- Predator control / mortality reduction; and
- Prevention of oil spills.

6.2 Review of Potential Compensation Measures – Measures suggested in the Defra report

258. In a report to Defra, Furness et al. (2013) suggested possible measures that could improve the conservation status of UK seabird populations. These are summarised for razorbill in Table 6.1.

Table 6.1 Measures listed in the Defra report (Furness et al. 2013) to improve conservation status of razorbill at colonies throughout the UK

Type of measure	Suggested method plus in parentheses comments on suitability in relation to the key SPA population
Prey enhancement	Closure of sandeel and sprat fisheries close to SPA colonies (sandeels are the key breeding season prey of razorbill at FFC)
	Closure of sandeel and sprat fisheries in wintering areas
Predator control / mortality reduction	Eradicate rats (not a pressure at FFC).
Prevent oil spills	Prevent illegal discharges, greater efforts to detect and prosecute transgression (these methods have largely already been adopted in UK waters)

259. Only some of the measures presented in Table 6.1 would be appropriate for the focal SPA populations of Flamborough and Filey Coast SPA for reasons summarised in Table 6.1 and detailed further in the following sections. In addition, knowledge of seabird ecology has advanced in the six years since publication of the Defra report so the suitability of these measures requires further consideration in relation to new evidence.

260. Furness et al. (2013) considered that there was strong evidence that preventing oil spills would benefit this species, but also acknowledged that considerable efforts are already made to avoid oil spills so it was not obvious what further steps could be taken. For these reasons prevention of oil spills is given no further consideration here.

6.3 Prey enhancement

261. Two mechanisms seem suitable to achieve this long-term, strategic compensation, as described below; closure of a defined area for sandeel fishing and purchase of sandeel fishery quota.

6.3.1 Closure of sandeel fishing to benefit razorbills at FFC SPA

6.3.1.1 Overview

262. Studies have highlighted the importance of maintaining sufficient prey densities in the vicinity of razorbill breeding colonies, suggesting that fine-scale spatial fisheries management is necessary to maintain high seabird breeding success (Chimienti et al. (2017, Hentati-Sundberg et al. 2020). Hentati-Sundberg et al. (2020) concluded that densities of forage fish corresponding to the fisheries management target for conserving seabirds proposed by Cury et al. (2011), equating to 1/3 of historical maximum prey biomass, was sufficient to maintain populations.

6.3.1.2 Delivery Mechanism

263. Closure of a defined area for sandeel fishing was achieved off the east coast of Scotland, and has been successful in recovering sandeel abundance and kittiwake breeding success (although these have also been affected over the years by climate change). This is an example of where the EU Common Fisheries Policy (as discussed further below) has previously been used as a management measure; ICES advised closure of the area off east Scotland and the EU took that advice. Rather than complete closure of the fishery, it is also possible to promote a closed box under the Common Fisheries Policy.

264. ICES promotes 'ecosystem-based management' of fish stocks. However, their management of the sandeel stock has recently been criticised as not being 'ecosystem-based' because it sets a quota only on the basis of sustaining the sandeel stock and not on the basis of the needs of higher trophic level predators (such as kittiwakes) (Hill et al. 2019). ICES should therefore be highly receptive to the need to better manage that sandeel stock to avoid adverse impacts on razorbills and other top predators.

265. The Common Fisheries Policy recognises that conservation measures which affect fishing interests may need to be adopted to comply with obligations in relation to environmental legislation[15]. Member States are allowed to adopt measures which do not affect other Member States under their own legislation, e.g. through byelaws under Section 129 (promoted by the MMO) and Section 155 (promoted by Inshore Fisheries Conservation Authorities) of the MCAA 2009. However, where conservation objectives would affect other Member States which have a direct management

[15] Articles 11 and 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy

interest in the fishery, a joint recommendation must be made to the European Commission (EC) to adopt those measures.

266. Following EU Exit in December 2020, the UK is no longer part of the Common Fisheries Policy. Instead, the Fisheries Act 2020 establishes the legal framework for managing fishing in the UK. It contains objectives for managing fisheries under which a Joint Fisheries Statement is currently being prepared, which will set out fisheries policy in the UK to achieve the stated objectives. There are still a number of controls used to manage fisheries in a sustainable way and this includes through byelaws promoted under the MCAA 2009 (as referred to above) which have been amended under the Fisheries Act 2020, so that powers now extend to make byelaws beyond territorial waters and outside of Marine Protected Areas.

267. However, the purpose of promoting byelaws relates to conserving marine flora or fauna, or marine habitats or habitat types. EC Guidance[16] states that compensatory measures should be additional to the actions that are considered normal practice under the Habitats and Birds Directives or obligations laid down in EU law, including the standard measures required for designation, protection and management of Natura 2000 sites.

268. Whilst this compensatory measure would be analogous to the examples above, and could even be achieved simply by extending the existing closed area box southward to beyond FFC SPA, at present, no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate powers to a relevant management body and, potentially, through the delivery of legislation to secure the necessary powers.

6.3.1.3 Spatial Scale

269. The worst case mortality of razorbills from the FFC SPA predicted as a result of displacement from Norfolk Vanguard was 6 individuals (for the worst case rates of 70% displacement and 10% mortality). However, it should be noted that the mortality rate Natural England applied in their assessment [REP9-057] equated to 1/5th of this (i.e. 2% mortality compared with 10%). Application of the lower mortality rate reduces the mortality to 1 individual. Thus, to compensate for the worst case of 6 individuals it would be necessary to increase fledgling production at FFC SPA by at least 12 fledglings per year (as approximately half the birds fledged are typically expected to reach breeding age). Since there are over 15,000 pairs of razorbills at FFC SPA, that compensation can be achieved by increasing breeding

[16] Managing Natura 2000 sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC – C(2018) 7621

success by a maximum of 0.0008 chicks per nest on average (or one additional chick for every 1,250 pairs). The change in breeding success at this colony required in order to compensate for loss of a maximum of 6 birds per year is extremely small.

270. It can therefore be concluded that reducing fishing mortality on sandeels may be an effective long-term, strategic compensation, but it would be very difficult to precisely achieve the small amount of proportionate compensation for Norfolk Vanguard and it would also be very difficult to measure the effect of the very small change required to compensate for loss of 6 birds.

271. Nonetheless, there is scope for compensation through either reducing fishing effort directed at sandeels, or through closing areas within the main foraging range of this razorbill population to sandeel fishing.

6.3.1.4 Timescale

272. There is some evidence to suggest that recovery of sandeel stocks may be slow, or incomplete, as a consequence of other ecological factors (for example the effects of climate change on zooplankton on which sandeels feed, such as large copepods, and the recovery to high abundance of predatory fish such as cod, hake, haddock and whiting that eat sandeels) and impacts of climate change (Lindegren et al. 2018).

273. This therefore represents a long-term, strategic opportunity for compensation for all relevant offshore wind farms with a cumulative/in-combination impact on North Sea guillemot populations, since fishery closures would deliver considerably larger benefits to the population than the worst case cumulative impact estimated for all UK offshore wind developments in the North Sea.

6.3.1.5 Monitoring

274. The breeding success of razorbills at FFC SPA is already monitored, so the consequence of adjusting sandeel fishing effort would be visible from the long-term data on razorbill breeding success. Breeding success is also already monitored at other colonies that are distant from the southern North Sea sandeel stock and the productivity of those colonies would provide some baseline data against which to compare FFC SPA productivity. However, there would be no ideal ‘control’ for this manipulation. Similarly, sandeel stock biomass is assessed annually by ICES. There is no ‘control’ site in that case either, but population modelling (Lindegren et al. 2018) provides strong evidence of the changes resulting from adjustment of fishing effort. By such mechanisms it would therefore be possible to monitor the effectiveness of this compensation.

6.3.1.6 Feasibility

275. As noted above, at present no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate rights to a relevant management body and, potentially, through the delivery of legislation to secure the necessary rights. The feasibility of this measure is, therefore, currently uncertain and so the Applicant would not propose to progress this option.

276. However, if initiatives are developed by the relevant authorities in the future with a view to enabling fishery management to be undertaken as strategic compensation then Vattenfall would be willing to participate in their delivery, on the basis that these were within acceptable timeframes for the project.

6.4 Rat eradication

6.4.1 Overview

277. The razorbill breeding sites at FFC SPA are predominantly on cliff ledges which are inaccessible to rats. Therefore rats are not expected to be a significant predator of razorbill eggs and chicks at FFC SPA. However, there is potential for rat eradication to be undertaken at other razorbill colonies, both SPAs and otherwise. Seabird populations comprise inter-connected, meta-populations, with many birds recruiting to breed at other colonies than the one they hatched in. Therefore improving reproductive success at other colonies benefits the population as a whole, including those sites designated for their conservation.

278. Rats were eradicated from Lundy (between 2002 and 2004), following which there was a rapid increase in razorbill breeding numbers from 950 to 1,735 individuals. Increases occurred both at parts of the island already in use by the species and also across parts of the island which were previously little used, presumably due to the presence of rats. Thus, productivity increases were attributed to the removal of the pressure of predation by rats (Booker et al. 2019). The Lundy case study provides strong evidence that rat eradication from island colonies can benefit razorbills, but the degree of success is very likely to depend on the amount of ground nesting habitat and whether or not razorbill numbers can increase into such habitat or are constrained by other factors such as food availability.

6.4.2 Delivery

279. Rat eradication from offshore islands to benefit breeding birds has been undertaken on numerous islands worldwide. The methods used and the success achieved vary

depending on the island characteristics. Options range from placing baits by hand (e.g. as undertaken at Canna) to the use of helicopters to distribute bait over wide areas (e.g. Campbell Island, New Zealand), and combinations of the above. Therefore, following identification of a suitable island for an eradication campaign it would then be necessary to determine the most appropriate delivery mechanism.

6.4.3 Spatial scale

280. It is critical to ensure complete eradication in the first instance, that efforts are then taken to minimise the risk of recolonisation and that careful monitoring is undertaken in order to quickly identify recolonisation events in a timely manner. Thus, it is important to distribute bait throughout the site in question (to ensure no survivors) and to take steps to prevent accidental reintroduction (e.g. use of sealed containers for transporting supplies to the island). A grid of traps around potential 'entry' points can also be maintained and checked regularly. In some cases (e.g. islands close to the mainland) where there may be a risk of rats swimming to the island themselves, traps can also be set up along the nearest points of the mainland to suppress the population of potential invading rats.

281. Selection of a suitable island for an eradication programme would need to consider factors such as whether rats are thought to be limiting the razorbill population (i.e. do the birds nest in places that rats can access, or are the birds excluded from areas due to the presence of rats), accessibility, bait delivery method, likelihood of reintroduction and whether the island has human inhabitants (and how this would affect the programme). Selection of the colony would be based on criteria, developed by Ratcliffe et al., (2009) and Stanbury et al. (2017), to rank locations in terms of the cost-effectiveness and consideration of the risk of re-invasion by rats (and other introduced mammalian predators). The list of islands identified by Stanbury et al. (2017) which have rats present is provided in Table 6.2, of which 12 have breeding razorbill which could potentially benefit from a rat eradication programme.

Table 6.2 Rank order of islands identified by Stanbury et al (2017) for which rat eradication would offer benefits to breeding seabirds. Note that only those islands which had rats listed are shown here, but the original ranking scores have been retained. Key to conservation status: UNc = unfavourable no change ; UD = unfavourable declining; FM = favourable maintained.

Rank order	Name, location	SPA for razorbill?	Most recent razorbill count (individuals) in JNCC SMP database, year of count and conservation status on NatureScot SiteLink
4b	Rousay, Orkney	Yes	469 (2016); FR
4c	Rathlin Island, Northern Ireland	Yes	22,975 (2011)
7a	Colonsay and Oronsay, Inner Hebrides	Yes	262 (2018)

Rank order	Name, location	SPA for razorbill?	Most recent razorbill count (individuals) in JNCC SMP database, year of count and conservation status on NatureScot SiteLink
7b	Unst, Shetland	Yes	146 (2016)
10	Rum, Small Isles	Yes	94 (2000)
12b	Inchkeith, Forth Estuary	No	178 (2020)
14	Hoy, Orkney	Yes	1,718 (2017)
15	Flotta, Orkney	No	267 (2019)
16a	Tiree, Inner Hebrides	No	372 (2018)
18a	Stronsay, Orkney	No	14 (2018)
18b	Eilean Mhuire, Shiant Islands	Yes	371 (2015) FR
25	Herm, Channel Islands	No	35 (2015)

282. If razorbill compensation is required by the SoS, and it is agreed that a rat eradication programme is the appropriate means to achieve this, the list of islands in Table 6.2 would be used as the starting point for more detailed consideration leading to the identification of the most suitable location(s).

6.4.4 Temporal scale

283. Eradication programmes are typically conducted intensively over a relatively short space of time (weeks/months) as this improves success rates (by preventing animals from moving around and avoiding baited areas) and also minimises the risk that the rat population will have time to recover. Once completed, apart from ongoing measures to prevent reintroduction, no additional funding would be required. Seabird species often show recoveries in numbers and breeding success within a short period of time (e.g. within 1 to 2 years), although this would be very dependent on the specific situation. Therefore if this compensation is required by the SoS, the target will be to commence the programme at least two years prior to wind farm operation.

6.4.5 Monitoring

284. Monitoring for both the presence of rats and the status of the target seabird populations would be essential. Regularly checked traps is the simplest means to check for the presence of rats, while annual counts of the razorbill population and monitoring of sample plots to estimate productivity rates would reveal how successful the measure had been. A relatively modest increase in productivity would be required to offset the predicted mortality at the project. In most seabirds around 50% of fledged chicks reach breeding adult age. Therefore an additional 12 fledged chicks would provide the 6 breeding adults at risk of mortality under the worst case scenario (70% displaced, 10% mortality).

6.4.6 Feasibility

285. Rat eradications are an established method for improving the conservation status of breeding seabird populations. However, since this is not an option for the FFC SPA itself it would need to be conducted at another location, as discussed above.

6.5 Proposed Approach to Delivery of Compensation (if required)

286. If compensation is deemed to be required by the SoS following the Appropriate Assessment, the Applicant proposes that undertaking a rat eradication programme at a suitable location would be the most appropriate measure to deliver compensation prior to the construction of Norfolk Vanguard.

6.5.1 Implementation timetable

287. If razorbill compensation is deemed to be required by the SoS following the Appropriate Assessment, the Applicant proposes the following measures would be undertaken:

- The first step would be to identify suitable razorbill colonies for further consideration, using the criteria noted above and guided by ornithological experts with experience in this topic (Q3-4 2021);
- Following identification of a short list of suitable locations, the Applicant would liaise with the relevant landowners and appropriate authorities to determine the permitting requirements (e.g. licences) and land access (Q4 2021);
- A report detailing the short-listing process and outcomes would be shared with Natural England for discussion, following which a final decision on the site to be taken forward would be made (Q4 2021);
- If required, a Habitats Regulations Assessment would be undertaken detailing the potential for adverse effects and how these would be avoided, with similar assessment and reporting undertaken if the sites is designated under other legislation (e.g. SSSI) (Q3-4 2021);
- A steering group would be appointed (comprising representation from relevant stakeholders, e.g. Natural England, landowners, etc.) to oversee the planning, implementation, monitoring and reporting of the compensation measures (Q1-2 2022);
- Baseline monitoring of the razorbill population and breeding success would be initiated (if not already conducted) to provide a yardstick against which post-eradication monitoring would be measured (Q2-3 2022, and ongoing);
- A delivery plan, which would include contingencies for reasonably foreseeable issues which might reduce the success achieved, would be developed and submitted to the SoS for approval (Q3 2022).

- Eradication would be planned for the next suitable nonbreeding period, expected to be winter 2023-2024, with contingency for the following winter (2024-2025) depending on practical considerations such as bait deployment method, island size, necessary licensing, etc.
- The success of the eradication measures would be monitored using traps, while the outcomes for the razorbill population would be determined through population counts and productivity estimation. If the monitoring indicates a need for additional actions, then these would be taken as per the contingency planning, or developed in conjunction with the steering group as necessary.
- Monitoring on an annual basis and, if necessary, repeat eradication efforts would continue, until the wind farm has been decommissioned or a determination is made by the SoS, following consultation with the relevant statutory nature conservation body, that compensation is no longer required.

Table 6.3 GANTT chart of the timeline for implementing razorbill compensation through rat eradication.

	2021		2022				2023				2024				2025				2026			
Stage	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Long-list of sites																						
Landowner liaison and licensing review																						
Discussions with NE and final decision on site																						
Steps to obtain necessary consents and authorisations																						
Steering group appointed																						
Baseline monitoring																						
Delivery plan submitted to SoS																						
Eradication programme (inc. contingency)																						
Monitoring (start)																						
Start of Norfolk Vanguard offshore construction																						
Start of first generation at Norfolk Vanguard																						

6.5.2 Proposed routine maintenance and species population monitoring during the project lifetime and funding mechanisms for delivery

6.5.2.1 Maintenance

288. As discussed above, there is no specific maintenance requirement following the rat eradication programme, with the exception of ensuring that the mechanisms used to check for the presence of rats (traps, baits, etc.) are maintained in a serviceable condition and checked on a regular basis. Depending on the island selected for rat eradication it may be feasible for other measures to be taken (e.g. use of sealed containers for goods brought to the island to prevent rat stowaways, which will need to be checked and repaired or replaced as necessary to ensure they remain fit for the intended purpose).

6.5.2.2 Monitoring

289. As discussed above, the razorbill population will be monitored before and after the eradication programme, to obtain population counts and if possible, estimates of breeding success (the latter is dependent on the accessibility or visibility of the breeding sites). Standard seabird census methods will be used (e.g. Walsh et al. 1995). This will allow estimation of the success of the eradication scheme to be determined. This monitoring would initially be undertaken each year, however the requirement to continue this for the lifetime of the wind farm would be discussed with Natural England (e.g. after 3-5 years a lower frequency may be appropriate, such as every 5 or 10 years).

6.5.2.3 Funding

290. The cost of rat eradication is very dependent on the size of island and its topography. Recent UK examples are set out below, however, in each case there were a considerable number of volunteer days, of which it is not clear how many have been included in the quoted costs. Therefore, these costs should be considered as an estimate only:

   i. Canna, Inner Hebrides. The cost was estimated to be approximately £725,000[17], however this estimate does not include a cost breakdown and it is considered that a large amount of unpaid (volunteer) time was used in this project. As no estimate of days is provided for this project (Bell et al. 2011) it is not possible to estimate the staff cost equivalent.

[redacted]

ii. Lundy, Bristol Channel. The cost for this is quoted as £76,500 (Lock 2006), however a total of 2,700 days is also given, of which it is unclear how many were included in the cost estimate. If it is assumed that all the time was volunteered, the time cost for employees would be in the region of £400,000.

iii. The Shiants, Outer Hebrides. These islands were cleared of rats by the RSPB, at a quoted cost of 'more than £1 million'[18], however this project involved approximately 600 days of apparent volunteer effort (Main et al. 2019), which is estimated to be the equivalent of approximately £100,000 of employee time.

291. Estimated costs for each phase of the compensation are provided in Table 6.4

Table 6.4 Indicative costs for proposed FFC SPA compensation.

Compensation Option	Cost Estimate subcategories	Norfolk Boreas cost estimate
Island rat eradication	Development Expenditure	£150,000
	Capital Expenditure	£850,000
	Operational Expenditure	£1,150,000
	Decommissioning Expenditure	NA
Total estimated cost		**£2,150,000**

292. Having regard to the estimated costs for delivery of the compensation measures set out above (as well as other compensation measures which may be required for the FFC SPA, and those measures which may be required for compensation in relation to the Alde-Ore Estuary Special Protection Area and the Haisborough, Hammond and Winterton Special Area of Conservation), the Applicant considers that delivery of the measures, in line with the timescales proposed in the implementation programme, is financially feasible. Therefore, in the event that it is necessary to deliver these (and/or other) compensation measures, the Applicant is confident that the commercial viability of the project would not be prejudiced.

293. The Applicant provided a Funding Statement [APP-009] with the Application, which explains that the Applicant will have the ability to procure the financial resources necessary to fund the works to be authorised by the Order, subject to final Board authority. The Applicant's parent company (Vattenfall Wind Power Ltd), which is part of the wider Vattenfall Group (Europe's fifth largest generator of electricity and the largest generator of heat), have the experience and reputation to enable funds to be procured and this applies equally in respect of the funds to deliver the compensation measures. The Applicant will secure funding for the project after certainty is obtained on development consent, the tender process is complete for

18 [redacted]

the major construction contracts, and the investment case has been satisfied. Once these criteria are met the Applicant will take a final investment decision (FID) which will irrevocably commit funding for the project. Should funding for any compensation measures be required as part of the project then these costs will be factored into any FID.

294. In summary, the Applicant, its parent company, and the wider Vattenfall Group have substantial net assets (as outlined in the accounts shown at Annex 1 and Annex 2 of the Funding Statement, [APP-009]) as well as a positive track record in the field of renewable energy development. The Applicant and the parent company are therefore able to provide the required funding for the project, which would include funding to guarantee the success of any compensation measures required.

6.6 Guillemot and razorbill – potential compensation synergies

295. The same in-principle compensation has been proposed for guillemot and razorbill (hereafter referred to as auks), since these species have similar ecologies, distributions and conservation threats. Thus, should this compensation be undertaken for one species it will in fact deliver for all those present on the island which are subject to predation by rats (i.e. not just auks). Similarly, as discussed above, the compensation would deliver a large degree of over-compensation for the predicted impact magnitudes for the Norfolk Vanguard wind farm (an absolute worst case maximum of 15 guillemots and 6 razorbills), and therefore such measures would in fact provide compensation for impacts from more than one project.

296. Therefore, there is considerable scope for an island rat eradication project to provide compensation for several wind farms and hence this should be considered from a strategic perspective. This is further supported by the fact that the nature of this compensation is ‘all or nothing’ (to all intents, an island is either cleared of rats or it is not), and it is highly probable that for any individual wind farm there would be a very considerable degree of over-compensation derived from such a scheme. The Applicant would be very willing to undertake the proposed compensation (rat eradication) as part of a joint measure with other developers, should this be an appropriate option.

6.7 DCO Condition

297. The Applicant has provided (in a document titled Extract of Schedule 17 to the draft DCO Compensation to protect the coherence of the Natura 2000 Network) proposed wording for a condition which could be inserted into the Norfolk Vanguard DCO should the SoS decide that compensation is required. Natural England and the MMO have been consulted on the proposed wording and are in agreement with much of the principle of the wording, however agreement has not been reached on the

timing of delivery of the compensation measures and on the inclusion of strict timeframes for consultation of the compensation strategy, which the Applicant does not consider necessary to include on the face of the DCO given the ongoing and iterative engagement.

6.8 Proposed content of razorbill compensation plan

298. Following advice from Natural England the razorbill compensation plan will provide the following:

- What, where, when: clear and detailed statements regarding the location and design of the proposal.
- Why and how: ecological evidence to demonstrate compensation for the impacted site feature is deliverable in the proposed locations.
- Demonstration that deliverability is secured.
- Demonstration of the policy/legislative mechanism for delivering the compensation (where relevant).
- Set out clear aims and objectives of the compensation.
- Include proposals for adaptive management.
- Governance proposals for the post-consent phase (where relevant).
- Timescales for implementation including how these timescales relate to the ecological impacts from the development.
- Commitments to monitoring specified success criteria.
- Proposals for reporting on monitoring.
- Proposals for management of the compensation area to support the continued success of the compensation measures (where relevant).

6.9 Summary

299. The most deliverable option for compensating displacement risk for razorbill from the FFC SPA is through rat eradication at another location where this would be anticipated to improve the population status and breeding success of the wider razorbill population and thereby increase the pool of birds available to recruit to the FFC SPA.

300. It is noted that compensation would only be required should the Secretary of State conclude that an AEoI on the razorbill feature of the FFC SPA cannot be ruled out and there is agreement on the Assessment of Alternative Solutions and IROPI case presented in the Applicant’s Habitats Regulations Derogation Provision of Evidence (document reference ExA; IROPI; 11.D10.3).

301. However, it is the Applicant's firm conclusion that there is no AEoI for FFC SPA as a result of the project alone and in-combination with other plans and projects.

7 REDUCTION OF SEABIRD BYCATCH AS COMPENSATION FOR GUILLEMOT AND RAZORBILL

302. In their discretionary advice provided to Norfolk Boreas following review of the draft additional information produced by the Applicant, Natural England requested the Applicant to include investigation of the potential for measures to reduce ornithological bycatch, which could possibly benefit a number of species, with particular reference to guillemot and razorbill. Natural England point out that for bycatch reduction proposals to represent compensation, implementation of bycatch reduction measures would need to potentially benefit the FFC SPA populations of these species. Therefore, the Applicant has also considered these points below.

303. Studies of bycatch mortality in Britain showed that large numbers of common guillemots may be caught and drowned in fixed gill nets set to catch salmonids, gadoids and sea bass, all of which were fisheries that increased considerably in extent in British waters in the 1970s and 1980s (Northridge et al. 1991, Potter and Pawson 1991). However, bycatch rates were found to be too low to cause local population declines (reviewed in Mitchell et al. 2004). Higher bycatch rates occurred in salmon nets in Ireland and those were associated with population declines (Mitchell et al. 2004). Use of fixed gill nets in British and Irish waters decreased in the 2000s, and Mitchell et al. (2004) concluded that "the bycatch threat posed to auks is now reduced". The use of fixed gill nets was also widespread along the coasts of continental Europe in the 1970s to 2000s, and is estimated to have killed tens of thousands of auks. However, according to Mitchell et al. (2004) "mortality in nets outside British waters during winter was insufficient to cause population declines of auks in Britain and Ireland to date and, unless there are large increases in fishing effort using these methods, it is unlikely to do so in the future". The evidence presented in Mitchell et al. (2004) suggests that bycatch reduction may not be adequate as a compensation measure, given that the levels of bycatch seem unlikely to be influencing population trends of UK guillemots or razorbills, despite the fact that quite large numbers are killed in net bycatch.

304. In relation to guillemot and razorbill bycatch, Wernham et al. (2002) pointed out that "naïve birds in their first year of life are much more likely to be caught in nets than adults" and therefore the bycatch data will be strongly biased towards young birds, rather than breeding adults. That may go towards explaining the lack of clear impacts of bycatch of auks on population trends. Bycatch of juvenile auks will have much less impact on the population because their natural mortality is much higher than that of adults.

305. Northridge et al. (2020) reviewed data from 18,916 hauls of static gill nets, 2,239 hauls of midwater trawl nets, and 103 hauls of longlines in UK waters in 1996-2018 that reported bycatch of 267 guillemots and 12 razorbills in static nets and 27 guillemots and 3 razorbills in midwater trawls, but none of either auk species on longlines. Most of the data used from North Sea sites were from 1996 to 2004, so are somewhat out of date now. However, they estimated that bycatch of guillemots by UK fishing vessels in UK waters was around 2,000 to 3,000 guillemots per year and 100 to 200 razorbills per year. Their analysis did find "hot-spots" of guillemot and razorbill bycatch in waters off FFC SPA, in the English Channel, and off Cornwall.

306. Miles et al. (2020) used the data in Northridge et al. (2020) and estimates of seabird population size and demographic parameters to estimate the proportion of annual mortality that was attributable to bycatch. Their modelling assumed that the only guillemots and razorbills in UK waters were those from UK breeding colonies. By ignoring the presence of birds from overseas populations their modelling will have overestimated the impact of bycatch on UK populations. Their modelling also assumed that all age classes were equally vulnerable to bycatch which is contrary to evidence from ringing studies (Wernham et al. 2002). The assumption that younger birds are subject to higher risk of bycatch will also tend to result in their estimates overestimating the impact on populations. However, they estimated that bycatch of guillemots contributed 1.5% to guillemot mortality in the North Sea and contributed 0.9% to razorbill mortality in the North Sea (during the period 1995 to 2004 when the data were collected). According to Miles et al. (2020) "If less than 1% of total annual mortality can be attributed to bycatch, it is reasonable to assume that mitigating bycatch would make negligible difference to population growth rates. The "1% guideline" has been applied in other settings (e.g. from assessments of the impact of windfarms) and derives from EU guidance (European Commission 2018) on the concept of "small numbers" (Article 9.2.c of the Birds Directive), devised to address exploitation of species that may be hunted or taken judiciously for other purposes, under Article 9 of the Birds Directive. It is based on the concept that parameters that inform population dynamics are rarely known to within one percentage point, so that the taking of less than 1% can be considered negligible in terms of mathematical models".

307. Since according to Miles et al. (2020) the estimated level of bycatch of guillemots probably contributed just slightly over 1% to natural mortality in the North Sea UK population, this suggests some scope for compensation by reducing bycatch. However, measures have already been put in place in relation to FFC SPA to achieve that reduction.

308. In 2008, very high levels of bycatch of guillemots and razorbills (hundreds of birds) were found in gillnets set from the sea surface to the seabed to catch salmonids in Filey Bay (RSPB 2015). As a result of this discovery, the Environment Agency introduced a bylaw in 2010 setting out a series of measures to avoid impacts on FFC SPA seabirds. Under the byelaw, netsmen must take reasonable steps to ensure the use of the net does not result in the death of seabirds, must ensure the quick release of live birds, must record all bycatch and, during the month of June, may fish only from 0500 to 2100, and must use high visibility corline in the leader/tailpiece of the net, restricting the monofilament to 70 m or less and ensuring net attendance at all times. Since the introduction of these mitigation measures, seabird bycatch has fallen dramatically, and has remained low (RSPB 2015). In 2008, the bycatch exceeded 500 auks. This was reduced to fewer than 20 in 2013 and 2014 (RSPB 2015). North Eastern Inshore Fisheries and Conservation Authority (2020) report that they introduced a further seasonal netting prohibition in the waters surrounding FFC SPA in 2019, with the aim to further reduce risk of seabird bycatch in fixed nets, although their report does not explain either the definition of the season or the definition of "waters surrounding FFC SPA".

309. It is important to note that Northridge et al. (2020) used bycatch data from 1996 to 2018 in their assessment of impact, so included years before this mitigation was put into effect. In fact, the data in Northridge et al. (2020) for the North Sea are almost all from 1996 to 2004, and so pre-date the implementation of this mitigation. That gives a false impression of the current situation, especially for the area close to FFC SPA which Northridge et al. (2020) did identify as a guillemot and razorbill bycatch hotspot. Since 2010 that has no longer been the case (RSPB 2015). Therefore, the estimates of population level impact in Miles et al. (2020) are also out of date for this region, as they are based on the 1996-2004 data and not on data from the years after implementation of the bylaw controls.

310. Census data for Flamborough Head and Bempton Cliffs SPA (data are not available for the whole of FFC SPA for years before 2017, but Flamborough Head and Bempton Cliffs represents most of the whole FFC SPA seabird population) suggest no clear change in rate of change of guillemot (Fig. 1) or razorbill (Fig. 2) breeding numbers comparing before the introduction of bycatch mitigation measures in 2010 with since 2010, but that comparison is only based on a single census after 2010 (in 2017) so must be treated with caution. However, the lack of any obvious impact of the bycatch is consistent with the suggestion in Miles et al. (2020) that bycatch of razorbills in the North Sea by UK fisheries should be classified as "negligible" in population terms while that of guillemots was not much above the definition of negligible, even before mitigation measures introduced in 2010.

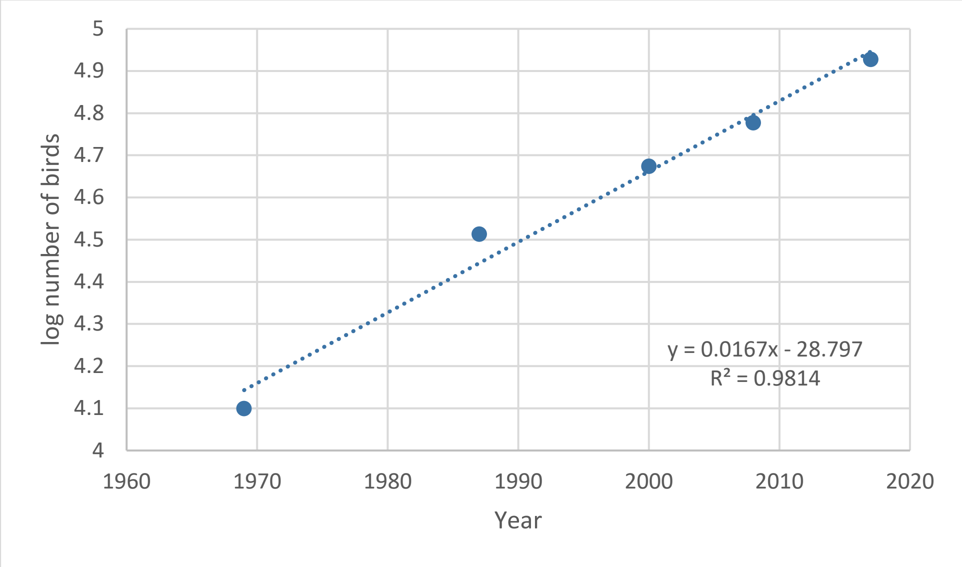

Figure 1. Log10 number of individual guillemots counted at Flamborough Head and Bempton Cliffs SPA 1969 to 2017 (data from Lloyd et al. 2019). The best fit line suggests no difference in rate of population growth after bycatch mitigation measures were introduced in 2010 compared to that beforehand, but the data are limited to only one census since 2010, so must be treated with caution.

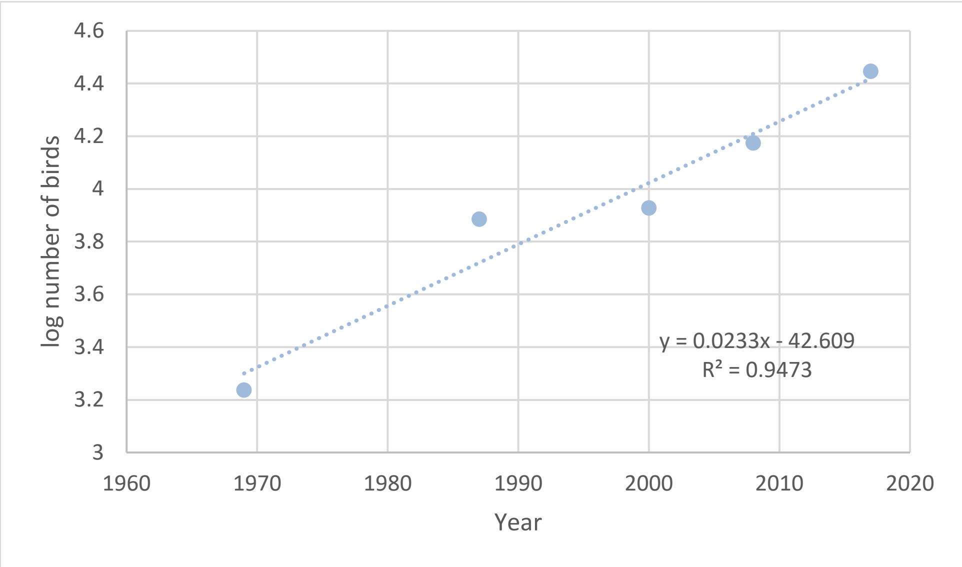

Figure 2. Log10 number of individual razorbills counted at Flamborough Head and Bempton Cliffs SPA 1969 to 2017 (data from Lloyd et al. 2019). The best fit line suggests no clear difference in rate of population growth after bycatch mitigation measures were introduced in 2010 compared to that beforehand, but the data are limited to only one census since 2010, so must be treated with caution.

311. Based on the considerations above, it seems unlikely that measures to reduce bycatch of guillemots and razorbills in UK fisheries in UK waters would provide sufficient scope for compensation. Although there is bycatch of these species in fisheries in the waters of other European countries, the conclusion of Mitchell et al. (2004) that those have little or no impact on the population trend of UK populations of guillemots and razorbills suggests that measures to reduce bycatch in those fisheries is also unlikely to provide robust compensation, especially if that is expected to apply particularly to breeding adults from FFC SPA. Those birds are unlikely to show extensive spatial overlap with overseas fisheries, although higher proportions of immature birds from UK colonies do travel overseas during the nonbreeding season, more so in the case of razorbills than guillemots (Wernham et al. 2002). Overall, the evidence does not suggest that bycatch reduction would provide robust compensation for FFC SPA guillemots or razorbills.

Table 7.1 Summary of In Principle Compensation Measures for guillemot and razorbill

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
Prey enhancement	Partial or complete closure of sandeel fishery in the North Sea would improve fish stocks. Some evidence that this would be beneficial for FFC SPA guillemot and razorbill productivity and survival (and also for other species which feed on sandeel).	✓ Define a closed area	✓ For practical reasons this would need to be an area much in excess of that required to compensate for the loss of up to 15 guillemots and 6 razorbills attributed to Norfolk Vanguard. On this basis the Applicant considers this option is more suitable as a long-term strategic measure covering the potential impacts for multiple wind farms.	✓ Long-term, likely requiring >5 years for effects to become apparent at the colony.	? Currently no authority has the jurisdiction to deliver fisheries management areas for the purposes of compensation. The feasibility of this measure therefore requires government intervention.	x Due to the uncertainty in deliverability of this compensatory measure in the timescales required for the project, the Applicant would not propose to progress this option.
Predator control	Guillemots and razorbills can be subject to high levels of mammalian predation at colonies where nests are accessible (e.g. under boulders). Removal of predators, in particular rats, can result in marked	✓ Delivered through a rat eradication programme conducted at an offshore island thereby improving productivity at target site and leading to increased numbers of adult birds available to recruit into North Sea population of which FFC SPA is a part.	✓ Conducted at the scale of an island, via delivery of rodenticide baits in bespoke boxes. Regular checks of baits and replenishment of bait for a period of weeks or months.	✓ Primary programme conducted over a period of weeks or months over the non-breeding period. Follow up monitoring to determine success over period of up to two years. Benefits to seabirds from first breeding season.	✓ Considered feasible, with recent examples of similar actions at UK sites within recent years. Benefits to Natura suite, with preference for islands closer to FFC SPA if possible.	✓

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
	improvement in productivity.					
Reduction of bycatch in UK fisheries	Reduction in mortality of birds accidentally caught in fixed gill nets.	? Reduction in use of fine mesh fixed gill nets in areas used for foraging. Historical estimates suggest bycatch contributed up to 1.5% of total guillemot mortality and 0.9% to razorbill mortality. But very little of this type of fishing currently appears to be conducted in UK waters.	? Unclear if there are any active fisheries using gear which causes auk bycatch within areas used by birds from FFC SPA. Historical fishery in Filey Bay near the SPA has been controlled since 2010 to minimise risks to seabirds and is no longer a concern. No evidence to indicate bycatch has any detectable effect on auk populations.	? Any changes to fishing gear or other related fishery management measures would need to begin when the wind farm is constructed (i.e. impact predicted to occur) and be maintained for the lifetime of the wind farm.	x Not considered feasible since there is little or no evidence that auks are currently subject to bycatch in the North Sea above negligible levels and there are very few fisheries operating gear which is considered a threat to these species. No indication that the FFC SPA auk populations have been affected by bycatch.	x Very little or no benefit expected due to near total absence of this source of mortality in the UK North Sea fisheries.

7.1 Summary

312. Fishery bycatch for guillemot and razorbill, while historically a local concern near FFC SPA, is now considered to cause very few mortalities and is no longer a concern (RSPB 2015). Therefore reducing bycatch cannot provide compensation for other impacts on these species.

313. As discussed in sections 5 (guillemot) and 6 (razorbill), the most feasible compensation is considered to be eradication of rats at another location where this would be anticipated to improve the population status and breeding success of the wider guillemot and razorbill populations and thereby increase the pool of birds available to recruit to the FFC SPA.

8 CONCLUSION

314. This document (and the equivalent document (document reference: 8.24 and ExA; IROPI; 11.D11.3.App2) which details compensation for lesser black gull at the AOE SPA) has provided the additional ornithological information requested in the letter to the Applicant from the SoS dated 5th July 2021, comprising:

- Updated cumulative and in-combination collision impacts for gannet and kittiwake;
- Updated cumulative and in-combination displacement impacts for gannet, guillemot and razorbill;
- Details of the proposed in-principle compensation for lesser black-backed gull at the AOE SPA, including how these have progressed since the previous request from the SoS;
- Details of the proposed in-principle compensation for kittiwake at the FFC SPA, including how these have progressed since the previous request from the SoS; and,
- Provision of in-principle compensation proposals for guillemot and razorbill from FFC SPA; and,
- Consideration of reducing fishery bycatch as compensation for guillemot and razorbill (as requested by Natural England in their discretionary advice to Norfolk Boreas Limited).

315. The Applicant's position remains that there will be no adverse effects on the integrity of any SPAs as a result of the Norfolk Vanguard wind farm, operating either alone or in-combination with other projects, and that on this basis there is no requirement for these compensation measures. Nonetheless, the Applicant has been actively engaging with relevant stakeholders to progress the compensation requested both during and since the Examination (for kittiwake from FFC SPA and lesser black-backed gull at AOE SPA and also guillemot and razorbill following the request from the SoS for these also to be considered), in order that these management measures can be implemented with minimal delay should the SoS determine they are required.

9 REFERENCES

Booker, H., Price, D., Slader, P., Frayling, T., Williams, T. and Bolton, M. 2019. Seabird recovery on Lundy population change in Manx shearwaters and other seabirds in response to the eradication of rats. British Birds 112: 217-230.
Brown, A. and Grice, P. 2005. Birds in England. T & AD Poyser, London.
Carroll, M.J., Bolton, M., Owen, E., Anderson, G.Q.A., Mackley, E.K., Dunn, E.K. and Furness, R.W. 2017. Kittiwake breeding success in the southern North Sea correlates with prior sandeel fishing mortality. Aquatic Conservation: Marine and Freshwater Ecosystems 27: 1164-1175.
Chimienti, M., Cornulier, T., Owen, E., Bolton, M., Davies, I.M., Travis, J.M.J. and Scott, B.E. 2017. Taking movement data to new depths: inferring prey availability and patch profitability from seabird foraging behavior. Ecology and Evolution 7: 10252-10265.
Coulson, J.C. 2011. The Kittiwake. T & AD Poyser, London.
Coulson, J.C. 2017. Productivity of the black-legged kittiwake Rissa tridactyla required to maintain numbers. Bird Study 64: 84-89.
Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J-P., Shannon, L. and Sydeman, W.J. 2011. Global seabird response to forage fish depletion – one-third for the birds. Science 334: 1703-1706.
Daunt, F., Wanless, S., Greenstreet, S.P.R., Jensen, H., Hamer, K.C. and Harris, M.P. 2008. The impact of the sandeel fishery closure on seabird food consumption, distribution, and productivity in the north-western North Sea. Canadian Journal of Fisheries and Aquatic Sciences 65: 362-381.
Defra (2012): Habitats and Wild Birds Directives: guidance on the application of article 6(4) Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures. Available at: [redacted]
Dunn, R.E., Wanless, S., Green, J.A., Harris, M.P. and Daunt, F. 2019. Effects of body size, sex, parental care and moult strategies on auk diving behaviour outside the breeding season. Journal of Avian Biology 50: e02012.
EC (2012) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC Clarification of the Concepts of: Alternative Solutions, Imperative Reasons of Overriding

Public Interest, Compensatory Measures, Overall Coherence, Opinion of the Commission. [redacted]
EC (2018). Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Brussels, 21.11.2018 C(2018) 7621 final.
Frederiksen, M., Wanless, S., Harris, M.P., Rothery, P. and Wilson, L.J. 2004. The role of industrial fisheries and oceanographic change in the decline of North Sea black-legged kittiwakes. Journal of Applied Ecology 41: 1129-1139.
Frederiksen, M., Wright, P.J., Harris, M.P., Mavor, R.A., Heubeck, M. & Wanless, S. 2005. Regional patterns of kittiwake Rissa tridactyla breeding success are related to variability in sandeel recruitment. Marine Ecology Progress Series 300: 201-211.
Frederiksen, M., Furness, R.W. and Wanless, S. 2007. Regional variation in the role of bottom-up and top-down processes in controlling sandeel abundance in the North Sea. Marine Ecology Progress Series 337: 279-286.
Frederiksen, M., Jensen, H., Daunt, F., Mavor, R.A. and Wanless, S. 2008. Differential effects of a local industrial sand lance fishery on seabird breeding performance. Ecological Applications 18: 701-710.
Furness, R.W. 2007. Responses of seabirds to depletion of food fish stocks. Journal of Ornithology 148: S247-252.
Furness, R.W. and Birkhead, T.R. 1984. Seabird colony distributions suggest competition for food supplies during the breeding season. Nature 311: 655-656.
Furness, R.W. and Tasker, M.L. 2000. Seabird-fishery interactions: Quantifying the sensitivity of seabirds to reductions in sandeel abundance, and identification of key areas for sensitive seabirds in the North Sea. Marine Ecology Progress Series 202: 253-264.
Furness, R.W., MacArthur, D., Trinder, M. and MacArthur, K. 2013. Evidence review to support the identification of potential conservation measures for selected species of seabirds. Report to Defra.
Greenstreet, S.P.R., Armstrong, E., Mosegaard, H., Jensen, H., Gibb, I.M., Fraser, H.M., Scott, B.E., Holland, G.J. and Sharples, J. 2006. Variation in the abundance of sandeels Ammodytes marinus off southeast Scotland: an evaluation of area-closure fisheries management and stock abundance assessment methods. ICES Journal of Marine Science 63: 1530-1550.

Heaney, V. 2018. Seabird Monitoring and Research Project Isles of Scilly 2018. Downloaded from [redacted]

Hentati-Sundberg, J., Olin, A.B., Evans, T.J., Isaksson, N., Berglund, P. and Olsson, O. 2020. A mechanistic framework to inform the spatial management of conflicting fisheries and top predators. Journal of Applied Ecology, 58, 125-134

Hill, S.L., Hinke, J., Bertrand, S., Fritz, L., Furness, R.W., Ianelli, J.N., Murphy, M., Oliveros-Ramos, R., Pichegru, L., Sharp, R., Stillman, R.A., Wright, P.J. and Ratcliffe, N. 2019. Reference points for predators will progress ecosystem-based management of fisheries. Fish and Fisheries doi: 10.1111/faf.12434

Horswill, C. and Robinson, R.A. 2015. Review of seabird demographic rates and density dependence. JNCC Report No. 552. JNCC, Peterborough.

ICES 2017. Report of the Benchmark on Sandeel (WKSand 2016), 31 October – 4 November 2016, Bergen, Norway. ICES CM 2016/ACOM:33. 301pp.

ICES 2018. ICES advice on fishing opportunities, catch and effort, Sandeel (Ammodytes spp.) in divisions 4.b-c, Sandeel Area 1r (central and southern North Sea, Dogger Bank). ICES, Copenhagen.

ICES 2019. Herring assessment working group for the area south of 62oN (HAWG). Volume 1 Issue 2. ICES Scientific Reports. ICES, Copenhagen.

Kadin, M., Olsson, O., Hentati-Sundberg, J., Ehrning, E.W. and Blenckner, T. 2016. Common guillemot Uria aalge parents adjust provisioning rates to compensate for low food quality. Ibis 158: 167-178.

Lindegren, M., van Deurs, M., MacKenzie, B.R., Clausen, L.W., Christensen, A. and Rindorf, A. 2018. Productivity and recovery of forage fish under climate change and fishing: North Sea sandeel as a case study. Fisheries Oceanography 27: 212-221.

Lloyd, I., Aitken, DE., Wildi, J. and O'Hara, D. 2019. Flamborough and Filey Coast SPA Seabird Monitoring Programme 2019 Report. RSPB, Bempton.

Mavor, R.A., Pickerell, G., Heubeck, M. and Thompson, K.R. 2001. Seabird numbers and breeding success in Britain and Ireland, 2000. JNCC. Peterborough. (UK Nature Conservation, No. 25).

Mavor, R.A., Pickerell, G., Heubeck, M. and Mitchell, P.I. 2002. Seabird numbers and breeding success in Britain and Ireland, 2001. JNCC. Peterborough. (UK Nature Conservation, No. 26).

Mavor, R.A., Parsons, M., Heubeck, M., Pickerell, G. and Schmitt, S. 2003. Seabird numbers and breeding success in Britain and Ireland, 2002. JNCC. Peterborough. (UK Nature Conservation, No. 27).
Merkel, B., Descamps, S., Yoccoz, N.G., Gremillet, D., Daunt, F., Erikstad, K.E., Ezhov, A.V., Harris, M.P., Gavrilo, M., Lorentsen, S-H., Reiertsen, T.K., Steen, H., Systad, G.H., Þorarinsson, Þ.L., Wanless, S. and Strøm, H. 2020. Individual migration strategy fidelity but no habitat specialization in two congeneric seabirds. Journal of Biogeography DOI: 10.1111/jbi.13883.
Miles, J., Parsons, M. and O'Brien, S. 2020. Preliminary assessment of seabird population response to potential bycatch mitigation in the UK-registered fishing fleet. Report prepared for Defra Project Code ME6024. JNCC. Defra, UK - Science Search
Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird Populations of Britain and Ireland. Results of the Seabird 2000 Census (1998-2002). T & AD Poyser, London.
Montevecchi, W.A., Gerrow, K., Buren, A.D., Davoren, G.K., Lewis, K.P., Montevecchi, M.W. and Regular, P.M. 2019. Pursuit-diving seabird endures regime shift involving a three-decade decline in forage fish mass and abundance. Marine Ecology Progress Series 627: 171-178.
North Eastern Inshore Fisheries and Conservation Authority 2020. North Eastern Inshore Fisheries and Conservation Authority Annual Report 2019/2020. www.ne-ifca.gov.uk
Northridge, S., di Natale, A., Kinze, C., Lankester, K., de Zarate, V.O. and Sequeria, M. 1991. Gillnet fisheries in the European Community and their impacts on the marine environment. Report to the European Commission Directorate General Environment, Nuclear Safety and Civil Protection.
Northridge, S., Kingston, A. and Coram, A. 2020. Preliminary estimates of seabird bycatch by UK vessels in UK and adjacent waters. Report to JNCC. Defra report ME6024 October 2020. [redacted] ID=20461&FromSearch=Y&Publisher=1&SearchText=ME6024&SortString=ProjectCode&So rtOrder=Asc&Paging=10#Description
Oro, D. and Furness, R.W. 2002. Influences of food availability and predation on survival of kittiwakes. Ecology 83: 2516-2528.

Ørsted 2020. Hornsea Project Three Offshore Wind Farm. Response to the Secretary of State's Minded to Approve Letter Annex 2 to Appendix 2: Kittiwake Artificial Nest Provisioning: Ecological Evidence https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003241-HOW03_30Sep_Appendix_2_Annex_2%20Ecological%20Evidence%20(06543000_A)%20combined%20(06543760_A).pdf

Potter, E.C.E. and Pawson, M.G. 1991. Gill netting. MAFF Directorate of Fisheries Research Leaflet 69, Lowestoft.

Ratcliffe, N., Mitchell, I., Varnham, K., Verboven, N. and Higson, P. 2009. How to prioritize rat management for the benefit of petrels: a case study of the UK, Channel Islands and Isle of Man. Ibis 151: 699-708.

Rijkswaterstaat Zee & Delta 2020. Assessment of relative impact of anthropogenic pressures on marine species in relation to Offshore Wind. SEANSE.

RSPB 2015. Filey Bay: Safe seas for seabirds. ww2.rspb.org.uk/Images/RSPB Filey Bay Safe Seas for Seabirds

Schaefer, A.L., Bishop, M.A. and Thorne, R. 2020. Marine bird response to forage fish during winter in subarctic bays. Fisheries Oceanography 29: 297-308.

Sherley, R.B., Ladd-Jones, H., Garthe, S., Stevenson, O. and Votier, S.C. 2020. Scavenger communities and fisheries waste: North Sea discards support 3 million seabirds, 2 million fewer than in 1990. Fish and Fisheries 21: 132-145.

Stanbury, A., Thomas, S., Aegerter, J., Brown, A., Bullock, D., Eaton, M., Lock, L., Luxmoore, R., Roy, S., Whitaker, S. and Oppel, S. 2017. Priotitising islands in the United Kingdom and crown dependencies for the eradication of invasive alien vertebrates and rodent biosecurity. European Journal of Wildlife Research 63: 31.

Storey, A.E., Ryan, M.G., Fitzsimmons, M.G., Kouwenberg, A.L., Takahashi, L.S., Robertson, G.J., Wilhelm, S.I., McKay, D.W., Herzberg, G.R., Mowbray, F.K., MacMillan, L. and Walsh, C.J. 2017. Balancing personal maintenance with parental investment in a chick-rearing seabird: physiological indicators change with foraging conditions. Conservation Physiology 5: cox055.

Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clemet, P., Lewis, P., McLean, I., Baker, H. and Whitehead, S. (2001) The UK SPA network: its scope and contents. Peterborough: Joint Nature Conservation Committee.

Turner, D. 2010. Counts and breeding success of Black-legged Kittiwakes *Rissa tridactyla* nesting on man-made structures along the River Tyne, northeast England, 1994-2009. Seabird 23, 111-126
Tveit, B.O., Mobakken, G. and Bryne, O. 2004. Fugler og fuglafolk på Utsira. Utsira Fuglestasjon, Utsira.
Wakefield, E.D., Owen, E., Baer, J. et al. 2017. Breeding density, fine-scale tracking, and large-scale modeling reveal the regional distribution of four seabird species. Ecological Applications 27: 2074-2091.
Walsh, P.M., Brindley, E. and Heubeck, M. 1995. Seabird numbers and breeding success in Britain and Ireland, 1994. UK Nature Conservation No. 18. JNCC, Peterborough.
Wanless, S., Harris, M.P., Newell, M.A., Speakman, J.R. and Daunt, F. 2018. Community-wide decline in the occurrence of lesser sandeels Ammodytes marinus in seabird chick diets at a North Sea colony. Marine Ecology Progress Series 600: 193-206.
Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. and Baillie, S. 2002. The Migration Atlas: Movements of the birds of Britain and Ireland. T & AD Poyser, London.
Wright, P., Regnier, T., Eerkes-Medrano, D. and Gibb, F. 2018. Climate change and marine conservation: Sandeels and their availability as seabird prey. MCCIP, Lowestoft.

10 FFC SPA UPDATED CUMULATIVE AND IN-COMBINATION COLLISION AND DISPLACEMENT ESTIMATES

Table 10.1 Gannet cumulative and in-combination collision risk.

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	0.6	0	0.9	0.04	0.7	0.05	2.2	0.1
1	Greater Gabbard	14	0	8.8	0.42	4.8	0.3	27.5	0.7
1	Gunfleet Sands	-	-	-	-	-	-	-	-
1	Kentish Flats	1.4	0	0.8	0.04	1.1	0.07	3.3	0.1
1	Kentish Flats Extension	-	-	-	-	-	-	-	-
1	Lincs	2.1	2.1	1.3	0.06	1.7	0.1	5	2.3
1	London Array	2.3	0	1.4	0.07	1.8	0.11	5.5	0.2
1	Lynn and Inner Dowsing	0.2	0.2	0.1	0.01	0.2	0.01	0.5	0.2
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	14.1	14.1	3.5	0.17	0	0	17.6	14.3
1	Teesside	4.9	2.4	1.7	0.08	0	0	6.7	2.5
1	Thanet	1.1	0	0	0	0	0	1.1	0
1	Humber Gateway	1.9	1.9	1.1	0.05	1.5	0.09	4.5	2
1	Westermost Rough	0.2	0.2	0.1	0.01	0.2	0.01	0.5	0.2
1	Hywind	5.6	0	0.8	0.04	0.8	0.05	7.2	0.1
2	Kincardine	3	0	0	0	0	0	3	0
2	Beatrice	37.4	0	48.8	2.34	9.5	0.59	95.7	2.9
2	Dudgeon	22.3	22.3	38.9	1.87	19.1	1.18	80.3	25.3
2	Galloper	18.1	0	30.9	1.48	12.6	0.78	61.6	2.3
2	Race Bank	33.7	33.7	11.7	0.56	4.1	0.25	49.5	34.5
2	Rampion	36.2	0	63.5	3.05	2.1	0.13	101.8	3.2
2	Hornsea Project One	11.5	11.5	32	1.54	22.5	1.4	66	14.4
3	Blyth Demonstration Project	3.5	0	2.1	0.1	2.8	0.17	8.4	0.3
3	Dogger Bank Creyke Beck Projects A and B	81.1	40.6	83.5	4.0	54.4	3.4	219.0	47.9
3	East Anglia ONE	3.4	3.4	131	6.3	6.3	0.4	140.7	10.1
3	European Offshore Wind Deployment Centre	4.2	0	5.1	0.25	0.1	0	9.3	0.3
3	Firth of Forth Alpha and Bravo	800.8	0	49.3	2.37	65.8	4.08	915.9	6.4
3	Inch Cape	336.9	0	29.2	1.4	5.2	0.32	371.3	1.7
3	Methil	6	0	0	0	0	0	6	0
3	Moray Firth (EDA)	80.6	0	35.4	1.7	8.9	0.55	124.9	2.3
3	Neart na Gaoithe	143	0	47	2.26	23	1.43	213	3.7
3	Dogger Bank Teesside Projects A and B	14.8	7.4	10.1	0.49	10.8	0.67	35.7	8.5
3	Triton Knoll	26.8	26.8	64.1	3.08	30.1	1.87	121	31.7
3	Hornsea Project Two	7	7	14	0.67	6	0.37	27	8
4	East Anglia THREE	6.1	6.1	33.3	1.6	9.6	0.6	49	8.3
5	Hornsea Project Three	10	6	5	0	4	0	19	7
5	Norfolk Vanguard	8.2	8.2	18.6	0.89	5.3	0.33	32.1	9.4
6	Moray West	10	0	2	0.1	1	0.06	13	0.2
6	Norfolk Boreas	14.1	14.2	12.7	0.61	3.9	0.24	30.7	15.1
6	East Anglia TWO	12.5	12.5	23.1	1.1	4.0	0.2	39.6	13.8
6	East Anglia ONE North	12.4	12.4	11.0	0.5	1.1	0.1	24.5	13.0

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
6	*Hornsea 4 (PEIR)**	*43.3*	*43.3*	*9.9*	*0.48*	*8.1*	*0.5*	*61.3*	*44.3*
6	*Dudgeon Extension and Sheringham Extension*	*4.0*	*4.0*	*6.4*	*0.3*	*0.4*	*0.02*	*10.8*	*4.3*
	Total (all projects)	**1839.3**	**280.3**	**839.1**	**40.1**	**333.5**	**20.4**	**3012.0**	**341.6**
	Total (minus Hornsea Project Four & Dudgeon and Sheringham Extensions)	**1792.0**	**233.0**	**822.8**	**39.3**	**325.0**	**19.9**	**2939.9**	**293.0**

* Note that Hornsea Project Four has now submitted a final application but these have not been updated in this table. However the PEIR figures represent a wort case and therefore the totals remain precautionary.

Table 10.2 Updated kittiwake cumulative and in-combination collision risk.

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	0.0	0.0	2.1	0.1	1.7	0.1	3.8	0.2
1	Greater Gabbard	1.1	0.0	15.0	0.8	11.4	0.8	27.5	1.6
1	Gunfleet Sands	-	-	-	-	-	-	-	
1	Kentish Flats	0.0	0.0	0.9	0.1	0.7	0.1	1.6	0.1
1	Kentish Flats Extension	0.0	0.0	0.0	0.0	2.7	0.2	2.7	0.2
1	Lincs	0.7	0.7	1.2	0.1	0.7	0.1	2.6	0.8
1	London Array	1.4	0.0	2.3	0.1	1.8	0.1	5.5	0.3
1	Lynn and Inner Dowsing	-	-	-	-	-	-	-	
1	Scroby Sands	-	-	-	-	-	-	-	
1	Sheringham Shoal	-	-	-	-	-	-	-	
1	Teesside	38.4	0.0	24.0	1.3	2.5	0.2	64.9	1.5
1	Thanet	0.2	0.0	0.5	0.0	0.4	0.0	1.1	0.1
1	Humber Gateway	1.9	1.9	3.2	0.2	1.9	0.1	7.0	2.2
1	Westermost Rough	0.1	0.1	0.2	0.0	0.1	0.0	0.5	0.1
1	Hywind	16.6	0.0	0.9	0.1	0.9	0.1	18.3	0.1
2	Kincardine	22.0	0.0	9.0	0.5	1.0	0.1	32.0	0.6
2	Beatrice	94.7	0.0	10.7	0.6	39.8	2.9	145.2	3.5
2	Dudgeon	-	-	-	-	-	-	-	
2	Galloper	6.3	0.0	27.8	1.5	31.8	2.3	65.9	3.8
2	Race Bank	1.9	1.9	23.9	1.3	5.6	0.4	31.4	3.6
2	Rampion	54.4	0.0	37.4	2.0	29.7	2.1	121.5	4.2
2	Hornsea Project One	44.0	36.5	55.9	3.0	20.9	1.5	120.8	41.0
3	Blyth Demonstration Project	1.7	0.0	2.3	0.1	1.4	0.1	5.4	0.2
3	Dogger Bank Creyke Beck Projects A and B	288.6	55.8	135.0	7.3	295.4	21.3	719.0	84.3
3	East Anglia ONE	1.8	0.0	160.4	8.7	46.8	3.4	209.0	12.0
3	European Offshore Wind Deployment Centre	11.8	0.0	5.8	0.3	1.1	0.1	18.7	0.4
3	Firth of Forth Alpha and Bravo	153.1	0.0	313.1	16.9	247.6	17.8	713.8	34.7
3	Inch Cape	13.1	0.0	224.8	12.1	63.5	4.6	301.4	16.7
3	Methil	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0
3	Moray Firth (EDA)	43.6	0.0	2.0	0.1	19.3	1.4	64.9	1.5
3	Neart na Gaoithe	32.9	0.0	56.1	3.0	4.4	0.3	93.4	3.4
3	Dogger Bank Teesside Projects A and B	136.9	26.4	90.7	4.9	216.9	15.6	444.5	46.9
3	Triton Knoll	24.6	24.6	139.0	7.5	45.4	3.3	209.0	35.4
3	Hornsea Project Two	16.0	13.3	9.0	0.5	3.0	0.2	28.0	14.0
4	East Anglia THREE	6.1	0.0	69.0	3.7	37.6	2.7	112.7	6.4
5	Hornsea Project Three	77	0 (72)	38	0 (2)	8	0 (1)	123	0 (65-75)*
5	Norfolk Vanguard	21.8	18.7	16.4	0.9	19.3	1.4	57.5	21.0
6	Moray West	79.0	0.0	24.0	1.3	7.0	0.5	110.0	1.8
6	Norfolk Boreas	13.3	11.4	32.2	1.7	11.9	0.9	57.5	14.0
6	East Anglia TWO	29.5	0.0	5.4	0.3	7.4	0.5	42.3	0.8
6	East Anglia ONE North	40.4	0.0	8.1	0.4	3.5	0.3	51.9	0.7
6	*Hornsea 4 (PEIR)**	*153.3*	*153.3*	*34.7*	*1.9*	*9.9*	*0.7*	*197.9*	*155.9*

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
6	*Dudgeon Extension and Sheringham Extension*	*18.1*	*18.1*	*10.5*	*0.6*	*2.2*	*0.2*	*30.8*	*18.9*
	Total (all projects)	**1446.7**	**362.7**	**1591.5**	**83.9**	**1205.2**	**86.4**	**4243.4**	**532.1**
	Total (minus Hornsea Project Four & Dudgeon and Sheringham Extensions)	**1275.3**	**191.3**	**1546.3**	**81.4**	**1193.1**	**85.5**	**4014.7**	**357.3**

* Note that Hornsea Project Four has now submitted a final application but these have not been updated in this table. However the PEIR figures represent a wort case and therefore the totals remain precautionary.

Table 10.3 Updated gannet numbers at risk of cumulative and in-combination displacement. Note these are abundance estimates, not mortalities.

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	-	-	-	-	-	-	-	-
1	Greater Gabbard	252	0	69	3.3	105	6.5	426	9.8
1	Gunfleet Sands	0	0	12	0.6	9	0.6	21	1.2
1	Kentish Flats	-	-	-	-	-	-	-	-
1	Kentish Flats Extension	0	0	13	0.6	0	0	13	0.6
1	Lincs	-	-	-	-	-	-	-	-
1	London Array	-	-	-	-	-	-	-	-
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	47	47	31	1.5	2	0.1	80	48.6
1	Teesside	1	0.5	0	0	0	0	1	0.5
1	Thanet	-	-	-	-	-	-	-	-
1	Humber Gateway	-	-	-	-	-	-	-	-
1	Westermost Rough	-	-	-	-	-	-	-	-
1	Hywind	10	0	0	0	4	0.2	14	0.2
2	Kincardine	120	0	0	0	0	0	120	0
2	Beatrice	151	0	0	0	0	0	151	0
2	Dudgeon	53	53	25	1.2	11	0.7	89	54.9
2	Galloper	360	0	907	43.5	276	17.1	1543	60.6
2	Race Bank	92	92	32	1.5	29	1.8	153	95.3
2	Rampion	0	0	590	28.3	0	0	590	28.3
2	Hornsea Project One	671	671	694	33.3	250	15.5	1615	719.8
3	Blyth Demonstration Project	-	-	-	-	-	-	-	-
3	Dogger Bank Creyke Beck A	518	259	916	44	176	10.9	1610	313.9
3	Dogger Bank Creyke Beck B	637	318.5	1132	54.3	218	13.5	1987	386.3
3	East Anglia ONE	161	161	3638	174.6	76	4.7	3875	340.3
3	European Offshore Wind Deployment Centre	35	0	5	0.2	0	0	40	0.2
3	Firth of Forth Alpha	1716	0	296	14.2	138	8.6	2150	22.8
3	Firth of Forth Bravo	1240	0	368	17.7	194	12	1802	29.7
3	Inch Cape	2398	0	703	33.7	212	13.1	3313	46.8
3	Methil	23	0	0	0	0	0	23	0
3	Moray Firth (EDA)	564	0	292	14	27	1.7	883	15.7
3	Neart na Gaoithe	1987	0	552	26.5	281	17.4	2820	43.9
3	Dogger Bank Teesside A	968	484	379	18.2	226	14	1573	516.2
3	Dogger Bank Teesside B	1282	641	508	24.4	238	14.8	2028	680.2
3	Triton Knoll	211	211	15	0.7	24	1.5	250	213.2
3	Hornsea Project Two	457	457	1140	54.7	124	7.7	1721	519.4
4	East Anglia THREE	412	412	1269	60.9	524	32.5	2205	505.4
5	Hornsea Project Three	1333	844	984	47	524	32	2843	924
5	Norfolk Vanguard	271	271	2453	117.7	437	27.1	3161	415.8
6	Moray West	2827	0	439	21.1	144	8.9	3410	30
6	Norfolk Boreas	1229	1229	1723	82.7	526	32.6	3478	1344.3
6	East Anglia TWO	192	192	891	42.8	192	11.9	1275	246.7
6	East Anglia ONE North	149	149	468	22.5	44	2.7	661	174.2
6	*Hornsea 4 (PEIR)**	*1892*	*1892*	*1192*	*57.2*	*659*	*40.9*	*3743*	*1990.1*
6	*Dudgeon Extension and Sheringham Extension*	*401*	*401*	*638*	*30*	*47*	*3*	*1086*	*434*

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
	Total (all projects)	**22660**	**8785**	**22374**	**1073**	**5717**	**354**	**50751**	**10213**
	Total (minus Hornsea Project Four & Dudgeon and Sheringham Extensions)	**20367**	**6492**	**20544**	**986**	**5014**	**311**	**45925**	**7789**

* Note that Hornsea Project Four has now submitted a final application however these have not been updated in this table.

Table 10.4 Updated guillemot numbers at risk of cumulative and in-combination displacement. Note these are abundance estimates, not mortalities.

Tier	Wind farm	Breeding season		Nonbreeding season		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	-	-	-	-	-	-
1	Greater Gabbard	345	0	548	24.1	893	24.1
1	Gunfleet Sands	0	0	363	16	363	16
1	Kentish Flats	0	0	3	0.1	3	0.1
1	Kentish Flats Extension	0	0	4	0.2	4	
1	Lincs & LID	582	0	814	35.8	1396	35.8
1	London Array	192	0	377	16.6	569	16.6
1	Scroby Sands	-	-	-	-	-	-
1	Sheringham Shoal	390	0	715	31.5	1105	31.5
1	Teesside	267	267	901	39.6	1168	306.6
1	Thanet	18	0	124	5.5	142	5.5
1	Humber Gateway	99	99	138	6.1	237	105.1
1	Westermost Rough	347	347	486	21.4	833	368.4
1	Hywind	249	0	2136	94	2385	94
2	Kincardine	632	0	0	0	632	0
2	Beatrice	13610	0	2755	121.2	16365	121.2
2	Dudgeon	334	0	542	23.8	876	23.8
2	Galloper	305	0	593	26.1	898	26.1
2	Race Bank	361	0	708	31.2	1069	31.2
2	Rampion	10887	0	15536	683.6	26423	683.6
2	Hornsea Project One	9836	4554.1	8097	356.3	17933	4910.4
3	Blyth Demonstration Project	1220	0	1321	58.1	2541	58.1
3	Dogger Bank Creyke Beck A	5407	1892.5	6142	270.2	11549	2162.7
3	Dogger Bank Creyke Beck B	9479	3317.7	10621	467.3	20100	3785
3	East Anglia ONE	274	0	640	28.2	914	28.2
3	European Offshore Wind Deployment Centre	547	0	225	9.9	772	9.9
3	Firth of Forth Alpha	13606	0	4688	206.3	18294	206.3
3	Firth of Forth Bravo	11118	0	4112	180.9	15230	180.9
3	Inch Cape	4371	0	3177	139.8	7548	139.8
3	Methil	25	0	0	0	25	0
3	Moray Firth (EDA)	9820	0	547	24.1	10367	24.1
3	Neart na Gaoithe	1755	0	3761	165.5	5516	165.5
3	Dogger Bank Teesside A	3283	1149.1	2268	99.8	5551	1248.9
3	Dogger Bank Teesside B	5211	1823.9	3701	162.8	8912	1986.7
3	Triton Knoll	425	425	746	32.8	1171	457.8
3	Hornsea Project Two	7735	3581.3	13164	579.2	20899	4160.5
4	East Anglia THREE	1744	0	2859	125.8	4603	125.8
5	Hornsea Project Three	13374	0	17772	782	31146	782
5	Norfolk Vanguard	4320	0	4776	210.2	9096	210.2
6	Moray West	24426	0	38174	1679.7	62600	1679.7
6	Norfolk Boreas	7767	0	13777	606.2	21544	606.2
6	East Anglia TWO	2077	0	1675	73.7	3752	73.7
6	East Anglia ONE North	4183	0	1888	83.1	6071	83.1
6	*Hornsea 4 (PEIR)**	*15245*	*15245*	*69555*	*3060.4*	*84800*	*18305.4*
6	*Dudgeon Extension and Sheringham Extension*	*3576*	*0*	*8671*	*382*	*12247*	*382*
	Total (all projects)	**189442**	**32702**	**249100**	**10961**	**438542**	**43663**

Tier	Wind farm	Breeding season		Nonbreeding season		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
	Total (minus Hornsea Project Four & Dudgeon and Sheringham Extensions)	**170621**	**17457**	**170874**	**7519**	**341495**	**24975**

* Note that Hornsea Project Four has now submitted a final application but these have not been updated in this table. However the PEIR figures represent a wort case and therefore the totals remain precautionary.

Table 10.5 Updated razorbill numbers at risk of cumulative and in-combination displacement. Note these are abundance estimates, not mortalities.

Tier	Wind farm	Breeding season		Autumn migration		Nonbreeding season		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	-	-	-	-	-	-	-	-	-	-
1	Greater Gabbard	0	0	0	0	387	10.5	84	2.8	471	13
1	Gunfleet Sands	0	0	0	0	30	0.8	0	0	30	1
1	Kentish Flats	-	-	-	-	-	-	-	-	-	-
1	Kentish Flats Extension	-	-	-	-	-	-	-	-	-	-
1	Lincs & LID	45	0	34	1.1	22	0.6	34	1.1	134	3
1	London Array	14	0	20	0.7	14	0.4	20	0.7	68	2
1	Scroby Sands	-	-	-	-	-	-	-	-	-	-
1	Sheringham Shoal	106	0	1343	45.7	211	5.7	30	1	1690	52
1	Teesside	16	0	61	2.1	2	0.1	20	0.7	99	3
1	Thanet	3	0	0	0	14	0.4	21	0.7	37	1
1	Humber Gateway	27	0	20	0.7	13	0.4	20	0.7	80	2
1	Westermost Rough	91	91	121	4.1	152	4.1	91	3.1	455	102
1	Hywind	30	0	719	24.4	10	0.3			759	25
2	Kincardine	22	0		0		0			22	0
2	Beatrice	873	0	833	28.3	555	15	833	28.3	3094	72
2	Dudgeon	256	0	346	11.8	745	20.1	346	11.8	1693	44
2	Galloper	44	0	43	1.5	106	2.8	394	13.4	587	18
2	Race Bank	28	0	42	1.4	28	0.8	42	1.4	140	4
2	Rampion	630	0	66	2.2	1244	33.6	3327	113.1	5267	149
2	Hornsea Project One	1109	534.5	4812	163.6	1518	41	1803	61.3	9242	800
3	Blyth Demonstration Project	121	0	91	3.1	61	1.6	91	3.1	364	8
3	Dogger Bank Creyke Beck A	1250	375	1576	53.6	1728	46.7	4149	141.1	8703	616
	Dogger Bank Creyke Beck B	1538	461.4	2097	71.3	2143	57.9	5119	174	10897	765
3	East Anglia ONE	16	0	26	0.9	155	4.2	336	11.4	533	17
3	European Offshore Wind Deployment Centre	161	0	64	2.2	7	0.2	26	0.9	258	3
3	Firth of Forth Alpha	5876	0			1103	29.8			6979	30
3	Firth of Forth Bravo	3698	0			1272	34.3			4970	34
3	Inch Cape	1436	0	2870	97.6	651	17.6			4957	115

Tier	Wind farm	Breeding season		Autumn migration		Nonbreeding season		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
3	Methil	4	0	0	0	0	0	0	0	4	0
3	Moray Firth (EDA)	2423	0	1103	37.5	30	0.8	168	5.7	3724	44
3	Neart na Gaoithe	331	0	5492	186.7	508	13.7			6331	200
3	Dogger Bank Teesside A	834	250.2	310	10.6	959	25.9	1919	65.2	4022	352
3	Dogger Bank Teesside B	1153	345.9	592	20.1	1426	38.5	2953	100.4	6125	505
3	Triton Knoll	40	0	254	8.6	855	23.1	117	4	1265	36
3	Hornsea Project Two	2511	1210.3	4221	143.5	720	19.4	1668	56.7	9119	1430
4	East Anglia THREE	1807	0	1122	38.1	1499	40.5	1524	51.8	5952	130
5	Hornsea Project Three	630	0	2020	69	3649	99	2105	72	8404	240
5	Norfolk Vanguard	879	0	866	29.5	839	22.7	924	31.4	3508	84
6	Moray West	2808	0	3544	120.5	184	5	3585	121.9	10121	247
6	Norfolk Boreas	630	0	263	8.9	1065	28.8	345	11.7	2303	49
6	East Anglia TWO	281	0	44.1	1.5	136.4	3.7	230	7.8	692	13
6	East Anglia ONE North	403	0	85	2.9	54	1.5	207	7	749	11
6	*Hornsea 4 (PEIR)**	*580*	*580*	*5960*	*202.6*	*685*	*18.5*	*1361*	*46.3*	*8586*	*847.4*
6	*Dudgeon Extension and Sheringham Extension*	*1064*	*0*	*4295*	*146*	*1310*	*35*	*420*	*14*	*7089*	*195*
	Total (all projects)	**33768**	**3848**	**45355**	**1542**	**26090**	**705**	**34312**	**1166**	**139523**	**7262**
	Total (minus Hornsea Project Four & Dudgeon and Sheringham Extensions)	**32124**	**3268**	**35100**	**1194**	**24095**	**651**	**32531**	**1106**	**123848**	**6220**

* Note that Hornsea Project Four has now submitted a final application but these have not been updated in this table. However the PEIR figures represent a wort case and therefore the totals remain precautionary.

APPENDIX 1 – MODELLED COLONY PRODUCTION OF ADULTS AGAINST ACCUMULATED COLLISION MORTALITY

Table A1. Modelled accumulation of collision mortality at Norfolk Vanguard against production of adults (assuming 4 years to maturation) and various colony growth rate and starting size assumptions. Shaded cell indicates year in which accumulated adult production exceeds accumulated mortality.

Year	Norfolk Boreas collision mortality (upper 95% c.i.). Wind farm operation in year 5	Accumulated mortality at Norfolk Boreas	Production of adults (colony initialised in 2022)			
			Annual colony growth = 20%, initial colony size = 50 pairs, excess productivity = 0.6	Annual colony growth = 20%, initial colony size = 50 pairs, excess productivity = 0.8	Annual colony growth = 20%, initial colony size = 100 pairs, excess productivity = 0.6	Annual colony growth = 20%, initial colony size = 100 pairs, excess productivity = 0.6
2022	0	0	0	0	0	0
2023	0	0	0	0	0	0
2024	0	0	0	0	0	0
2025	0	0	0	0	0	0
2026	60 (operation starts)	60	15	20	30	40
2027	60	120	33	44	66	88
2028	60	180	55	73	109	145
2029	60	240	81	108	160	214
2030	60	300	113	150	222	296
2031	60	360	150	200	297	396
2032	60	420	195	260	386	515
2033	60	480	249	333	493	657
2034	60	540	314	419	621	829
2035	60	600	392	523	776	1034
2036	60	660	486	648	961	1281
2037	60	720	598	798	1183	1577
2038	60	780	733	978	1449	1932
2039	60	840	895	1193	1769	2359
2040	60	900	1075	1452	2153	2870
2041	60	960	1255	1763	2613	3484
2042	60	1020	1435	2135	3166	4221
2043	60	1080	1615	2583	3829	5105
2044	60	1140	1795	3119	4624	6166
2045	60	1200	1975	3763	5579	7439
2046	60	1260	2155	4536	6725	8966
2047	60	1320	2335	5463	8100	10800
2048	60	1380	2515	6576	9750	12999
2049	60	1440	2695	7911	11729	15639

Year	Norfolk Boreas collision mortality (upper 95% c.i.). Wind farm operation in year 5	Accumulated mortality at Norfolk Boreas	Production of adults (colony initialised in 2022)			
			Annual colony growth = 20%, initial colony size = 50 pairs, excess productivity = 0.6	Annual colony growth = 20%, initial colony size = 50 pairs, excess productivity = 0.8	Annual colony growth = 20%, initial colony size = 100 pairs, excess productivity = 0.6	Annual colony growth = 20%, initial colony size = 100 pairs, excess productivity = 0.6
2050	60	1500	2875	9514	14105	18807
2051	60	1560	3055	11437	16956	22608
2052	60	1620	3235	13744	20377	27170
2053	60	1680	3415	16513	24483	32644
2054	60	1740	3595	19836	29409	39212
2055	60	1800	3775	23824	35321	47094
2056	60	1860	3955	28608	42415	56553