

Hornsea Offshore Wind Farm

Project Two

Clarification Note – Apportioning of predicted gannet mortality to the Flamborough and Filey Coast pSPA population

Appendix N to the Response submitted for Deadline IIA

Application Reference: EN010053

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| Date/Print Name | |
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1 Apportioning and assessment of predicted gannet mortality of the Flamborough and Filey Coast pSPA population

1.1 Introduction

- 1.1.1 This clarification note has been prepared in respect of the application for a development consent order (DCO) to the Secretary of State under the Planning Act 2008 ('the Application') by SMartWind Ltd on behalf of Optimus Wind Ltd and Breesea Ltd (the 'Applicant') for the Hornsea Project Two Offshore Wind Farm (the 'Project').
- 1.1.2 This note has been prepared in response to queries raised by Natural England in both their Relevant and Written Representations regarding the apportioning of gannets present within the Project site to the Flamborough and Filey Coast (FFC) pSPA during the breeding, post-breeding and pre-breeding seasons. Specifically, this note explores the assumptions made regarding the spatial and numerical distribution of non-breeding (including immature) birds during the breeding season and features of the apportioning methodology applied in the post-breeding and pre-breeding seasons.
- 1.1.3 The note provides details of the applicants considered position and deemed implications for the FFC pSPA in addition to the position of Natural England. Where differences between the Applicant and Natural England occur, these are explored to provide appropriate clarity.
- 1.1.4 The report is structured to include the following sections:
- A description of consultation with Natural England from the Section 42 consultation to the final application submission and any consultation that has taken place as part of the examination process (Section 1.2);
 - Gannet phenology – definition of seasonal extents (Section **Error! Reference source not found.**);
 - Breeding season apportioning – Project Two alone (Section **Error! Reference source not found.**);
 - Post- and pre-breeding apportioning – Project Two alone (Section **Error! Reference source not found.**);
 - Gannet displacement and apportioning (Section **Error! Reference source not found.**);
 - Annual predicted mortality apportioning to FFC pSPA – Project Two alone (Section 1.8);
 - Assessment of predicted gannet mortality from Project Two in combination with other plans or projects (Section 1.8); and
 - Conclusions – implications for FFC pSPA (Section **Error! Reference source not found.**).

1.2 Consultation with Natural England

- 1.2.1 This section outlines the evolution of the assessment of the gannet feature of FFC pSPA, including; the consultation and development of the Biologically Defined Minimum Population Scale (BDMPS) approach, and the apportioning methodologies applied. During Section 42, post-application and within the examination period there have been ongoing discussions with Natural England that have informed the BDMPS and apportioning methodologies presented in the submitted application and within this clarification note.
- 1.2.2 The remaining text in Section 1.2 of this note details queries raised by Natural England at various stages of the application and which are clarified within this note.

Section 42 and application

- 1.2.3 In the Section 42 submission, gannet was included within the draft HRA Report as the Project site falls within the mean-maximum foraging range (Thaxter et al; 2012) from the FFC pSPA therefore exhibiting potential connectivity with the Project site. Following Section 42 consultation with Natural England, the Applicant applied the BDMPS and seasonal definitions from Furness (2015) to the assessment within the HRA Report (Doc. Ref. 12.6).

Natural England's Relevant Representation

- 1.2.4 Natural England's Relevant Representation included a number of queries related to the apportioning methodology used for gannet presented in Appendix B of the HRA Report (Doc Ref 12.6) (paragraphs 36 to 44 of Natural England's Relevant Representation).
- 1.2.5 The first query in their Relevant Representation raised relates to the apportioning undertaken in the breeding season. Natural England query the assumption, as detailed in the HRA Report (Doc ref No. 12.6), that all gannet present at the Project site originate from the pSPA versus the suggestion in Appendix B of the HRA Report (Doc ref No. 12.6), which alludes immature and non-breeding birds having been considered as part of the apportioning exercise. A breeding adult proportion for gannets of 0.586 is referenced in Appendix B of the HRA Report (Doc ref No. 12.6), however, Natural England consider that, if immatures are to be accounted for, then any proportion should be site-specific, specifically the percentage of adults (72%) recorded during boat-based surveys and quoted in the Ornithology Technical Report (Doc ref No. 7.5.5.1).
- 1.2.6 In the post-breeding season the Applicant calculated that 1.9% of birds present within the Project site may originate from the FFC pSPA based on the Project site lying to the north of the pSPA. Natural England point out that the Project site actually lies slightly to the south of the pSPA and as a result Natural England recommend that the proportion of birds originating from the FFC pSPA ranges

from between 4.8% (based on figures from Furness 2015) and 5.2% (based on the Applicant's approach).

Pre-examination and examination consultation

1.2.7 At a consultation meeting on the 3rd June 2015, the apportioning of impacts to the FFC pSPA gannet population was discussed. The implications of these discussions are applied to the positions of the Applicant and Natural England in the remainder of this note.

1.3 Gannet phenology – seasonal definitions

1.3.1 Following Section 42 consultation with Natural England, three seasons were defined for gannet based on information presented in Furness (2015), these are presented in Table 1-1.

Table 1-1: Seasonal extents used for gannet throughout the assessment of Hornsea Project Two.

| Season | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pre-breeding | | | | | | | | | | | | |
| Breeding | | | | | | | | | | | | |
| Post-breeding | | | | | | | | | | | | |

1.3.2 Natural England have not raised any disagreements with the seasonal definitions presented in Table 1-1 within their Relevant and Written Representations. Therefore, the Applicant and Natural England are aligned in their application for all assessment purposes.

1.4 Breeding season apportioning – Project Two alone

Foraging range

1.4.1 The proportion of gannets present at the Project site from FFC pSPA during the breeding season was derived using the mean-maximum foraging range data for gannet taken from Thaxter et al. (2012) and specific to the Bempton Cliffs colony from Wakefield et al. (2013). For the purposes of the assessment, a precautionary assumption was applied in that 100% of the mortality predicated for Project Two could be attributed to the FFC pSPA. It was also assumed that breeding birds from any other breeding colonies would not be present at the Project site during the breeding season based on information presented in Wakefield et al., (2013). The approach applied was consistent with the approach recommended by Natural England during Section 42 consultation.

1.4.2 Although, the precautionary assumption that 100% of gannets recorded in the breeding season originate from the pSPA has been subject of debate (see

following section) the application of foraging range is not. The Applicant and Natural England agree that a foraging range of 229.4 km, as applied within the HRA Report (Doc ref. 12.6), is appropriate.

Population age structure

- 1.4.3 Within Appendix B of the HRA Report (Doc ref No. 12.6), some consideration is given to the proportion of the population at the Project site that may be represented by immature and non-breeding adult birds. However, this proportion was not applied to the collision or displacement figures and instead was used to determine the number of immatures associated with the colonies incorporated into the BDMPS, consistent with the approach in Furness (2015).
- 1.4.4 Immature birds are not as restricted in terms of foraging range during the breeding season, when compared to breeding adults which are provisioning young. Nelson (2002) states that in the breeding season immature birds “pursue extensive and probably haphazard summer foraging which can take them anywhere in their total range...”, while birds in all stages of plumage development are seen in all parts of their range throughout the year (Wernham et al., 2002). Taking account of the movements of immature birds described in Nelson (2002) and Wernham et al. (2002), it is considered likely that in addition to immature gannets originating from the FFC pSPA, there will also be immature birds associated with other breeding colonies in the North Sea and beyond, present at the Project site during the breeding season. These birds, described as ‘floaters’ in Nelson (2002), are present throughout the North Sea in the breeding season.
- 1.4.5 Immature and non-breeding gannets may be present at colonies in gatherings called ‘clubs’. These clubs are attended by immature/non-breeding birds throughout the breeding season although the composition of the clubs, in terms of age classes and origin of birds, may change throughout this period (Nelson, 2002). Therefore a proportion of immature gannet will occur at the Project site in the breeding season and it is appropriate to consider this in the assessment.
- 1.4.6 Site-specific survey data for Project Two indicated that, during the breeding season, 72% of the gannets recorded were classed as adult birds. Natural England suggest that this value could be applied in order to calculate the number of breeding adults within the wider breeding season BDMPS population. However, assigning age classes to gannet during at sea surveys can prove problematic, with immature feathers on four and five year old birds deemed difficult to observe meaning that these age classes will be under-estimated. Immature and non-breeding adult birds are present at breeding colonies throughout the breeding season in gatherings called ‘clubs’ (Nelson, 2002) and therefore fourth and fifth-year birds are likely to be also be present at the Project site. As such, the 72% value from site specific surveys will not account for a notable proportion of immature birds. Further to this, it is not known what proportion of birds recorded as adults are breeding birds associated with the FFC pSPA, with some of these adult birds possibly non-breeding birds.

- 1.4.7 There is no recent or firm evidence that specifies a more accurate proportion of how many immature birds may be present in the North Sea during the breeding season. Historical evidence suggests that the proportion of immature gannet in the population may be quite high (Tasker et al., 1985). Tasker et al. (1985) recorded observations of gannet from non-fishing vessels in the North Sea and observations were analysed to provide the proportion of immatures present within five sea areas in the North Sea on a monthly basis. In the south-east North Sea the percentage of immatures in the population ranged from 50% in May to 61% in August. In the region described as 'Offshore Bass Rock' by Tasker et al. (1985) which is to the north of the Project site, the percentage of immature birds ranged from 28% in June to 61% in July.
- 1.4.8 The Applicant accepts that a value of 72% adults can be referred to as a very precautionary maximum breeding adult proportion at the Project site, notwithstanding the above noted concerns that this percentage is almost certainly a considerable overestimate.

Summary of the Applicant and Natural England positions

- 1.4.9 The Applicant and Natural England agree on the application of a 229.4 km foraging range from FFC pSPA in the breeding season. With regards to age structure, Natural England's position is that the use of a 72% proportion of breeding adult gannets derived from Project Two specific data is appropriate. Notwithstanding concerns on the likely over estimate of breeding adults birds using boat-based data, the Applicant accepts its application as a very precautionary maximum breeding adult proportion.
- 1.4.10 Apportioned predicted collision mortality to FFC pSPA in the breeding season is shown in Table 1.2.

Table 1.2: Breeding season gannet collision results apportioned to FFC pSPA from Project Two alone.

| Predicted collisions (no apportioning) | | Age structure proportions (%) | | Apportioned collisions to FFC pSPA | |
|--|----------------|---|----------------------------------|------------------------------------|----------------|
| Option 2 (98.9%) | Option 4 (98%) | Proportion of adult birds from FFC pSPA | Immature/non-breeding proportion | Option 2 (98.9%) | Option 4 (98%) |
| 19.8 | 17.3 | 72 | 28 | 14.2 | 12.4 |

- 1.4.11 The Applicant and Natural England disagree on the application of Options (and avoidance rates) within the Band (2012) Collision Risk Model, as detailed in the HRA Report (Doc. ref. 12.6) and within the Statement of Common Ground, as submitted by the Applicant in their second response (Appendix R).. When applying a breeding adult proportion of 72% at Option 2 (98.9% AR) Natural England

position is that 14.2 collisions are apportioned to FFC pSPA in the breeding season from Project Two alone.

1.4.12 When applying Option 4 of Band (2012) as favoured by the Applicant, 12.4 collisions are apportioned to the pSPA during the breeding season utilising the same breeding adult proportion. The Applicant notes that if alternative data are used (e.g. from Furness 2015 or Tasker 1985) to determine the adult ratio then between 3.6 and 8.6 collisions would be apportioned to FFC pSPA.

1.5 Apportioning in post- and pre-breeding seasons – Project Two alone

1.5.1 Within the HRA Report (Doc ref. No. 12.6) assessment of the post-breeding season involved deriving the population of birds from all UK colonies that may pass through the Project site by interrogating tracking data associated with gannet breeding colonies. This establishes the direction of travel of gannet from different breeding colonies. The population data used was sourced from Furness (2015) with the proportion of birds flying north or south consistent with that used in the approach recommended by Natural England during Section 42 consultation.

1.5.2 For each gannet colony, the proportion of birds that migrated either south, through the English Channel or north around the northern coast of Scotland and down the western coast of the UK was defined. The number of birds from a colony predicted to migrate through the Project site was determined based on the location of the colony (for example birds flying south from Bass Rock would potentially pass through the Project site). It was assumed that the Project site was located to the north of the pSPA. The number of birds from the pSPA that were predicted to exhibit connectivity with the Project site was then compared to the total population exhibiting connectivity with the Project site to provide an adult proportion attributable to the FFC pSPA. The proportion was calculated as 1.9%, where Appendix B assumed that the Project site was located on a northerly trajectory from the pSPA.

1.5.3 The approach used in the post-breeding season was also applied in the pre-breeding season, with the Project site again assumed in Appendix B to be on a northerly trajectory from the pSPA. Using this approach it was estimated that 6.7% of the birds passing through the Project site were birds from the FFC pSPA.

1.5.4 Natural England query the population numbers to be used for apportioning in the pre- and post-breeding seasons with figures from Furness (2015) recommended. For North Sea SPA colonies, these data have been used within the assessment however, the approach to estimating the number of gannet at non-SPA colonies does differ.

1.5.5 The methodology used by the Applicant makes use of flight direction data derived from the detailed tagging studies which have been conducted on birds from the FFC pSPA and Bass Rock colonies as detailed in Appendix B of the HRA Report (Doc ref No. 12.6). This approach is slightly different from that presented in Furness (2015), where proportions were estimated without specific reference to these tagging data. The use of data from tagging studies also results in a slightly

different approach to how migration of different age classes was calculated. Although the Applicant considers that the use of flight direction data allows for a more accurate assessment, a sensitivity analysis incorporating the approaches suggested by Natural England in their Relevant Representations has been undertaken for both migratory seasons within this note. Two approaches have been defined. The first (Approach 1) uses the methodology as applied in the HRA Report (Doc ref No. 12.6) and re-assigns the pSPA colony as being south of the Project site. The second approach (Approach 2) uses data from Furness (2015) to calculate the contribution of birds from the pSPA to the migratory populations present at the Project site.

- 1.5.6 The approach used by the Applicant in the HRA Report (Doc ref No. 12.6) does not incorporate colonies in western UK waters and Ireland. The inclusion of birds from western colonies, as in Approach 2 based on the figures in Furness (2015) (Table 1.4), would introduce a further 17,402 and 5,832 immature birds in the post-breeding and pre-breeding seasons respectively. These figures therefore further dilute the contribution of breeding birds from the FFC pSPA to the population that may exhibit connectivity with the Project site during each respective season.
- 1.5.7 Table 1.3 outlines the calculation of the proportion of birds attributable to the FFC pSPA in the pre- and post-breeding seasons using data from Furness (2015).

Table 1.3: Proportion of gannet present at Project Two attributable to FFC pSPA during post-breeding and pre-breeding seasons using data from Furness (2015).

| Season | Population scale | Total population (no. of birds) | Flamborough and Filey Coast pSPA population (no. of birds) | Proportion of adult birds from FFC pSPA (%) |
|---------------|------------------|---------------------------------|--|---|
| Post-breeding | UK | 411,126 | 22,122 | 5.4 |
| | All colonies | 456,300 | 22,122 | 4.8 |
| Pre-breeding | UK | 226,483 | 15,485 | 6.8 |
| | All colonies | 248,386 | 15,485 | 6.2 |

- 1.5.8 Two alternative approaches to providing an appropriate apportioning value for gannet in the pre- and post-breeding seasons are presented in Table 1.4. Approach 1 follows the methodology followed in the HRA Report while Approach 2 utilises Furness (2015). Both approaches update that given in the HRA Report (Doc. ref. 12.6) by re-assigning the Project to the south of the pSPA.
- 1.5.9 It is evident that both approaches provide overlapping values and can be considered broadly equivalent. On a precautionary basis the higher values, derived from Furness (2015) in reference to UK colonies only, are taken forward to inform the assessment in this note, 5.4% in the post-breeding season and 6.8% in the pre-breeding season .

Table 1.4: Alternative apportioning approaches for gannet in the post-breeding and pre-breeding seasons.

| Approach | Description | Proportion of adult birds from FFC pSPA (%) | |
|----------|--|---|--------------|
| | | Post-breeding | Pre-breeding |
| 1 | HRA Report approach; Project site re-assigned to the south of the pSPA | 5.2 | 6.7 |
| 2 | Data from Furness (2015) | 4.8 – 5.4 | 6.2 – 6.8 |

1.5.10 Table 1.5 presents breeding adult proportions established for the post-breeding season applied to collision estimates in order to determine the contribution to FFC pSPA. The Applicant and Natural England disagree on the application of Options (and avoidance rates) within the Band (2012) Collision Risk Model, as detailed in the HRA Report (Doc. ref. No. 12.6) and within the Statement of Common Ground as submitted by the Applicant in their second response (Appendix R). When applying an adult proportion of 5.4% at Option 2 (98.9% AR) Natural England position is that 2.0 collisions are apportioned to FFC pSPA in the post-breeding season from Project Two alone.

1.5.11 When applying Option 4 of Band (2012) as favoured by the Applicant, 1.7 collisions are apportioned to the FFC pSPA in the post-breeding season utilising the same breeding adult proportion.

Table 1.5: Post-breeding season gannet collision results apportioned to FFC pSPA from Project Two alone.

| Collisions (no apportioning) | | Age structure proportions (%) | | Apportioned collisions to FFC pSPA | |
|------------------------------|----------------|---|----------------------------------|------------------------------------|----------------|
| Option 2 (98.9%) | Option 4 (98%) | Proportion of adult birds from FFC pSPA | Immature/non-breeding proportion | Option 2 (98.9%) | Option 4 (98%) |
| 37.2 | 32.4 | 5.4 | 94.6 | 2.0 | 1.7 |

1.5.12 Table 1.6 presents breeding adult proportions established for the pre-breeding season applied to collision estimates in order to determine the contribution to FFC pSPA. When applying a breeding adult proportion of 6.8% at Option 2 (98.9% AR) Natural England position is that 1.0 collisions are apportioned to FFC pSPA in the pre-breeding season from Project Two alone.

1.5.13 When applying Option 4 of Band (2012) as favoured by the Applicant, 0.9 collisions are apportioned to the pSPA with the same breeding adult proportion.

Table 1.6: Pre-breeding season gannet collision results apportioned to FFC pSPA from Project Two alone.

| Collisions (no apportioning) | | Age structure proportions (%) | | Apportioned collisions to FFC pSPA | |
|------------------------------|----------------|---|----------------------------------|------------------------------------|----------------|
| Option 2 (98.9%) | Option 4 (98%) | Proportion of adult birds from FFC pSPA | Immature/non-breeding proportion | Option 2 (98.9%) | Option 4 (98%) |
| 14.8 | 12.9 | 6.8 | 93.2 | 1.0 | 0.9 |

1.6 Gannet displacement and apportioning to FFC pSPA – Project Two alone

1.6.1 Identical considerations in terms of population age structure are applied to the assessment of gannet displacement as for collision. Table 1.7 provides an overview of predicted displacement for each of the three biological seasons defined for gannet.

Table 1.7: Displacement mortality attributable to the FFC pSPA gannet population.

| | Percentage of breeding adults | Displacement / mortality rate (%) | Displacement estimate (no. of birds) | No. of birds apportioned to pSPA |
|---------------|-------------------------------|-----------------------------------|--------------------------------------|----------------------------------|
| Breeding | 72 | 70/2 | 5 | 3 |
| | | 70/10 | 23 | 17 |
| Post-breeding | 5.4 | 70/1 | 5 | 0 |
| | | 70/10 | 54 | 3 |
| Pre-breeding | 6.8 | 70/1 | 1 | 0 |
| | | 70/10 | 12 | 1 |

1.6.2 In the breeding season, the displacement mortality attributable to the FFC pSPA gannet population is 3 birds using the displacement and mortality rates advocated by the Applicant (70% displacement, 2% mortality). When using the maximum rates advocated by Natural England (70% displacement, 10% mortality), the displacement mortality attributable to the pSPA is 17 birds.

1.6.3 In the post-breeding season, the displacement mortality attributable to the FFC pSPA gannet population is 0 birds using the displacement and mortality rates advocated by the Applicant (70% displacement, 1% mortality). When using the maximum rates advocated by Natural England (70% displacement, 10% mortality), the displacement mortality attributable to the pSPA is 3 birds.

1.6.4 In the pre-breeding season, the displacement mortality attributable to the FFC pSPA gannet population is 0 birds using the displacement and mortality rates advocated by the Applicant (70% displacement, 1% mortality). When using the maximum rates advocated by Natural England (70% displacement, 10% mortality), the displacement mortality attributable to the pSPA is 1 bird.

1.7 Annual predicted mortality apportioning to FFC pSPA – Project Two alone

Annual collision risk impacts

1.7.1 Using the apportioned collision risk estimates presented in Table 1.2, Table 1.5 and Table 1.6 the annual collision risk considered attributable to the FFC pSPA gannet population can be calculated. When applying Band (2012) Option 2 (i.e. Natural England's Position) this equates to 17.2 collisions per annum (Table 1.8).

1.7.2 Notwithstanding the Applicants consideration that the application of a 0.72 adults ratio in the breeding season is overly precautionary, when using Option 4 (i.e. the favoured application of Band (2012) this equates to 15.0 collisions per annum (Table 1.8).

Table 1.8: Annual collision risk attributable to the FFC pSPA for Project Two alone.

| Season | Collision risk (no. of birds) | |
|---------------|-------------------------------|----------------|
| | Option 2 (98.9%) | Option 4 (98%) |
| Breeding | 14.2 | 12.4 |
| Post-breeding | 2.0 | 1.7 |
| Pre-breeding | 1.0 | 0.9 |
| Total | 17.2 | 15.0 |

Displacement

1.7.3 Natural England have noted within their Relevant and Written Representations that the displacement mortality estimated for each season should be summed to provide an annual level of risk. The Applicant considers that displacement represents a different mechanism to collision and that seasonal estimates should not be summed due to the clear potential for ‘double-counting’ of effects; it is highly unlikely that seasonal mortality is additive in this way and in any case, this approach takes no account of the relative duration of the displacement effect in each season. This disagreement is captured in in Table 3.3 of the Statement of Common Ground as submitted by the Applicant in their second response (Appendix R).

1.7.4 Based on Table 1.7, annual displacement mortality would represent 21 birds apportioned to FFC pSPA according to Natural England’s favoured maximum displacement and mortality rates (at the Applicants favoured rates the equivalent value would be 3 birds per annum).

Summary

1.7.5 The Applicant’s position is that 15 gannet collisions per annum can be apportioned to FFC pSPA per annum as a result of predicted collision impacts.

1.7.6 In line with previous similar assessments for offshore wind farms, the Applicant has not sought to combine displacement and collision effects. Doing so would inevitably result in an element of double counting as the effects are unlikely to be additive in the way that simply summing the respective effects would imply. The Applicant assesses displacement on a seasonal rather than annual basis and therefore predicted mortality cannot be summed with annual collision estimates. The Applicant considers that displacement has the potential to result in mortality of

3 birds apportioned to FFC pSPA during the breeding season only (no mortality is predicted for post- and pre-breeding seasons).

- 1.7.7 Natural England's position is that it is appropriate to sum predicted displacement and collision mortality to produce an annual estimation of risk. This leads to a conclusion that 35.2 birds can be apportioned to FFC pSPA from Project Two alone.

1.8 Assessment of impacts attributable to the FFC pSPA – In-combination

Consented capacity of projects considered in combination

- 1.8.1 In their Relevant and Written Representations, Natural England state that changes to collision risk estimates due to a reduction in the capacity at projects considered in-combination should be applied only where the reduction in project capacity is reflected in the consent granted for the project. Therefore the corrections made to the in-combination assessment presented in the HRA (Doc Ref No 12.6) have been reviewed and are further discussed below.
- 1.8.2 The EIA consent decision for Beatrice Offshore Wind Farm states that the project will have "not more than 140 wind turbines" (Marine Scotland, 2014a). However, the collision risk modelling for gannet was actually calculated using 142 turbines (Arcus Consultancy Services, 2013). However, due to the small difference between the modelled and consented turbine numbers no correction factor will be applied to the collision outputs for Beatrice.
- 1.8.3 The consent for Dudgeon Offshore Wind Farm was originally for a 168 turbine scenario, however the developer for the project applied for a variation to the Marine Licence in which the number of turbines proposed at the project was reduced to a maximum of 77 (Dudgeon Offshore Wind Farm, no date). A correction factor to take account of this reduction has been previously applied by Forewind (2014) during the examination of Dogger Bank Creyke Beck. As such, an identical correction factor is applied to the collision risk estimates for gannet calculated for Dudgeon with respect to Project Two.
- 1.8.4 Collision risk modelling for gannet at EA ONE was undertaken using a 325 turbine scenario (APEM, 2013). However, the Development Consent Order for the project was for up to 240 turbines (Infrastructure Planning, 2014). Therefore a correction factor of 26.2% is applied to the collision risk estimates for EA ONE. This correction factor has been previously applied by Forewind (2014) during the examination of Dogger Bank Creyke Beck.
- 1.8.5 The Moray Firth Offshore Wind Farm, which is composed of the Telford, Stevenson and MacColl wind farms, calculated collision risk modelling within the Environmental Statement using a 283 turbine scenario (139:72:72 turbines for the respective wind farms) (Moray Offshore Renewables, 2012). However, as part of further submissions to Marine Scotland it was stated that the ES had erroneously specified that 139 rather than 72 turbines had been modelled for two of the wind

farms (Natural Power, 2013). Further to this the final consent decision for all three of the constituent wind farms stated that each project will have a maximum of 62 turbines. Therefore a correction factor of 55.4% has been applied to the collision risk estimates for the Moray Firth Offshore Wind Farm.

1.8.6 Galloper Offshore Wind Farm received consent for 504MW, while in 2014 the developer committed to building a capacity of only 304MW. Triton Knoll Offshore Wind Farm received consent for a capacity of 1.2GW and in 2014 committed to reducing the capacity to between 600MW-900MW. As these projects could legally build out to their fully to their consented capacity no reductions have been applied to the collision risk results for these projects. However, it should be noted that these projects have publically announced their commitment not to build out to full capacity and are therefore unlikely to apply CfD for the full consented capacity.

1.8.7 Table 1-9 summarises the consent capacity correction factors to be applied to collision risk modelling within the in-combination assessment presented in this Note and any differences compared to the HRA Report (Doc ref No. 12.6).

Table 1-9: Review of consent capacity corrections applied to CRM for offshore wind farms considered in-combination with Project Two.

| Project | HRA reduction capacity applied (%) | Updated reduction capacity applied (%) | No. of turbines | |
|--------------|------------------------------------|--|---|--|
| | | | Assessment | Consented capacity |
| Beatrice | 25 | 0 | 142 (Arcus Consultancy Services, 2013) | 140 (Marine Scotland, 2014a) |
| Dudgeon | 54.2 | 54.2 | 168 (Dudgeon Offshore Wind Farm, no date) | 77 (Dudgeon Offshore Wind Farm, no date) |
| EA ONE | 26.2 | 26.2 | 325 (APEM, 2013) | 240 (Infrastructure Planning, 2014) |
| Galloper | 30 | N/A | 140 (Royal Haskoning, 2011) | 140 (Infrastructure Planning, 2013a) |
| Moray | 25 | 55.4 | 283 (Moray Offshore Renewables, 2012) | 186 (Marine Scotland, 2014b, 2014c, 2014d) |
| Triton Knoll | 25 | N/A | 333 (RWE npower renewables, 2011) | 288 (Infrastructure Planning, 2013b) |

Status of operational projects considered in combination

1.8.8 Natural England, as part of their Written and Relevant Representations, also query the exclusion of projects from the in-combination assessment that are considered by the Applicant to have been operational for a period long enough for impacts associated with a project to now be incorporated into the baseline. This refers to the Beatrice Demonstrator project and Scroby Sands Offshore Wind Farm only. There are no estimates of collision impacts for Scroby Sands (Natural England, 2013) and it has been agreed with Natural England that any contribution from Scroby Sands to the in-combination collision mortality is negligible (SoCG with Natural England, Appendix R of the Applicant's second response). With regard to the Beatrice Demonstrator project, collision risk estimates presented in Natural England (2013) are used to inform the in-combination assessment in this Note.

Projects considered in-combination

- 1.8.9 A mean-maximum foraging range of 229km has been used to determine which projects are included within the in-combination assessment during the breeding season. For those projects within mean-maximum foraging range it has been assumed that 100% of birds within the project sites originate from the pSPA during the breeding season. However, for the Dogger Bank projects it has been assumed that 50% of birds present within the project site are adult birds from that pSPA, as agreed during examination of the projects and consented by the Secretary of State, this approach has been agreed with Natural England.
- 1.8.10 Table 1.10 and Table 1.11 present collision risk estimates sourced for all projects considered in-combination across all biological seasons relevant for gannet.
- 1.8.11 Table 1.10 presents collision risk estimates from the Extended model (either Option 3 or 4) of Band (2012) where available, Table 1.11 presents collision estimates using the Basic (Options 1 or 2) model of Band (2012). Table 1.11 from the Basic (either Option 1 or 2) model of Band (2012).). Table 1.10 represents the Applicant's position and Table 1.11 represents Natural England's position.
- 1.8.12 Both tables present the breakdown of collisions across seasons, the apportioning value applied to each project in each season and the resulting collision estimates apportioned to the pSPA.

Table 1.10: Seasonal breakdown of predicted in-combination collision mortality for gannet using results from the Extended Band model, where available (Applicant's position).

| Offshore wind farm | Band Model | Option | Avoidance rate | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|---|--------------------|--------|----------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|--|
| Aberdeen European Offshore Wind Deployment Centre | Band (2012) | 2.0 | 98.9 | 9.4 | | | | 5.1 | 0.1 | 0.3 | 0.1 | 6.8 | 0.0 | |
| Beatrice | Band (2012) | 3.0 | 98.0 | 42.0 | | | | 21.4 | 0.1 | 1.2 | 4.2 | 6.8 | 0.3 | Corrected to account for reduction in number of turbines |
| Beatrice Demonstrator | Band (2000) | 1.0 | 98.9 | 2.8 | | | | 0.7 | 0.1 | 0.0 | 0.9 | 6.8 | 0.1 | |
| Blyth Demonstration Project | Band et al. (2007) | 1.0 | 98.9 | 8.4 | 3.6 | 100 | 3.6 | 2.1 | 0.1 | 0.1 | 2.9 | 6.8 | 0.2 | |
| Dogger Bank Creyke Beck A and B | Band (2012) | 3.0 | 98.0 | 121.0 | 40.9 | 50 | 20.4 | 48.4 | 0.1 | 2.6 | 31.7 | 6.8 | 2.2 | Applied 50% apportioning value in the breeding season as per project consent |

| Offshore wind farm | Band Model | Option | Avoidance rate | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|------------------------------|--------------------|--------|----------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|--|
| Dogger Bank Teesside A and B | Band (2012) | 3.0 | 98.0 | 136.0 | 68.0 | 50 | 34.0 | 34.0 | 5.4 | 1.8 | 34.0 | 6.8 | 2.3 | Applied 50% apportioning value in the breeding season as per project consent |
| Dudgeon | Band (2000) | 1.0 | 98.9 | 36.6 | 10.1 | 100 | 10.1 | 17.7 | 5.4 | 1.0 | 8.7 | 6.8 | 0.6 | Corrected to account for reduction in number of turbines |
| East Anglia One | Band (2012) | 3.0 | 98.0 | 67.9 | | | 0.0 | 64.3 | 5.4 | 3.5 | 2.4 | 6.8 | 0.2 | Corrected to account for reduction in number of turbines |
| Galloper | Band et al. (2007) | 1.0 | 98.9 | 61.6 | | | 0.0 | 30.8 | 5.4 | 1.7 | 12.6 | 6.8 | 0.9 | |
| Greater Gabbard | Band (2000) | 1.0 | 98.9 | 27.5 | | | 0.0 | 8.8 | 5.4 | 0.5 | 4.8 | 6.8 | 0.3 | |
| Hornsea Project One | Band (2012) | 4.0 | 98.0 | 38.0 | 7.0 | 100 | 7.0 | 17.8 | 5.4 | 1.0 | 13.3 | 6.8 | 0.9 | |

| Offshore wind farm | Band Model | Option | Avoidance rate | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|--------------------------------|---------------|--------|----------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|--|
| Hornsea Project Two | Band (2012) | 4.0 | 98.0 | 63.0 | 17.3 | 72 | 12.4 | 32.4 | 5.4 | 1.7 | 12.9 | 6.8 | 0.9 | |
| Humber Gateway | Not available | 1.0 | 98.9 | 4.4 | 1.8 | 100 | 1.8 | 1.1 | 5.4 | 0.1 | 1.5 | 6.8 | 0.1 | |
| Inch Cape | Band (2012) | 1.0 | 98.9 | 371.3 | | | 0.0 | 29.2 | 5.4 | 1.6 | 5.2 | 6.8 | 0.4 | |
| Kentish Flats Extension | Band (2012) | 1.0 | 98.9 | 3.3 | | | 0.0 | | 5.4 | 0.0 | | 6.8 | 0.0 | |
| Lincs | Band (2000) | 1.0 | 98.9 | 5.0 | 2.1 | 100 | 2.1 | 1.2 | 5.4 | 0.1 | 1.7 | 6.8 | 0.1 | |
| London Array | Band (2000) | 1.0 | 98.9 | 5.5 | | | 0.0 | 1.4 | 5.4 | 0.1 | 1.8 | 6.8 | 0.1 | |
| Moray Firth Project One (MORL) | Band (2012) | 3.0 | 98.0 | 18.1 | | | 0.0 | 5.1 | 5.4 | 0.3 | 1.3 | 6.8 | 0.1 | Corrected to account for reduction in number of turbines |
| Neart na Gaoithe | Band (2012) | 1.0 | 98.9 | 569.8 | | | 0.0 | 30.3 | 5.4 | 1.6 | 30.3 | 6.8 | 2.1 | |
| Race Bank | Band (2000) | 1.0 | 98.9 | 49.5 | 33.7 | 100 | 33.7 | 11.7 | 5.4 | 0.6 | 4.1 | 6.8 | 0.3 | |
| Seagreen Alpha | Band (2012) | 3.0 | 98.0 | 494.0 | | | 0.0 | 21.1 | 5.4 | 1.1 | 28.1 | 6.8 | 1.9 | |

| Offshore wind farm | Band Model | Option | Avoidance rate | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|--------------------|--------------------|--------|----------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|---|
| Seagreen Bravo | Band (2012) | 3.0 | 98.0 | 332.0 | | | 0.0 | 23.0 | 5.4 | 1.2 | 30.6 | 6.8 | 2.1 | |
| Sheringham Shoal | Band (2000) | 1.0 | 98.9 | 17.6 | 14.1 | 100 | 14.1 | 3.5 | 5.4 | 0.2 | 0.0 | 6.8 | 0.0 | |
| Teesside | Band (2000) | 1.0 | 98.9 | 6.6 | 4.9 | 100 | 4.9 | 1.7 | 5.4 | 0.1 | 0.0 | 6.8 | 0.0 | |
| Thanet | Band (2000) | 1.0 | 98.9 | 1.1 | | | 0.0 | 0.0 | 5.4 | 0.0 | 0.0 | 6.8 | 0.0 | Collision figures apportioned equally across the year |
| Triton Knoll | Band (2000) | 1.0 | 98.9 | 121.6 | 26.9 | 100 | 26.9 | 64.4 | 5.4 | 3.5 | 30.2 | 6.8 | 2.1 | |
| Westermost Rough | Band et al. (2007) | 1.0 | 98.9 | 0.6 | 0.2 | 100 | 0.2 | 0.1 | 5.4 | 0.0 | 0.2 | 6.8 | 0.0 | Collision figures apportioned equally across the year |
| Total | | | | | | | 171.2 | | | 25.8 | | | 17.9 | |

Table 1.11: Seasonal breakdown of predicted total in-combination collision mortality using the Basic Band model at 98.9% for gannet (Natural England’s position).

| Offshore wind farm | Band Model | Option | Avoidance rate (%) | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|---|--------------------|--------|--------------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|--|
| Aberdeen European Offshore Wind Deployment Centre | Band (2012) | 2.0 | 98.9 | 9.4 | | | | 5.1 | 5.4 | 0.3 | 0.1 | 6.8 | 0.0 | |
| Beatrice | Band (2012) | 1.0 | 98.9 | 95.7 | | | | 48.8 | 5.4 | 2.6 | 9.5 | 6.8 | 0.6 | Corrected to account for reduction in number of turbines |
| Beatrice Demonstrator | Band (2000) | 1.0 | 98.9 | 2.8 | | | | 0.7 | 5.4 | 0.0 | 0.9 | 6.8 | 0.1 | |
| Blyth Demonstration Project | Band et al. (2007) | 1.0 | 98.9 | 8.4 | 3.6 | 100 | 3.6 | 2.1 | 5.4 | 0.1 | 2.9 | 6.8 | 0.2 | |
| Dogger Bank Creyke Beck Projects A and B | Band (2012) | 2.0 | 98.9 | 16.5 | 5.6 | 50 | 2.8 | 6.6 | 5.4 | 0.4 | 4.3 | 6.8 | 0.3 | Applied 50% apportioning value in the breeding season as per project consent |
| Dogger Bank Teesside Projects A and B | Band (2012) | 2.0 | 98.9 | 35.2 | 17.6 | 50 | 8.8 | 8.8 | 5.4 | 0.5 | 8.8 | 6.8 | 0.6 | Applied 50% apportioning value in the breeding season as per project consent |
| Dudgeon | Band (2000) | 1.0 | 98.9 | 36.6 | 10.1 | 100 | 10.1 | 17.7 | 5.4 | 1.0 | 8.7 | 6.8 | 0.6 | Corrected to account for reduction in number of turbines |

| Offshore wind farm | Band Model | Option | Avoidance rate (%) | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|--------------------------------|--------------------|--------|--------------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|--|
| East Anglia One | Band (2012) | 2.0 | 98.9 | 131.6 | | | 0.0 | 124.5 | 5.4 | 6.7 | 4.7 | 6.8 | 0.3 | Corrected to account for reduction in number of turbines |
| Galloper | Band et al. (2007) | 1.0 | 98.9 | 61.6 | | | 0.0 | 30.8 | 5.4 | 1.7 | 12.6 | 6.8 | 0.9 | |
| Greater Gabbard | Band (2000) | 1.0 | 98.9 | 27.5 | | | 0.0 | 8.8 | 5.4 | 0.5 | 4.8 | 6.8 | 0.3 | |
| Hornsea Project One | Band (2012) | 1.0 | 98.9 | 66.0 | 12.0 | 100 | 12.0 | 31.0 | 5.4 | 1.7 | 23.0 | 6.8 | 1.6 | Option 1 collision figures used as per Project consent |
| Hornsea Project Two | Band (2012) | 2.0 | 98.9 | 102.0 | 19.8 | 72 | 14.3 | 37.2 | 5.4 | 2.0 | 14.8 | 6.8 | 1.0 | |
| Humber Gateway | Not available | 1.0 | 98.9 | 4.4 | 1.8 | 100 | 1.8 | 1.1 | 5.4 | 0.1 | 1.5 | 6.8 | 0.1 | |
| Inch Cape | Band (2012) | 1.0 | 98.9 | 371.3 | | | 0.0 | 29.2 | 5.4 | 1.6 | 5.2 | 6.8 | 0.4 | |
| Kentish Flats Extension | Band (2012) | 1.0 | 98.9 | 3.3 | | | 0.0 | 0.0 | 5.4 | 0.0 | 0.0 | 6.8 | 0.0 | |
| Lincs | Band (2000) | 1.0 | 98.9 | 5.0 | 2.1 | 100 | 2.1 | 1.2 | 5.4 | 0.1 | 1.7 | 6.8 | 0.1 | |
| London Array | Band (2000) | 1.0 | 98.9 | 5.5 | | | 0.0 | 1.4 | 5.4 | 0.1 | 1.8 | 6.8 | 0.1 | |
| Moray Firth Project One (MORL) | Band (2012) | 1.0 | 98.9 | 55.7 | | | 0.0 | 15.8 | 5.4 | 0.9 | 4.0 | 6.8 | 0.3 | Corrected to account for reduction in number of turbines |
| Neart na Gaoithe | Band (2012) | 1.0 | 98.9 | 569.8 | | | 0.0 | 30.3 | 5.4 | 1.6 | 30.3 | 6.8 | 2.1 | |
| Race Bank | Band | 1.0 | 98.9 | 49.5 | 33.7 | 100 | 33.7 | 11.7 | 5.4 | 0.6 | 4.1 | 6.8 | 0.3 | |

| Offshore wind farm | Band Model | Option | Avoidance rate (%) | Annual collisions | Breeding collisions | Breeding Apportioning % | Breeding pSPA collision figure | Post-breeding collisions | Post breeding Apportioning % | Post-breeding pSPA collision figure | Pre-breeding collisions | Pre-breeding Apportioning % | Pre-breeding pSPA collision figure | Notes |
|--------------------|--------------------|--------|--------------------|-------------------|---------------------|-------------------------|--------------------------------|--------------------------|------------------------------|-------------------------------------|-------------------------|-----------------------------|------------------------------------|---|
| | (2000) | | | | | | | | | | | | | |
| Seagreen Alpha | Band (2012) | 1.0 | 98.9 | 552.2 | | | 0.0 | 23.6 | 5.4 | 1.3 | 31.4 | 6.8 | 2.1 | |
| Seagreen Bravo | Band (2012) | 1.0 | 98.9 | 363.6 | | | 0.0 | 25.7 | 5.4 | 1.4 | 34.3 | 6.8 | 2.3 | |
| Sheringham Shoal | Band (2000) | 1.0 | 98.9 | 17.6 | 14.1 | 100 | 14.1 | 3.5 | 5.4 | 0.2 | 0.0 | 6.8 | 0.0 | |
| Teesside | Band (2000) | 1.0 | 98.9 | 6.6 | 4.9 | 100 | 4.9 | 1.7 | 5.4 | 0.1 | 0.0 | 6.8 | 0.0 | |
| Thanet | Band (2000) | 1.0 | 98.9 | 1.1 | | | 0.0 | 0.0 | 5.4 | 0.0 | 0.0 | 6.8 | 0.0 | Collision figures apportioned equally across the year |
| Triton Knoll | Band (2000) | 1.0 | 98.9 | 121.6 | 26.9 | 100 | 26.9 | 64.4 | 5.4 | 3.5 | 30.2 | 6.8 | 2.1 | |
| Westermost Rough | Band et al. (2007) | 1.0 | 98.9 | 0.6 | 0.2 | 100 | 0.2 | 0.1 | 5.4 | 0.0 | 0.2 | 6.8 | 0.0 | Collision figures apportioned equally across the year |
| TOTAL | | | | | | | 135.2 | | | 28.7 | | | 16.3 | |

Annual In-combination collision risk

1.8.13 The annual in-combination collision risk applying the Extended Model where available (i.e. the Applicant's position), is predicted to be 215 gannet (Table 1.12).

1.8.14 The annual in-combination collision risk using the Basic Band Model (i.e. Natural England's position) ranges is predicted to be 180 gannet (Table 1.12) .

Table 1.12: Annual in-combination gannet collision risk attributable to FFC pSPA.

| Season | Collision risk (no. of birds) | |
|---------------|-----------------------------------|--------------------------------|
| | Natural England (Basic Band 2012) | Applicant (Extended Band 2012) |
| Breeding | 135.23 | 171.24 |
| Post-breeding | 28.72 | 25.78 |
| Pre-breeding | 16.29 | 17.90 |
| Total | 180.24 | 215 |

1.9 Summary and conclusions


Summary

1.9.1 Applying the Extended Band Model where available the predicted in-combination collision mortality for FFC pSPA is 215 gannet per annum. Using the Basic Band Model the predicted in-combination collision mortality is 180 gannet per annum for FFC pSPA. The higher levels of collision estimated through the Extended Model are most due to the risk reported for the Dogger Bank projects (Creyke Beck A and B / Teeside A and B). These projects report significantly higher collision risk applying Option 3 than Option 2. This difference is considered to be due an aspect of the generic gannet flight height distribution as provided in Johnston *et al.* (2014) which directly corresponds with the turbine hub height specified in the assessment of these projects.

1.9.2 The annual apportioned in-combination collision risk figures using both the Extended (where available) and Basic Band Models, exceed the 1% threshold of baseline mortality at the FFC pSPA. Therefore Population Viability Analysis is deemed to be required to describe population level effects at FFC pSPA.

Conclusion

1.9.3 The observed rate of increase in the number of gannet AON at Bempton has averaged 10% between 1985 and 2008 and 13% between 2000 and 2008. The maximum predicted growth rate for this species is 9.9%, calculated using the method proposed by Niel & Lebreton (2005). Therefore, the population appears to have grown at a rate similar to or above the predicted maximum. Previous modelling has suggested that the population has undergone considerable net



immigration which has permitted the observed rate of growth (MacArthur Green 2014).

- 1.9.4 PVA modelling undertaken for the Project (MacArthur Green 2015) predicts a conservative growth rate of 1.79% (density independent and excluding any immigration). If additional mortality of 225 birds annum is assumed (the Applicant predicts that this will be no more than 215 in-combination) then the model predicts a growth rate of 0.76%, a reduction of 1.03%. Under this scenario, the predicted median impacted population size after 25 years would be approximately 78% of that which the model predicts would occur in the in the absence of any additional impact from the Project. This is a relative reduction in population size (compared to that which might otherwise have arisen). The model predicts a positive growth rate, and so the impacted population after 25 years would still be larger than that which was assumed for the initiation of the modelling exercise.
- 1.9.5 A density dependent model was also run. This model predicts a lesser change in growth rate, approximately 0.7% and consequently a higher ratio of impacted to unimpacted median population size after 25 years (approximately 84%).
- 1.9.6 On this basis, there is no indication that, at the level of mortality predicted to arise from the Project, the population is likely to decline, over a period of 25 years, to an extent that would mean that the breeding gannet population of the FFC pSPA would no longer be considered to be in favourable condition.

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