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HORNSEA OFFSHORE WIND FARM PROJECT TWO

**WRITTEN SUBMISSION FOR DEADLINE 3:
APPENDIX 6**

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HRA Puffin Displacement Impacts on Flamborough and Filey Coast pSPA (FFC pSPA).

This note sets out natural England's position on the displacement risk posed to puffin at the Flamborough and Filey coast (FFC) pSPA. Our analysis draws on data provided by the applicant on puffin in support of their submissions for Hornsea project 2. The paper sets out a summary of the range of impacts for different displacement scenarios for the project alone (Table 1 and 2) and then demonstrates what each of these scenarios means in terms of population growth rate (Table 3, 5 and 7) and mortality (Table 4 and 6) based on the outputs of PVA modelling carried out by the Applicant.

PUFFIN PROJECT ALONE

Table 1. Natural England summary of range of potential displacement impacts on FFC pSPA puffin for Project alone. Figures are adult mortalities. Lower displacement mortality represents 10% displacement and 1% mortality; upper displacement mortality represents 70% displacement and 10% mortality. (see Table 2 for complete annual matrix).

Species	Season	Apportioning % to FFC pSPA	FFC pSPA (no. of adult mortalities). Lower displacement mortality	FFC pSPA (no. of adult mortalities). Upper displacement mortality
Puffin	Breeding	38	0	12
	Non-breeding	0.41	0	1
	Annual		0	13

Table 2. Predicted annual displacement mortality for puffin adults apportioned to FFC pSPA. (Based on mean population estimates across the range of displacement and mortality levels considered by Natural England).

PU mortality figures	% Mortality			
FFC adults mean of pop ests	1	2	5	10

% Displacement	10	0	0	1	2
	20	0	1	2	4
	30	1	1	3	6
	40	1	1	4	7
	50	1	2	5	9
	60	1	2	6	11
	70	1	3	7	13

Table 3. Predicted reductions in population growth rate¹ for Project Alone. (Using density independent PVA model, demographic rate set 2 and mean densities of birds in project area. Shaded cells are those where the reduction in growth rate exceeds 0.5%).

PU GR figures		% Mortality			
FFC adults mean of pop ests		1	2	5	10
% Displacement	10	0	0	0.254	0.254
	20	0	0.254	0.254	0.254
	30	0.254	0.254	0.254	0.528

¹ Reductions in population growth rate relate to the nearest mortality level output from the PVA model that lies above the predicted displacement mortality, so for example, if the predicted displacement is 7 birds and PVA outputs are given in 5 bird increments, the reduction in growth rate in the matrix is that for the 10 birds mortality level.

	40	0.254	0.254	0.254	0.528
	50	0.254	0.254	0.254	0.528
	60	0.254	0.254	0.528	0.788
	70	0.254	0.254	0.528	0.788

Table 4. Predicted annual displacement mortality for puffin adults apportioned to FFC pSPA. (Based on upper 95% confidence limits of population estimates across the range of displacement and mortality levels considered by Natural England).

PU mortality figures		% Mortality			
FFC adults UCL of pop ests		1	2	5	10
% Displacement	10	0	1	2	4
	20	1	2	4	8
	30	1	2	6	11
	40	2	3	8	15
	50	2	4	9	19
	60	2	5	11	23
	70	3	5	13	26

Table 5. Predicted reductions in population growth rate² for Project Alone. (Using density independent PVA model, demographic rate set 2 and upper 95% confidence limits of species densities in project area. Shaded cells are those where the reduction in growth rate exceeds 0.5%, or 1%).

PU GR figures		% Mortality			
		1	2	5	10
FFC adults UCL of pop ests					
% Displacement	10	0	0.254	0.254	0.254
	20	0.254	0.254	0.254	0.528
	30	0.254	0.254	0.528	0.788
	40	0.254	0.254	0.528	0.788
	50	0.254	0.254	0.528	1.04
	60	0.254	0.254	0.788	1.24
	70	0.254	0.254	0.788	1.50

Table 6. Predicted annual displacement mortality for puffin adults apportioned to FFC pSPA. (Based on lower 95% confidence limits of population estimates across the range of displacement and mortality levels considered by Natural England).

² Reductions in population growth rate relate to the nearest mortality level output from the PVA model that lies above the predicted displacement mortality, so for example, if the predicted displacement is 7 birds and PVA outputs are given in 5 bird increments, the reduction in growth rate in the matrix is that for the 10 birds mortality level.

PU mortality figures		% Mortality			
FFC adults LCL of pop ests		1	2	5	10
% Displacement	10	0	0	0	1
	20	0	0	1	2
	30	0	1	1	3
	40	0	1	2	4
	50	0	1	2	5
	60	1	1	3	6
	70	1	1	3	7

Table 7. Predicted reductions in population growth rate³ for Project Alone. (Using density independent PVA model and demographic rate set 2 and lower 95% confidence limits of species densities. Shaded cells are those where the reduction in growth rate exceeds 0.5%).

PU GR figures		% Mortality			
FFC adults LCL of pop ests		1	2	5	10
% Displacement	10	0	0	0	0.254

³ Reductions in population growth rate relate to the nearest mortality level output from the PVA model that lies above the predicted displacement mortality, so for example, if the predicted displacement is 7 birds and PVA outputs are given in 5 bird increments, the reduction in growth rate in the matrix is that for the 10 birds mortality level.

	20	0	0	0.254	0.254
	30	0	0.254	0.254	0.254
	40	0	0.254	0.254	0.254
	50	0	0.254	0.254	0.254
	60	0.254	0.254	0.254	0.528
	70	0.254	0.254	0.254	0.528

Table 8. Natural England position on displacement impacts from Hornsea P2 for puffin population of FFC pSPA.

Likely impact considered by Natural England	For the purposes of assessing colony impacts against the outputs of the population models Natural England has focussed our assessment in the range 0-13 adults per annum generated using the mean population estimates for the Project area and 2km buffer and a range of displacement 10-70% and mortality 1-10% rates. Considering the variability in the baseline population estimates, Natural England consider that displacement impacts are unlikely to exceed 26 adults per annum (based on the upper 95% confidence limits of the population estimates and 70% displacement and 10% mortality).
Conclusions on AEOI for FFC pSPA for Project alone impacts	A density independent PVA model ⁴ using the demographic rate set 2 ⁵ predicts that with an additional annual adult mortality of 15 birds (closest modelled output to the predicted 13 bird mortality) the population growth rate would fall by 0.788% and the population size at 25 years would be 17.4% lower than an un-impacted population size. Considering an impact of 25-30 adults per annum (encompassing the 26 birds mortality based on the upper 95% CLs of the density data) the growth rate would fall by 1.24 - 1.5% and the final population size would be 26-30% lower than the un-impacted population size at 25 years.

⁴ SMartWind (2015). Appendix M - MacArthur Green Seabird PVA Report. Submitted Deadline 2a. Outputs from density independent model and demographic rate set 2 used.

⁵ Demographic rate set 2 provided the best fit to the observed population trend for the density independent PVA model.

There is evidence that puffin have a lower sensitivity to disturbance compared to razorbill and guillemot⁶ therefore Natural England considers that displacement levels will be at the lower end of the 10-70% range. There is considerable uncertainty around what level of mortality would be associated with displacement, therefore we consider it appropriate to consider a range of mortalities from 1-10%, but on the basis that Hornsea P2 lies in an area of the North Sea with relative low densities of puffin during the breeding and non-breeding seasons⁷ we do not expect mortality rates to be at the top of the range considered. Therefore even accounting for variability in the baseline population estimates we do not expect the mortality from displacement to exceed a level where the population growth rate would decline by more than 0.25% per annum.

A density dependent model would predict smaller declines in growth rate; however there is no evidence to support application of any particular form or magnitude of density dependence in the model.

The density independent PVA model using the demographic rate set 2 predicted a population decline of 0.77% per annum over the next 25 years. Due to methodological difficulties with surveying puffin numbers there is considerable uncertainty regarding the population trend for FFC pSPA puffin. Colony counts suggest that the population has declined since 1987, although numbers at the much bigger colonies on Coquet Island and the Farnes have increased over this period.

Puffin is a non-listed component of the breeding seabird assemblage of the FFC pSPA. Whilst there is uncertainty about the future population trend for puffin at FFC pSPA, Natural England do not consider that a decline in colony growth rate of 0.25% per annum for puffin would significantly alter the richness or size of the Seabird Assemblage feature of FFC pSPA as puffin would still be predicted to be a viable component of

⁶ Furness R. W., Wade H. M. and Masden E.A (2013) Assessing vulnerability of marine bird populations to offshore wind farms . *Journal of Environmental Management* 119 pp 56-66; Bradbury G., Trinder M., Furness B., Banks A.N, Caldow R.W.G. and Hume D (2014) Mapping Seabird Sensitivity to Offshore Wind Farms. *PLoS ONE* 9(9): e106366. doi:10.1371/journal.pone.0106366.

⁷ NE/MMO Seabird Sensitivity Mapping Tool. http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

the assemblage.

Natural England consider there is no indication that the predicted potential decline in the growth rate of the puffin population would mean that either the abundance or richness of the breeding seabird assemblage would be reduced to the extent that it would cause an adverse effect on site integrity. **No AEoSI for the project alone.**

PUFFIN IN-COMBINATION.

Table 9. Natural England summary of range of potential displacement impacts on FFC pSPA puffin for Project in-combination with other plans and projects. Figures are adult mortalities. Figures calculated using 100% apportioning for projects within mean maximum foraging range (Humber Gateway, Teeside, Westermost Rough, Triton Knoll), except for Hornsea P2 where 38% apportioning applied based on proportion of adults in baseline surveys during the breeding season. 38% also applied to Hornsea project 1; For Dogger Bank Creyke Beck and Dogger Bank Teesside 30% birds apportioned to FFC pSPA (as per examination for these projects). Apportioning for non-breeding season months for all projects in North Sea BDMPS follows percentages given in Table 1 (Furness 2015). Lower displacement mortality represents 10% displacement and 1% mortality; upper displacement mortality represents 70% displacement and 10% mortality. (see Table 10 for complete annual matrix).

Species	Season	FFC pSPA (no. of adult mortalities). Lower displacement level	FFC pSPA (no. of adult mortalities). Upper displacement level
Puffin	Breeding	1	50
	Non-breeding	0	4
	Annual	1	54

Table 10. Predicted annual displacement mortality for puffin adults apportioned to FFC pSPA. (All plans and projects in the North Sea BDMPS scale, across the range of displacement and mortality levels considered by Natural England).

PU mortality figures		% Mortality			
FFC adults In-combination		1	2	5	10
% Displacement	10	1	2	4	8
	20	2	3	8	15

	30	2	5	12	23
	40	3	6	15	31
	50	4	8	19	39
	60	5	9	23	46
	70	5	11	27	54

Table 11. Predicted reductions in population growth rate⁸ from Project in-combination with other plans and projects. (Using density independent PVA model and demographic rate set 2. Shaded cells are those where the reduction in growth rate exceeds 0.5%, 1% and 2%).

PU GR figures		% Mortality			
FFC adults In-combination		1	2	5	10
% Displacement	10	0.254	0.254	0.254	0.528
	20	0.254	0.254	0.528	0.788
	30	0.254	0.254	0.788	1.24
	40	0.254	0.528	0.788	1.75

⁸ Reductions in population growth rate relate to the nearest mortality level output from the PVA model that lies above the predicted displacement mortality, so for example, if the predicted displacement is 7 birds and PVA outputs are given in 5 bird increments, the reduction in growth rate in the matrix is that for the 10 birds mortality level.

	50	0.254	0.528	1.04	2.07
	60	0.254	0.528	1.24	2.47
	70	0.254	0.788	1.50	>2.47

Table 12. Natural England position on displacement impacts from Hornsea P2 in-combination with other plans and projects for puffin population of FFC pSPA.

Likely impact considered by Natural England	Natural England has based our assessment of impacts on the range 1-54 adults per annum based on a range of displacement 10-70% and mortality 1-10%.
Conclusions on AEOsI for FFC pSPA for Project in-combination impacts	<p>A density independent PVA model predicts that with an additional annual adult mortality of 50 birds (highest modelled output available) the population growth rate would fall by 2.5% and the population size at 25 years would be 46% lower than an un-impacted population size.</p> <p>There is evidence that puffin have a lower sensitivity to disturbance compared to razorbill and guillemot⁹ therefore Natural England considers that displacement levels will be at the lower end of the 10-70% range. There is considerable uncertainty around what level of mortality would be associated with displacement, therefore we consider it appropriate to consider a range of mortalities from 1-10%, but on the basis that the various project areas lie within areas of the North Sea with only low to medium densities of puffin during the breeding and non-breeding seasons¹⁰ we do not expect mortality rates to be at the top of the range considered. Therefore we do not expect the predicted mortality of puffin from FFC pSPA resulting from displacement to exceed a level where the population growth rate would decline by more than ~0.25% per annum.</p>

⁹ Furness et al 2013, Bradbury et al 2014.

¹⁰ NE/MMO Seabird Sensitivity Mapping Tool. http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

A density dependent model would predict smaller declines in growth rate; however there is no clear evidence to support application of any particular form or magnitude of density dependence in the modelling.

The density independent PVA model using the demographic rate set 2 predicted a population decline of 0.77% per annum over the next 25 years. Due to methodological difficulties with surveying puffin numbers there is considerable uncertainty regarding the population trend for FFC pSPA puffin. Colony counts suggest that the population has declined since 1987, although numbers at the much bigger colonies on Coquet Island and the Farnes increased over this period.

Puffin is a non-listed component of the breeding seabird assemblage of the FFC pSPA. Whilst there is uncertainty about the future population trend for puffin at FFC pSPA, Natural England do not consider that a decline in colony growth rate of 0.25% per annum for puffin would significantly alter the richness or size of the Seabird Assemblage feature of FFC pSPA and puffin would still be predicted to be a viable component of the assemblage.

Natural England consider there is no indication that the predicted potential decline in the growth rate of the puffin population would mean that either the abundance or richness of the breeding seabird assemblage would be reduced to the extent that it would cause an adverse effect on site integrity. **No AEOsI for the project in-combination with other plans and projects.**