

From: Dominika Phillips <DOMPH@orsted.co.uk>

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To: KJ Johansson <KJ.JOHANSSON@planninginspectorate.gov.uk>; Kay Sully <Kay.Sully@pins.gsi.gov.uk>; Hornsea Project Three <HornseaProjectThree@pins.gsi.gov.uk>

Cc: Andrew Guyton <ANGUY@orsted.co.uk>; Stuart Livesey <STLIV@orsted.co.uk>

Subject: Hornsea Project Three (UK) Ltd response to Deadline 6 (Part 8)

Dear Kay, K-J

Please find attached the 8th instalment of documents.

Best regards,

Dr Dominika Chalder PIEMA

Environment and Consent Manager



Environmental Management UK; Wind Power
5 Howick Place | London | SW1P 1WG



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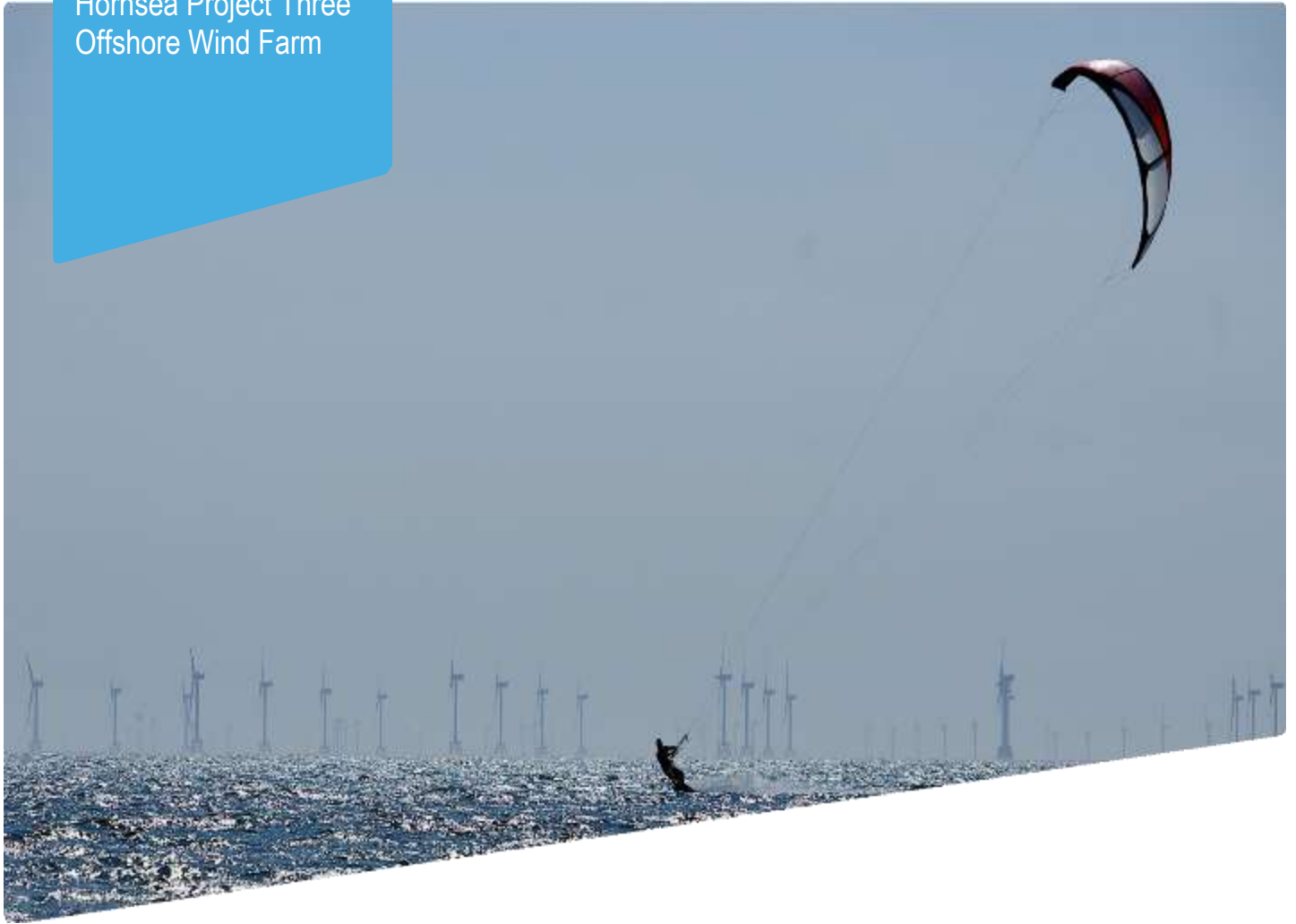
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Appendix 28 to Deadline 6 submission - Position of the
Applicant in relation to collision risk modelling

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5 Howick Place,

London, SW1P 1WG

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1. Introduction

- 1.1 Subsequent to the submission of the Hornsea Three Application there has been extensive discussion of the assumptions underpinning collision risk modelling and the publication of new evidence to inform those assumptions. This note clarifies the Applicant's position in light of these discussion and new evidence.

2. Assumptions

- 2.1 The Applicant's position in relation to the parameters used in collision risk modelling and other aspects of analyses used for assessment purposes is presented in Table 2.1.

Table 2.1: Assumptions in relation to collision risk modelling parameters and analysis techniques for the Applicant's position

Parameter / Analysis	Applicant's position	Justification
Density data	Mean estimate from aerial surveys with the variability associated with density values also presented	
Flight speed data	Skov <i>et al.</i> (2017)	Flight speed data in Skov <i>et al.</i> (2017) represents the best available evidence. Skov <i>et al.</i> (2017) was overseen by a Discretionary Project Screening Committee (which included representatives from industry bodies and developers) and an Expert Panel that included representatives from statutory advisory bodies (e.g. Natural England, Scottish Natural Heritage, etc.) and other interested parties (e.g. the RSPB) .
Nocturnal activity factors	Furness <i>et al.</i> (2018) – gannet Furness (unpub)/MacArthur Green (2018) – kittiwake Garthe and Hüppop (2004) – large gulls	These references provide the best available evidence for each species with the empirically derived nocturnal activity factors presented in Furness <i>et al.</i> (2018) and Furness (unpub) produced specifically for use in the Band (2012) CRM

Parameter / Analysis	Applicant's position	Justification
Band model	Option 1 (or 3)	<p>Site-specific data (in this case from boat-based surveys) represent the best available evidence for collision risk modelling. The proportion of birds at collision height (PCH) derived from boat-based survey data is supported by the results of LiDar surveys undertaken at Hornsea Three which provided comparable PCH values. The methodology used during LiDar surveys has been independently validated.</p> <p>In addition, regard is also given to the results from Option 3, although these do not form the main basis of the assessment. Option 3 provides a more mathematically robust calculation of collision risk (i.e. the Extended model) although still utilises generic flight height data. However, the more detailed appraisal of risk used in the Extended model (Option 3) goes some way to account for the over-estimation in the proportion of birds at collision height</p>
Avoidance rates	Bowgen and Cook (2018)	Bowgen and Cook (2018) provides the best available evidence in relation to the avoidance behaviour of birds at an operational wind farm for use in the Band (2012) CRM with the avoidance rates presented based on empirical evidence collected at an operational wind farm
Apportioning	<p><u>Breeding season</u></p> <ul style="list-style-type: none"> - Gannet = 40.4% - Kittiwake = 41.7% <p><u>Non-breeding seasons</u></p> <p>Apportioning values calculated using population data presented in Furness (2015)</p>	The proportion of gannet and kittiwake from FFC SPA assumed by the Applicant to be present at Hornsea Three in the breeding season is supported by a large body of scientific evidence including, of most relevance, Langston <i>et al.</i> (2013) for gannet and Cleasby <i>et al.</i> (2018) (REP4-049)
Seasonality	Seasonal definitions based on the occurrence of birds at Hornsea Three	Due to the limited connectivity between gannet and kittiwake from FFC SPA and Hornsea Three as indicated by scientific literature (e.g. Langston <i>et al.</i> (2013) for gannet and Cleasby <i>et al.</i> (2018)), the use of seasons that reflect the structure of populations present at Hornsea Three provides for a more accurate assessment of the impact of Hornsea Three on features of FFC SPA

3. Collision risk estimates

Gannet

EIA scale

Table 3.1: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using confidence intervals associated with density at a 99.5% avoidance rate.

Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean estimate	0.04	0.00	0.32	0.40	0.08	0.27	1.26	1.59	0.63	1.43	0.31	1.44
Upper confidence limit	0.11	0.00	0.53	0.55	0.15	0.43	1.65	2.19	0.83	1.80	0.44	2.10
Lower confidence limit	0.00	0.00	0.11	0.22	0.01	0.10	0.81	0.90	0.38	1.05	0.19	0.83

Table 3.2: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using confidence intervals associated with density and flight height distribution at a 98% avoidance rate.

Confidence metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density												
Mean estimate	0.09	0.00	0.67	0.83	0.17	0.57	2.63	3.32	1.31	2.99	0.65	3.01
Upper confidence limit	0.23	0.00	1.11	1.14	0.31	0.90	3.45	4.58	1.73	3.77	0.91	4.39
Lower confidence limit	0.00	0.00	0.22	0.46	0.03	0.21	1.69	1.88	0.79	2.20	0.39	1.74
Flight height distribution												
Maximum likelihood	0.09	0.00	0.67	0.83	0.17	0.57	2.63	3.32	1.31	2.99	0.65	3.01
Upper confidence limit	0.24	0.00	1.74	2.19	0.46	1.52	7.02	8.82	3.44	8.16	1.78	8.23
Lower confidence limit	0.02	0.00	0.15	0.19	0.04	0.13	0.62	0.78	0.30	0.72	0.16	0.73

HRA scale

Table 3.3: Apportioned collision risk estimates for gannet using Option 1 of Band (2012) using confidence metrics associated with density and an avoidance rate of 99.5%

Density	Breeding season	Post-breeding season	Pre-breeding season	Total
Mean estimate	1	0	0	2
Upper confidence limit	2	0	0	2
Lower confidence limit	1	0	0	1

Table 3.4: Apportioned collision risk estimates for gannet using Option 3 of Band (2012) using confidence intervals associated with density and flight height distribution and an avoidance rate of 98.0%

Confidence metric	Breeding season	Post-breeding season	Pre-breeding season	Total
Density				
Mean estimate	3	0	0	4
Upper confidence limit	4	0	0	5
Lower confidence limit	2	0	0	2
Flight height distribution				
Maximum likelihood	3	0	0	4
Upper confidence limit	8	1	1	9
Lower confidence limit	1	0	0	1

Kittiwake

EIA scale

Table 3.5: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using confidence intervals associated with density at a 99.0% avoidance rate.

Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean estimate	0.93	0.37	3.54	4.16	3.67	1.08	6.14	1.80	3.04	0.74	1.03	3.74
Upper confidence limit	1.37	0.75	5.89	5.52	4.84	1.42	8.47	2.22	4.29	0.94	1.22	5.70
Lower confidence limit	0.54	0.12	1.76	2.63	2.40	0.71	3.66	1.33	1.78	0.55	0.83	2.20

Table 3.6: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using confidence intervals associated with density at a 98.0% avoidance rate.

Confidence metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density												
Mean estimate	2.16	0.87	8.25	9.69	8.56	2.51	14.32	4.20	7.08	1.73	2.39	8.71
Upper confidence limit	3.19	1.75	13.73	12.88	11.29	3.32	19.76	5.17	10.00	2.18	2.85	13.30
Lower confidence limit	1.26	0.27	4.11	6.14	5.59	1.64	8.53	3.09	4.15	1.27	1.94	5.13
Flight height distribution												
Maximum likelihood	2.16	0.87	8.25	9.69	8.56	2.51	14.32	4.20	7.08	1.73	2.39	8.71
Upper confidence limit	3.05	1.23	11.33	13.41	11.90	3.50	19.94	5.83	9.98	2.43	3.38	12.29
Lower confidence limit	1.28	0.52	4.75	5.63	4.99	1.47	8.37	2.45	4.19	1.02	1.42	5.15

HRA scale

Table 3.7: Apportioned collision risk estimates for kittiwake using confidence metrics associated with density and an avoidance rate of 99.0%

Density	Breeding season	Post-breeding season	Pre-breeding season	Total
Mean estimate	6	1	0	7
Upper confidence limit	8	1	1	10
Lower confidence limit	4	0	0	4

Table 3.8: Apportioned collision risk estimates for gannet using Option 3 of Band (2012) using confidence intervals associated with density and flight height distribution and an avoidance rate of 98.0%

Confidence metric	Breeding season	Post-breeding season	Pre-breeding season	Total
Density				
Mean estimate	15	1	1	17
Upper confidence limit	20	2	1	23
Lower confidence limit	9	1	0	10
Flight height distribution				
Maximum likelihood	15	1	1	17
Upper confidence limit	20	2	1	23
Lower confidence limit	9	1	0	10

Lesser black-backed gull

EIA scale

Table 3.9: Monthly collision risk estimates for lesser black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density at a 99.5% avoidance rate.

Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean estimate	0.00	0.00	0.00	0.54	0.23	5.89	3.83	1.11	0.00	0.00	0.00	0.00
Upper confidence limit	0.00	0.00	0.00	1.01	0.52	9.33	6.72	2.25	0.00	0.00	0.00	0.00
Lower confidence limit	0.00	0.00	0.00	0.06	0.00	2.45	0.93	0.00	0.00	0.00	0.00	0.00

Table 3.10: Monthly collision risk estimates for lesser black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density at a 99.3% avoidance rate.

Confidence metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density												
Mean estimate	0.00	0.00	0.00	0.30	0.13	3.34	2.17	0.63	0.00	0.00	0.00	0.00
Upper confidence limit	0.00	0.00	0.00	0.57	0.29	5.28	3.81	1.27	0.00	0.00	0.00	0.00
Lower confidence limit	0.00	0.00	0.00	0.03	0.00	1.39	0.53	0.00	0.00	0.00	0.00	0.00
Flight height distribution												
Maximum likelihood	0.00	0.00	0.00	0.30	0.13	3.34	2.17	0.63	0.00	0.00	0.00	0.00
Upper confidence limit	0.00	0.00	0.00	0.87	0.37	9.61	6.24	1.82	0.00	0.00	0.00	0.00
Lower confidence limit	0.00	0.00	0.00	0.14	0.06	1.58	1.03	0.30	0.00	0.00	0.00	0.00

Herring gull

EIA scale

Table 3.11: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using confidence intervals associated with density at a 99.5% avoidance rate.

Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean estimate	0.00	0.96	0.00	0.00	0.00	0.30	0.31	0.00	1.51	0.00	0.00	2.47
Upper confidence limit	0.00	1.91	0.00	0.00	0.00	1.05	0.92	0.00	3.30	0.00	0.00	4.45
Lower confidence limit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74

Table 3.12: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using confidence intervals associated with density at a 99.3% avoidance rate.

Confidence metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density												
Mean estimate	0.00	0.68	0.00	0.00	0.00	0.21	0.22	0.00	1.07	0.00	0.00	1.75
Upper confidence limit	0.00	1.35	0.00	0.00	0.00	0.74	0.65	0.00	2.34	0.00	0.00	3.15
Lower confidence limit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53
Flight height distribution												
Maximum likelihood	0.00	0.68	0.00	0.00	0.00	0.21	0.22	0.00	1.07	0.00	0.00	1.75
Upper confidence limit	0.00	1.57	0.00	0.00	0.00	0.49	0.50	0.00	2.49	0.00	0.00	4.06
Lower confidence limit	0.00	0.40	0.00	0.00	0.00	0.13	0.13	0.00	0.63	0.00	0.00	1.03

Great black-backed gull

EIA scale

Table 3.13: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density at a 99.5% avoidance rate.

Density	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean estimate	2.49	0.66	0.71	0.17	0.00	0.46	5.62	0.55	1.94	1.64	2.79	8.47
Upper confidence limit	4.85	1.43	1.56	0.39	0.00	0.81	11.22	0.91	3.70	2.50	3.63	12.72
Lower confidence limit	0.54	0.00	0.00	0.00	0.00	0.10	0.03	0.18	0.00	0.00	1.95	5.04

Table 3.14: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density at a 99.3% avoidance rate.

Confidence metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density												
Mean estimate	1.27	0.34	0.36	0.09	0.00	0.23	2.87	0.28	0.99	0.84	1.42	4.32
Upper confidence limit	2.47	0.73	0.80	0.20	0.00	0.41	5.72	0.47	1.89	1.27	1.85	6.48
Lower confidence limit	0.27	0.00	0.00	0.00	0.00	0.05	0.02	0.09	0.00	0.00	1.00	2.57
Flight height distribution												
Maximum likelihood	1.27	0.34	0.36	0.09	0.00	0.23	2.87	0.28	0.99	0.84	1.42	4.32
Upper confidence limit	2.96	0.78	0.84	0.21	0.00	0.54	6.68	0.65	2.31	1.95	3.31	10.06
Lower confidence limit	0.90	0.24	0.26	0.06	0.00	0.16	2.03	0.20	0.70	0.59	1.00	3.05