HAVERIGG III WIND FARM LIFETIME EXTENSION

Report to Inform a Habitats Regulations Assessment

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Ecology Consulting

Client: **Windcluster Ltd**

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Executive Summary

Windcluster Ltd is proposing to extend the lifetime of the existing 4-turbine Haverigg III wind farm in south Cumbria for a further 15 years beyond their current planning consent (which expires in 2025) until 2040, plus a further 12 months to allow for decommissioning and restoration works to take place.

Following consultation with Natural England (and agreement over the scope of the surveys required), this report has been produced to address the increased collision risk that would result from the Haverigg III wind farm lifetime extension, in relation to the Habitats Regulations, specifically the Morecambe Bay and Duddon Estuary SPA and Ramsar sites. The baseline data used in this report included:

- Vantage point (VP) surveys during 2014 and 2019 breeding seasons, and the 2014-15 autumn/winter;
- Nocturnal surveys during the 2014-15 autumn/winter;
- Collision victim searches during 2014 and 2019 breeding seasons, and the 2014-15 autumn/winter.

Natural England has advised that it considers that a Likely Significant Effect cannot be ruled out for the Haverigg III Lifetime Extension for four species; lesser black-backed gull, herring gull, golden plover and curlew. As a result, this assessment provides the information required to inform an Appropriate Assessment.

Collision modelling was carried out for all the SPA species recorded over-flying the collision risk zone and at rotor height in sufficient numbers to possibly be at risk of a significant impact; golden plover, curlew, lesser black-backed gull and herring gull. As well as applying a range of theoretical avoidance rates, the collision search data were used in combination with the modelling to determine empirical site-specific avoidance rates for the two main groups at risk, gulls (99.2%) and waders (99.6%).

Collision risks (applying the empirical site-specific avoidance rates) were of negligible magnitude for golden plover and curlew, and for lesser black-backed gull and herring gull in winter, for the Haverigg III wind farm alone. No adverse effects on integrity under the Habitats Regulations were identified for these species at these times of year.

Collision risks for lesser black-backed gull and herring gull in the breeding season, however, were predicted to be of low magnitude. It was, though, concluded that there would be no adverse effect on integrity to the SPA herring gull and lesser black-backed gull breeding populations due to collision risk, for the following reasons:

- Only a very low amount of additional mortality was predicted from the collision risk modelling, and this was even lower when the actual observed collision rates were taken into account;
- Previous population analyses for offshore wind farms have shown that a much higher level of mortality could be sustained by the populations (Dept of Energy and Climate Change 2014) albeit based on higher population estimates than in the latest data;
- The risk from the Haverigg III wind farm is trivial in comparison with previous and recent gull culling schemes.

Cumulative collision risks were also concluded to have no adverse effect on integrity, for the same reasons.

Notwithstanding the conclusions reached above, Natural England has advised that it considers, on the basis of a precautionary approach, that mitigation measures are required in order to avoid the possibility of any adverse effect on the integrity of the SPA breeding lesser black-backed and herring gull populations. These measures would comprise provision of funding for the construction of predator-proof fencing at the main SPA breeding colony at South Walney.

In conclusion, the proposed Haverigg III lifetime extension would not adversely affect the ecological integrity of the Morecambe Bay and Duddon Estuary SPA/Ramsar, either alone or in combination with any other plan or project, and therefore authorisation for the project may be granted.

Introduction

1. Windcluster Ltd is proposing to extend the lifetime of the existing 4-turbine Haverigg III wind farm in south Cumbria for a further 15 years beyond their current planning consent (which expires in 2025) until 2040, plus a further 12 months to allow for decommissioning and restoration works to take place. The proposed lifetime extension would not involve replacement of turbines or changes to the existing infrastructure, so potential construction effects have been scoped out from this report. The decommissioning would not be changed from that which has already been consented as part of the original wind farm applications, so it too has been scoped out from this report.

2. The Haverigg III Wind Farm (Haverigg III) comprises four Vestas V52 wind turbines with a blade tip height of 76m and supporting infrastructure (including access tracks and switchgear). The total generating capacity of Haverigg III is 3.4 MW. Planning permission was granted for Haverigg III in 2002 (planning ref: 4/02/0505/0) and it was constructed in 2005.

3. Following the production of an EIA Screening Report for the scheme and subsequent consultation, Natural England has advised that a Habitats Regulations Assessment should be undertaken, as the proposed lifetime extension site lies in proximity to the Morecambe Bay and Duddon Estuary Special Protection Area (SPA)/Ramsar site. Natural England's main ornithological concern is in relation to birds from the SPA/Ramsar site that may over-fly the wind farm and hence be at risk of collision.

4. This report addresses the increased collision risk that would result from the Haverigg III wind farm lifetime extension, in relation to the Habitats Regulations. The report provides information on the existing baseline populations for the species for which the Duddon Estuary and Morecambe Bay SPA and Ramsar site have been designated (and that could be affected by the proposed development). It includes an assessment of the collision risk of the proposed development on those populations alone and in combination with other operational, consented and proposed wind farms and other relevant projects in the area.

5. The information presented in this report draws on all of the available information (including from the EIA screening report and its appendices and from previous surveys of the site) on the key species that are SPA qualifying features that could possibly be significantly affected by the wind farm, in order to provide the information required to inform the Habitats Regulations Assessment.

Special Protection Areas Considered in this Report

6. There is one SPA in the 20km search area around the proposed wind farm site which is considered in this report, the Morecambe Bay and Duddon Estuary SPA. Sections of the SPA are also designated as Ramsar sites, (a) the Duddon Estuary Ramsar site and (b) the Morecambe Bay Ramsar site.

7. The SPA lies 40m south from the nearest Haverigg III wind turbine at its closest point. It comprises extensive inter-tidal habitats with an internationally important wintering waterfowl community. Most species would be restricted to the inter-tidal habitats but some (including pink-footed goose, golden plover, curlew, lesser black-backed gull and herring gull) are likely to range more widely over adjacent farmland.

8. The qualifying features of the SPA are summarised in Table 1, and further details are given in the SPA citation in Appendix 1. The site qualifies under Article 4.1 of the Directive (2009/147/EC) as it is used regularly by 1% or more of the Great Britain populations of nine species listed in Annex I in any season. It qualifies under Article 4.2 of the Directive (79/409/EEC) as it is used regularly by 1% or more of the biogeographical populations of 15 regularly occurring migratory species (other than those listed in Annex I) in any season. The

wintering waterbird and seabird assemblages are additional qualifying features under Article 4.2.

9. The information sheets for the two Ramsar sites are given in Appendix 2. The Morecambe Bay Ramsar site is designated for several additional nationally important wintering waterbird populations that are not designated features of the SPA, including wigeon, goldeneye, red-breasted merganser, eider, great crested grebe, cormorant and lapwing (all are, though, noted on the citation as SPA assemblage species). The only additional designated species for the Duddon Estuary Ramsar site is red-breasted merganser (again a SPA assemblage species).

10. No other SPAs/Ramsar site would be affected by the proposed lifetime extension.

Table 1. Citation species for the Morecambe Bay and Duddon Estuary SPA.

Species	**Time of Year**	**Population**	**Importance**
Article 4.1 qualifying features			
Whooper swan	Non-breeding	113 individuals (2009/10 – 2013/14)	1.0% of GB population
Little egret	Non-breeding	134 individuals (2009/10 – 2013/14)	3.0% of GB population
Golden plover	Non-breeding	1,900 individuals (Morecambe Bay SPA citation value 1991)	1.0% of GB population (1991)
Bar-tailed godwit	Non-breeding	3,046 individuals (2009/10 – 2013/14)	8.0% of GB population
Ruff	Non-breeding	8 individuals (2009/10– 2013/14)	1.0% of GB population
Mediterranean gull	Non-breeding	18 individuals (2009/10– 2013/14)	1.0% of GB population
Little tern	Breeding	84 individuals (2010 –2014)	2.2% of GB population
Sandwich tern	Breeding	1,608 individuals (1988- 1992)	5.7% of GB population (1992)
Common tern	Breeding	570 individuals (Morecambe Bay SPA citation value 1991)	2.0% of GB population (1991)
Article 4.2 qualifying features			
Pink-footed goose	Non-breeding	15,648 individuals (2009/10 – 2013/14)	4.5% of biogeographic population
Shelduck	Non-breeding	5,878 individuals (2009/10 – 2013/14)	2.0% of biogeographic population
Pintail	Non-breeding	2,498 individuals (2009/10 – 2013/14)	4.2% of biogeographic population
Oystercatcher	Non-breeding	55,888 individuals (2009/10 – 2013/14)	6.8% of biogeographic population
Grey plover	Non-breeding	2,000 individuals (Morecambe Bay SPA citation value 1991)	1.0% of biogeographic population (1991)
Ringed plover	Non-breeding	1,049 individuals (2009/10 – 2013/14)	1.4% of biogeographic population
Curlew	Non-breeding	12,209 individuals (2009/10 – 2013/14)	1.5% of biogeographic population
Black-tailed godwit	Non-breeding	2,413 individuals (2009/10 – 2013/14)	4.0% of biogeographic population
Turnstone	Non-breeding	1,359 individuals (2009/10 – 2013/14)	1.0% of biogeographic population
Knot	Non-breeding	32,739 individuals (2009/10 – 2013/14)	7.3% of biogeographic population
Sanderling	Non-breeding	3,600 individuals (Morecambe Bay SPA citation value 1991)	3.0% of biogeographic population (1991)

Species	Time of Year	Population	Importance
Dunlin	Non-breeding	26,982 individuals (2009/10 – 2013/14)	2.0% of biogeographic population
Redshank	Non-breeding	11,133 individuals (2009/10 – 2013/14)	4.6% of biogeographic population
Lesser black-backed gull	Non-breeding	9,450 individuals (2009/10 – 2013/14)	1.7% of biogeographic population
Lesser black-backed gull	Breeding	9,720 individuals (2011-2015)	2.7% of biogeographic population
Herring gull	Breeding	20,000 individuals (Morecambe Bay SPA citation value 1991)	1.0% of biogeographic population (1991)
Wintering waterfowl community†	Wintering	266,751 individuals (During the period 2009/10 – 2013/14)	>20,000 individuals
Wintering seabird community	Wintering	40,672 individuals (Morecambe Bay SPA citation value 1997)	>20,000 individuals

† includes above waterfowl plus red-breasted merganser great crested grebe, black-tailed godwit, cormorant, wigeon, teal, mallard, eider, goldeneye, red-breasted merganser, lapwing and whimbrel.

11. Ecological links between the proposed wind farm lifetime extension site and this SPA (and Ramsar sites) are considered in this report. The main concern in relation to the SPA would be if there were sufficient numbers of any qualifying bird species over-flying the site at collision height to be at significant risk of collision.

Legislative Framework

12. Under the Conservation of Habitats and Species Regulations 2017 which translates the Birds and Habitats Directives into English Law (hereafter termed the Habitats Regulations), a development that is likely to have a significant effect on an SPA requires Appropriate Assessment. On the advice of Natural England, this development has been considered in the context of those Regulations.

13. The first test under the Habitats Regulations is whether the development is likely to have a significant effect on any of the populations of importance for which the site has been designated. If it is (as determined by the Competent Authority, in this case Copeland Borough Council), then an Appropriate Assessment needs to be carried out by the Competent Authority to determine whether the development could threaten the ecological integrity of the SPA (European Commission 2018). In this context ecological integrity is defined in "Managing Natura 2000 Sites" as:

> *"the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified"*

14. The Conservation Objectives for the Morecambe Bay and Duddon Estuary SPA (as published on the Natural England website[1]) apply to the site and the individual species and/or assemblage of species for which the site has been classified (the "Qualifying features" listed above).

[1] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9020326&HasCA=1&NumMarineSeasonality=25&SiteNameDisplay=Morecambe%20Bay%20and%20Duddon%20Estuary%20SPA#hlco. Accessed 9/12/19.

"The objectives 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 Wild Birds Directive, by maintaining or restoring:

Subject to natural change, to maintain or restore:

- *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 the qualifying features;*
- *The distribution of the qualifying features within the site."*

Scope of this report

15. The scope of this report to inform the Habitats Regulations Assessment is as follows:

- Desk study of the available ornithological data on the site (including review of existing reports and data);
- Collision risk modelling for Herring Gull and Lesser Black-backed Gull;
- Collision risk modelling for wintering waterbirds;
- Assess Nocturnal Flight Paths - use best available information (including local night surveys carried out during August 2014-March 2015) to determine the appropriate nocturnal activity values to include in the collision risk modelling;
- Cumulative impact assessment - cumulative and 'in combination' effects have been considered in relation to other operational, consented or proposed wind turbine developments that could affect these SPA species.

Key Ornithological Interests: Baseline Conditions

16. The data available for this assessment include field data obtained from detailed year-round baseline studies carried out during the 2014 breeding season, the 2014/15 autumn/winter period and the 2019 breeding season. Further details are provided in the EIA Screening Report (Arcus Consultancy Services 2019). Data used for this report included:

- April-July 2014 vantage point (VP) surveys - 36 hours' surveys from a single VP (Percival et al. 2014).
- August 2014-March 2015 VP surveys - 72 hours' surveys from a single VP (Percival et al. 2015).
- May-July 2019 VP surveys - 36 hours' surveys from a single VP (Arcus Consultancy Services 2019).
- Nocturnal surveys August 2014-March 2015 - eight surveys using an image intensifier (Percival et al. 2015), using an infra-red lamp to assist viewing without disturbing the birds (Gillings et al. 2005).
- Collision victim searches from April-June 2014 (Percival et al. 2014), April-August 2019 and September 2018-February 2019 (Arcus Consultancy Services 2019).

Baseline Flight Activity

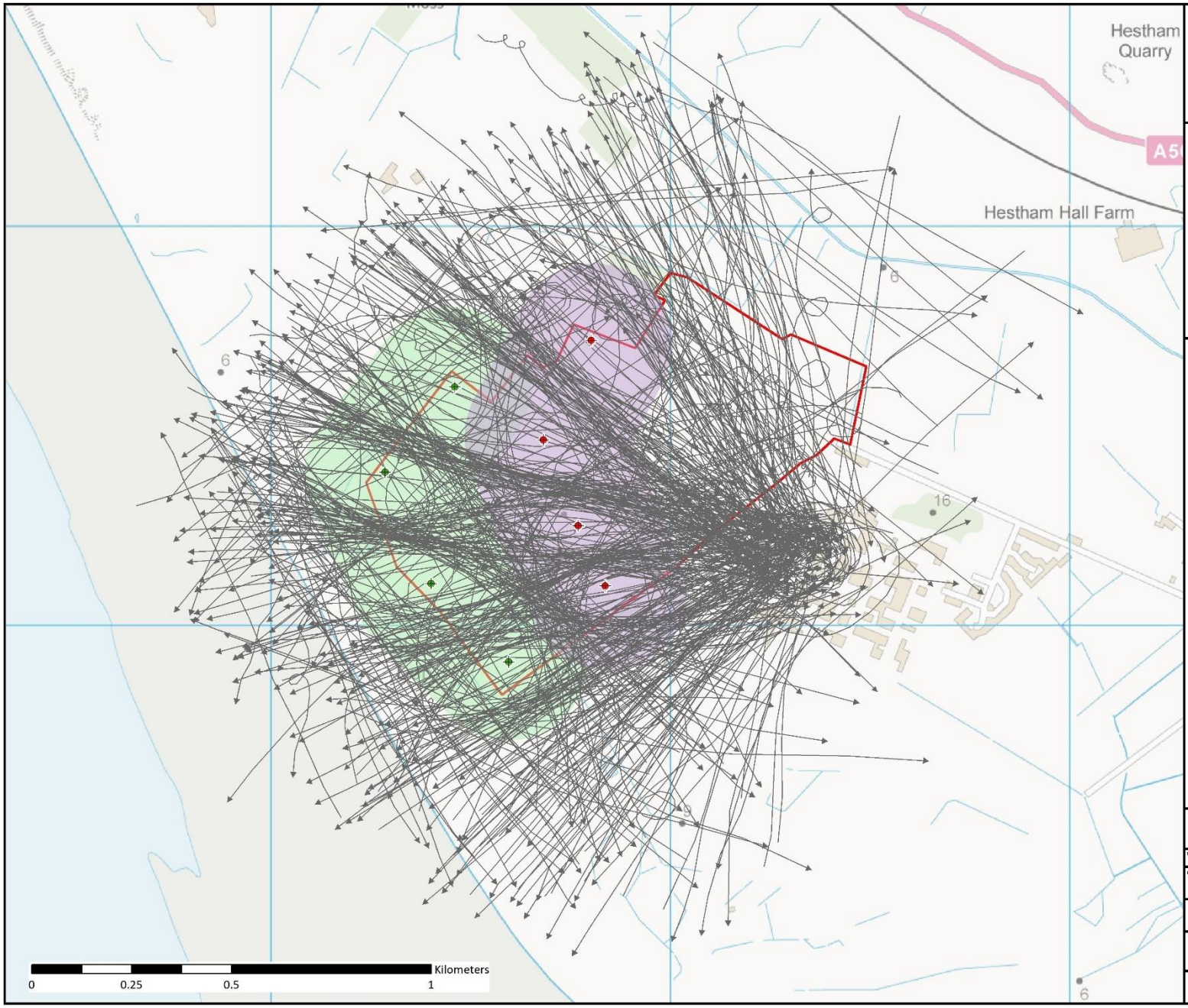
17. The rates of bird flight movement observed across the survey area during the 2014-15 autumn/winter vantage point surveys are summarised in Table 2. This gives the mean over-flying rate per hour for each key species during the autumn (August-November) and winter (December-March) surveys. This includes all the observations of the target species flying over the proposed lifetime extension site and its surrounds.

18. Table 2 also gives the percentage of flights of each species that were recorded at the rotor height of the existing turbines. The existing turbines rotor blades are 20.5-62.5m above the ground (Haverigg II) and 24-76m above the ground (Haverigg III).

Table 2. SPA species (qualifying and assemblage) flight rates recorded over the survey area during the August 2014 – March 2015 vantage point surveys (36 hours autumn Aug-Nov, 36 hours winter Dec-Mar).

Species	Autumn flight rate (no/hr)	Winter flight rate (no/hr)	Autumn total number of flights	Winter total number of flights	% flights at rotor height	
					Haverigg II (20.5-62.5m)	Haverigg III (24-76m)
Qualifying Species:						
Whooper Swan	0.3	0.0	10	0	0%	0%
Pink-footed Goose	26.1	17.8	940	641	8%	13%
Shelduck	0.0	0.1	0	3	100%	100%
Little Egret	0.1	0.0	4	0	0%	0%
Oystercatcher	0.1	0.0	2	1	0%	0%
Ringed Plover	0.1	0.0	4	0	0%	0%
Golden Plover	19.0	51.2	684	1842	71%	76%
Curlew	3.9	54.0	141	1944	44%	39%
Lesser Black-backed Gull	12.3	5.3	442	190	37%	36%
Herring Gull	62.4	109.5	2245	3943	39%	37%
Sandwich Tern	0.0	0.0	1	0	0%	0%
Assemblage Species:						
Teal	0.0	0.0	0	1	0%	0%
Mallard	0.0	0.3	1	10	50%	50%
Cormorant	0.9	1.2	31	44	47%	47%
Lapwing	4.0	5.1	144	185	73%	82%

19. Much the most frequently recorded SPA species was herring gull. Their flight lines are shown in Figure 1. Other SPA species seen over-flying the wind farm site included pink-footed goose (Figure 2), golden plover (Figure 3), curlew (Figure) and lesser black-backed gull (Figure 5).



THRIVE RENEWABLES

Haverigg II Wind Farm Lifetime Extension

FIGURE 1

Vantage Point Survey 2014-15 Flight Lines: Herring Gull

KEY:

- Haverigg II turbines
- Haverigg III turbines
- Flight lines 2014-15
- Haverigg III Collision Zone (200m)
- Haverigg II Collision Zone (200m)
- Wind farm site boundary

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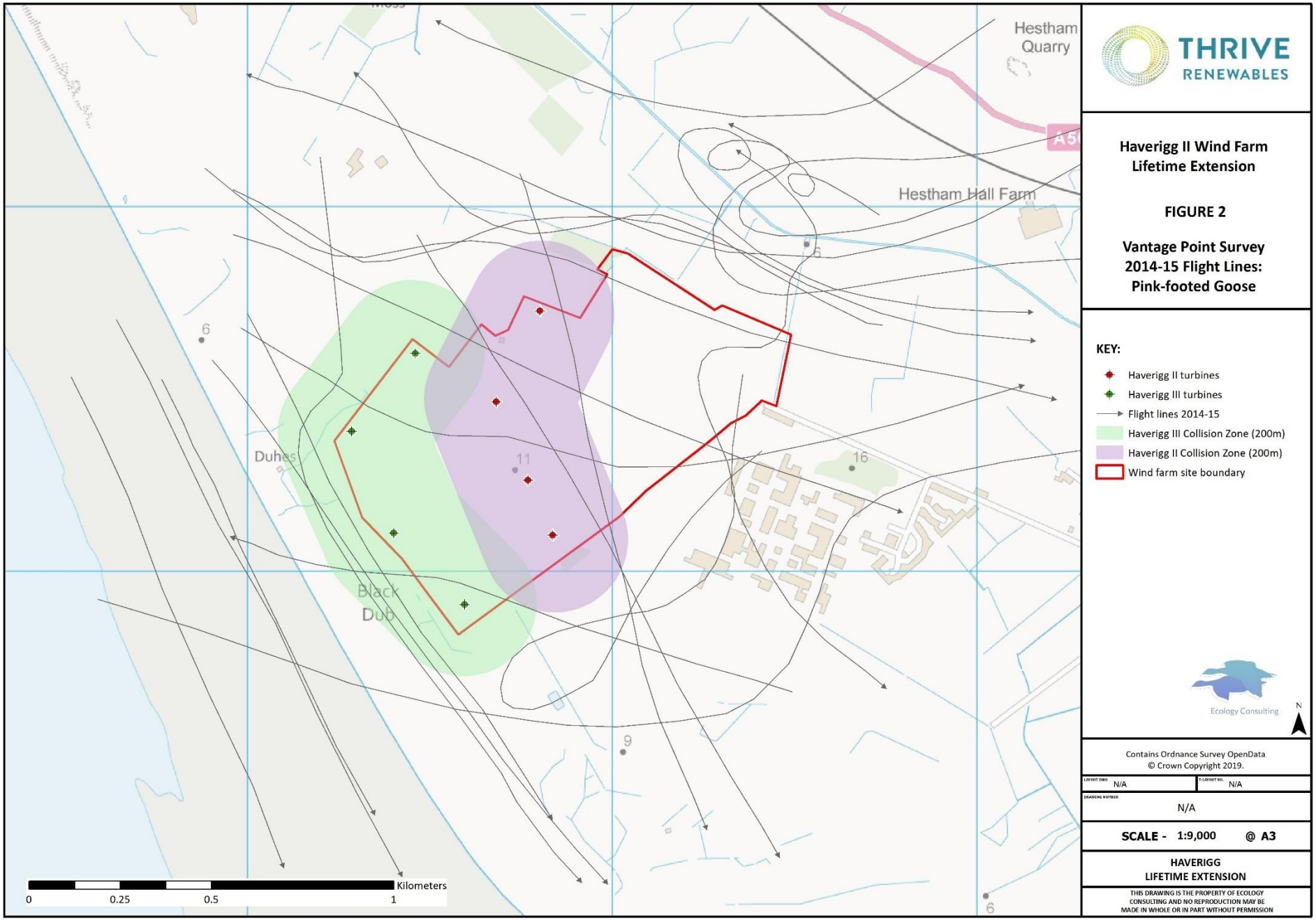
HAVERIGG LIFETIME EXTENSION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Haverigg II Wind Farm Lifetime Extension
FIGURE 2
Vantage Point Survey 2014-15 Flight Lines: Pink-footed Goose
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines 2014-15
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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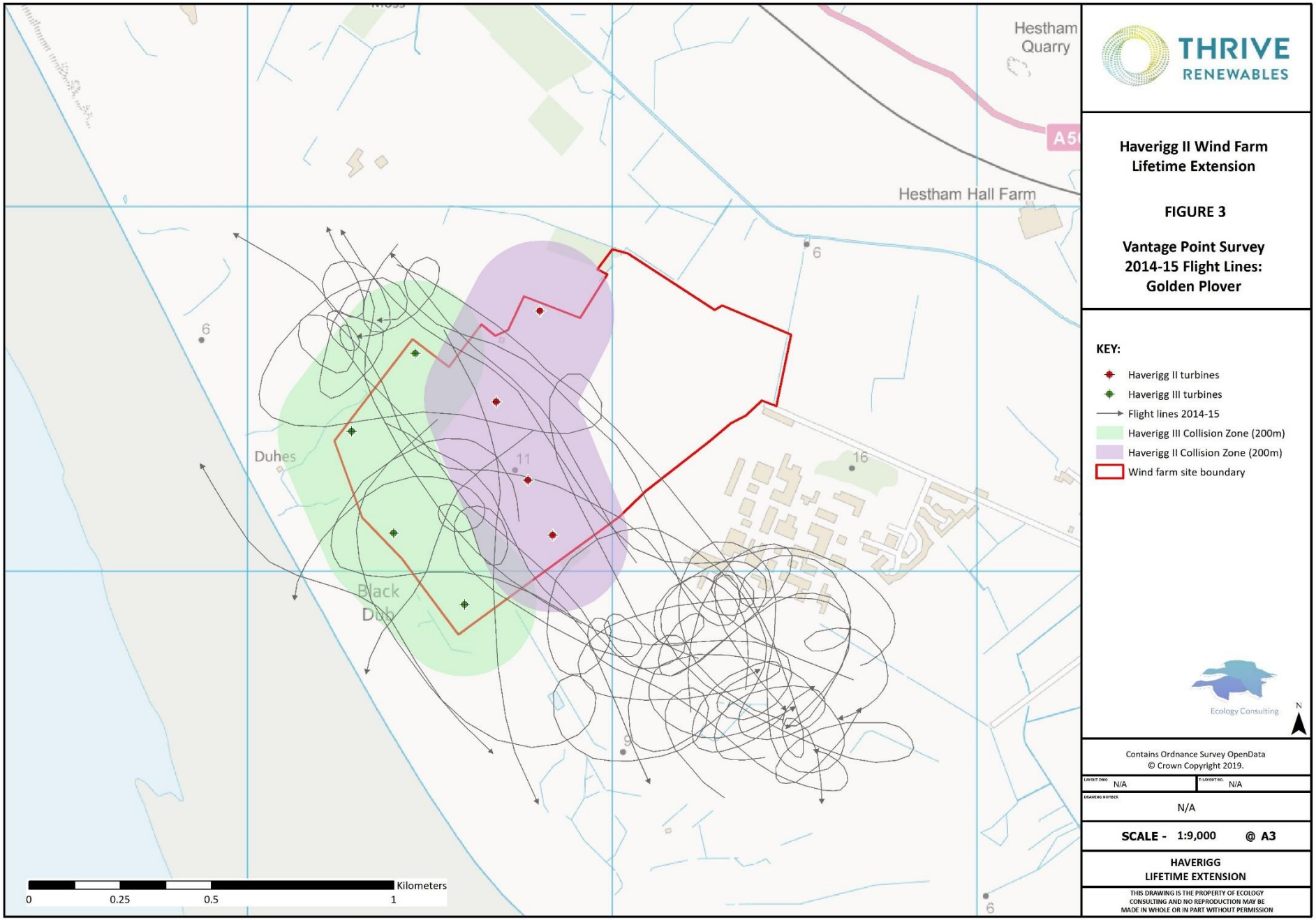
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THRIVE RENEWABLES
Haverigg II Wind Farm Lifetime Extension
FIGURE 3
Vantage Point Survey 2014-15 Flight Lines: Golden Plover
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines 2014-15
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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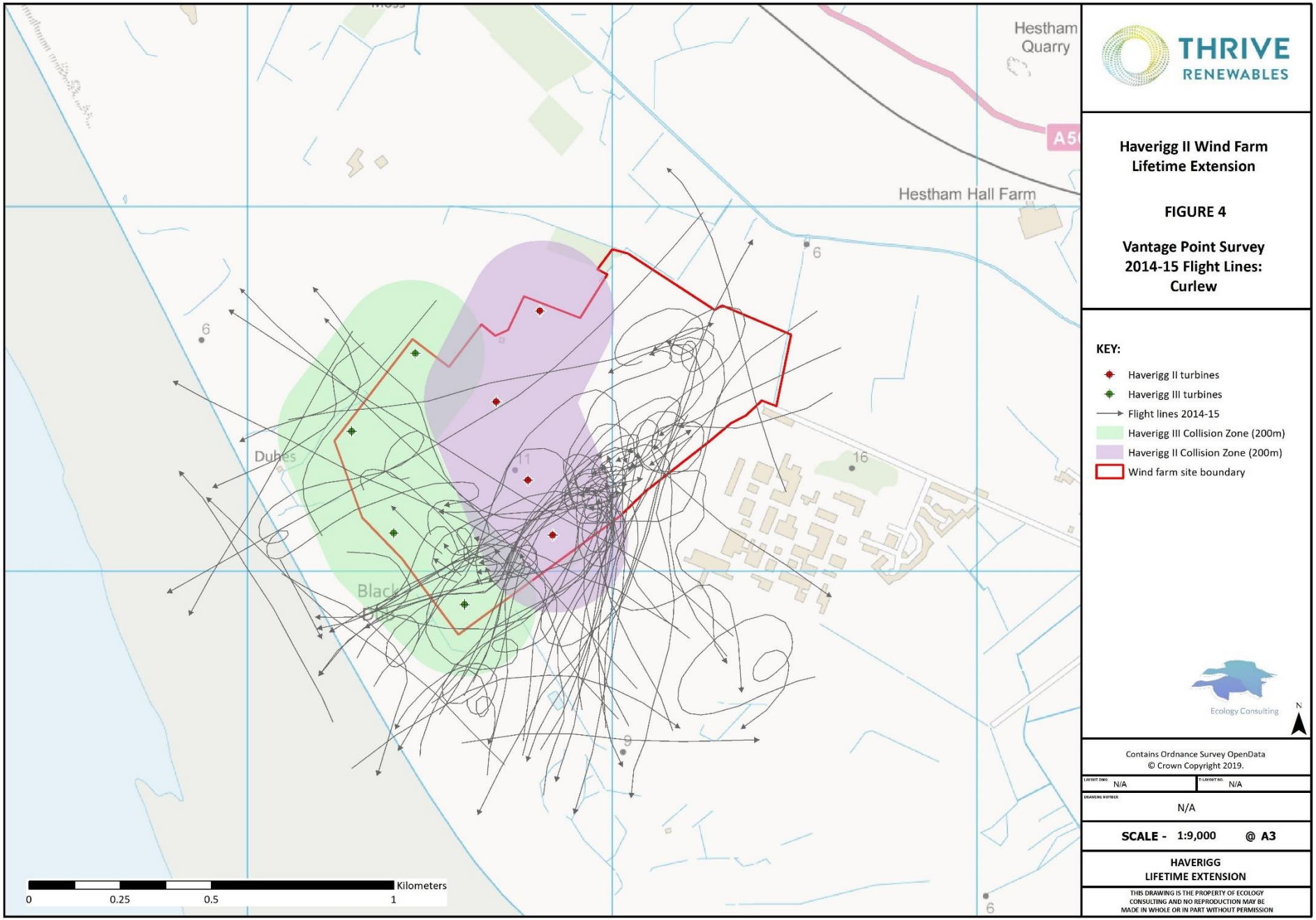
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Haverigg II Wind Farm
Lifetime Extension
FIGURE 4
Vantage Point Survey
2014-15 Flight Lines:
Curlew
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines 2014-15
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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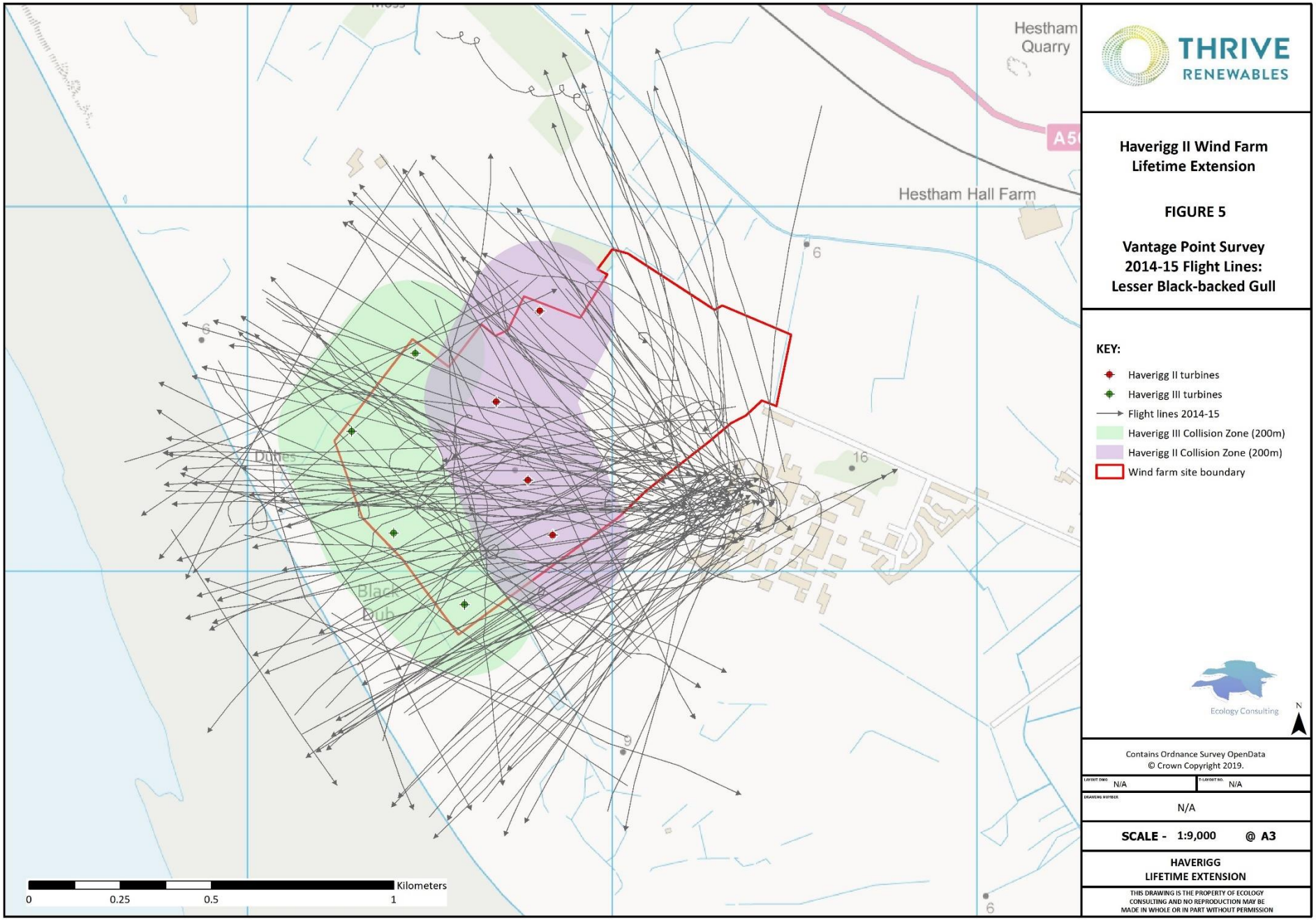
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Haverigg II Wind Farm
Lifetime Extension
FIGURE 5
Vantage Point Survey
2014-15 Flight Lines:
Lesser Black-backed Gull
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines 2014-15
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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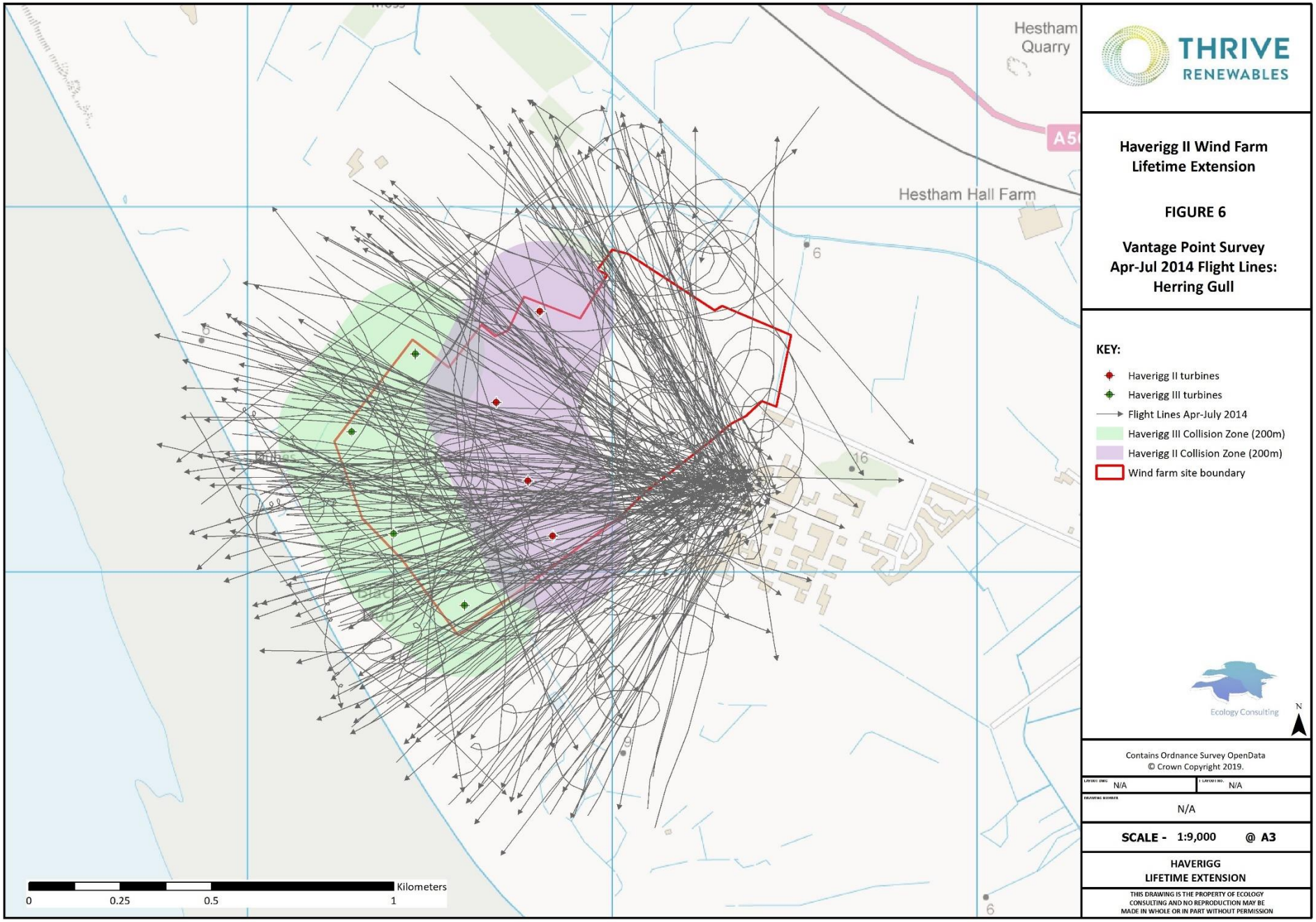
20. The rates of bird flight movement observed across the survey area during the 2014 breeding season vantage point surveys are summarised in Table 3. This gives the mean over-flying rate per hour for each key species over the study period. This includes all the observations of the target species flying over the proposed lifetime extension site and its surrounds.

21. Table 3 also gives the percentage of flights of each species that were recorded at the rotor height of the existing turbines.

Table 3. SPA species (qualifying and assemblage) flight rates recorded over the breeding bird survey area during the April-July 2014 vantage point surveys (36 hours).

Species	Flight Rate (no/hr)	Total number of flights	% flights at rotor height	
			Haverigg II (20.5-62.5m)	Haverigg III (24-76m)
Qualifying Species:				
Shelduck	0.11	4	0%	0%
Oystercatcher	1.14	41	32%	29%
Golden Plover	0.53	19	0%	0%
Curlew	5.58	201	50%	50%
Lesser Black-backed Gull	39.2	1,411	36%	34%
Herring Gull	90.9	3,273	26%	24%
Assemblage Species:				
Mallard	0.22	8	100%	100%
Cormorant	0.11	4	50%	100%
Lapwing	0.64	23	50%	42%
Whimbrel	0.14	5	0%	100%

22. Much the most frequently recorded SPA species were herring gull and lesser black-backed gull, with most records being of birds moving to/from their breeding colonies on HMP Haverigg prison, which is located adjacent to the eastern boundary of the proposed lifetime extension site. Their flight lines are shown in Figures 6 and 7. Flight lines of the only other SPA species recorded in higher numbers during these surveys, curlew, are shown in Figure 8.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THRIVE RENEWABLES
Haverigg II Wind Farm
Lifetime Extension
FIGURE 6
Vantage Point Survey
Apr-Jul 2014 Flight Lines:
Herring Gull
KEY:
Haverigg II turbines
Haverigg III turbines
Flight Lines Apr-July 2014
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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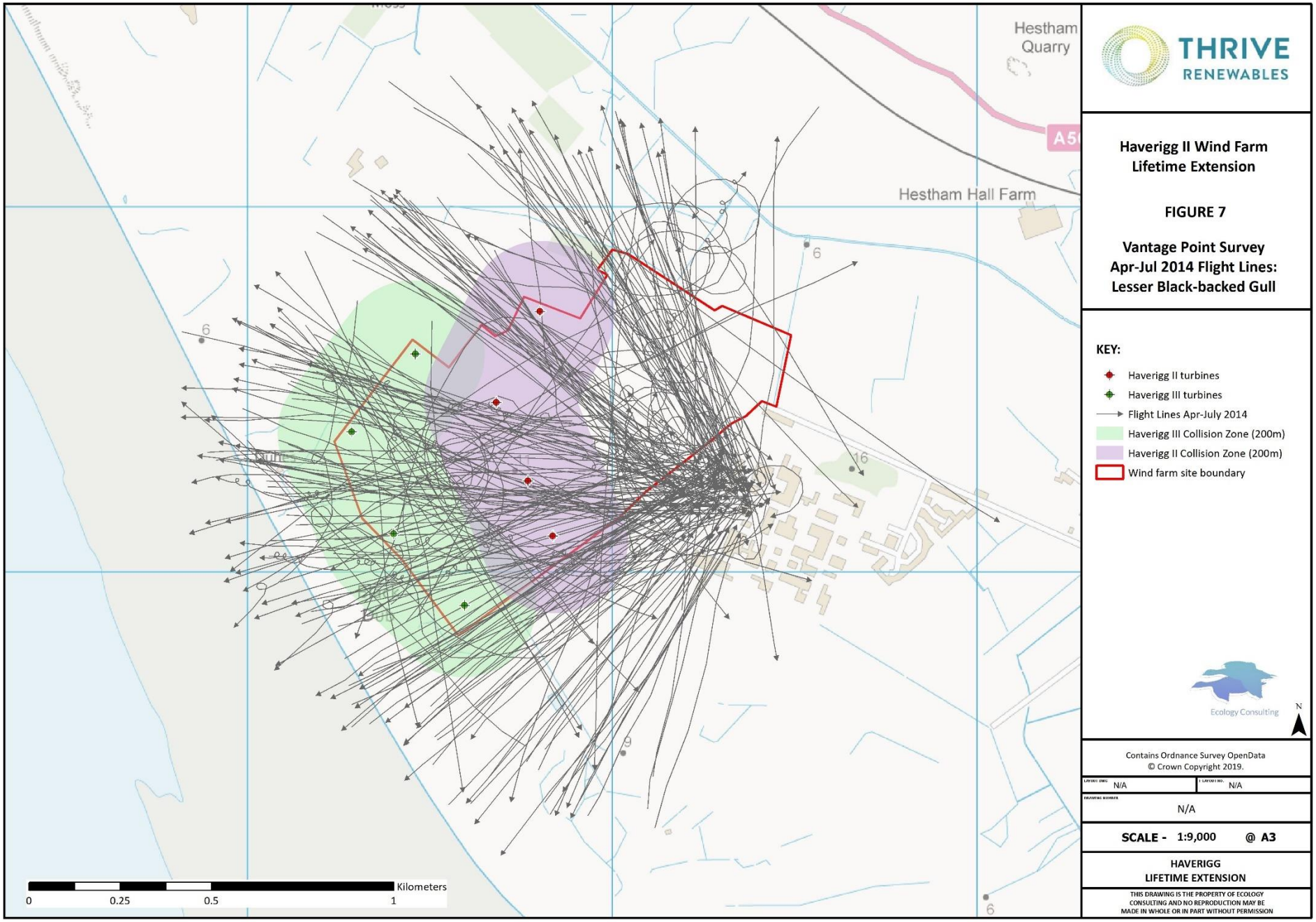
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Haverigg II Wind Farm
Lifetime Extension
FIGURE 7
Vantage Point Survey
Apr-Jul 2014 Flight Lines:
Lesser Black-backed Gull
KEY:
Haverigg II turbines
Haverigg III turbines
Flight Lines Apr-July 2014
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
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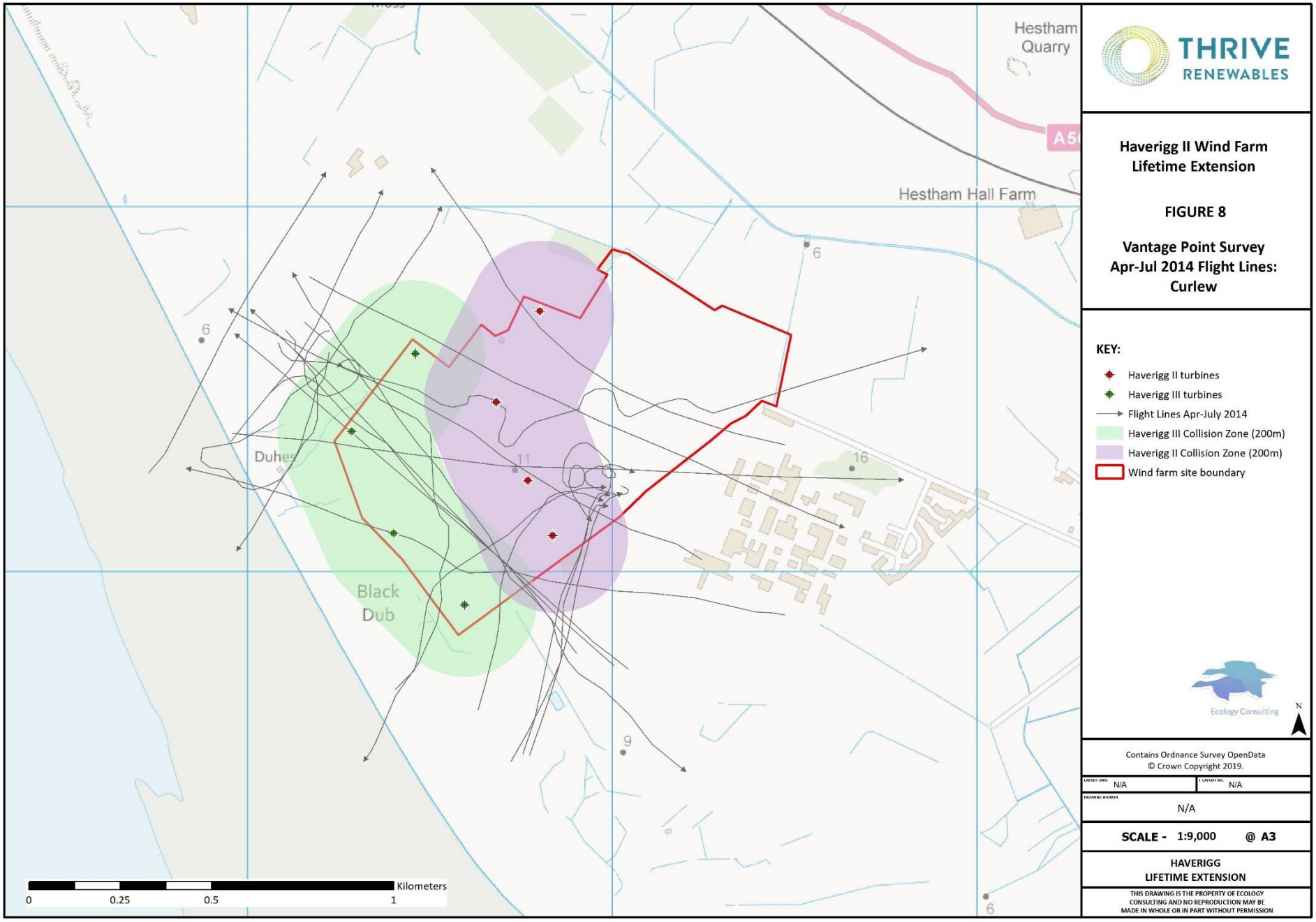
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THRIVE RENEWABLES
Haverigg II Wind Farm Lifetime Extension
FIGURE 8
Vantage Point Survey Apr-Jul 2014 Flight Lines: Curlew
KEY:
Haverigg II turbines
Haverigg III turbines
Flight Lines Apr-July 2014
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
Ecology Consulting
N
Contains Ordnance Survey OpenData
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N/A
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SCALE - 1:9,000 @ A3
HAVERIGG LIFETIME EXTENSION
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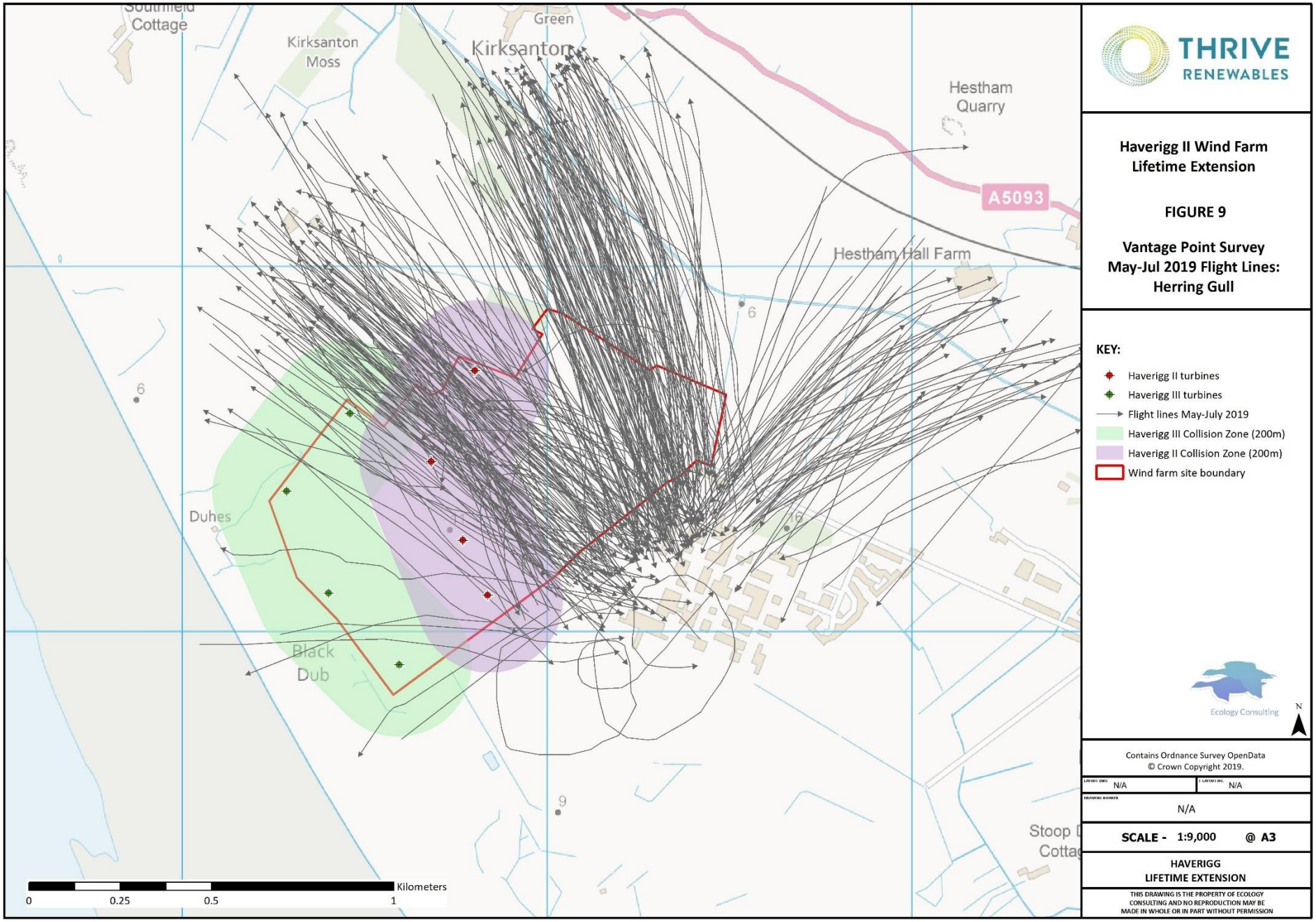
23. The rates of bird flight movement observed across the survey area during the 2019 breeding season vantage point surveys are summarised in Table 4. This gives the mean over-flying rate per hour for each key species over the study period. This includes all the observations of the target species flying over the proposed lifetime extension site and its surrounds.

24. Table 4 also gives the percentage of flights of each species that were recorded at the rotor height of the existing turbines. Flight heights were recorded to broad bands in the 2019 surveys, so it was not possible to estimate the percentage at rotor height for Haverigg II and III separately.

Table 4. SPA species (qualifying and assemblage) flight rates recorded over the survey area during the May-July 2019 vantage point surveys (36 hours).

Species	Flight Rate (no/hr)	Total number of flights	Approximate % flights at rotor ht
Qualifying Species:			
Little Egret	0.11	4	67%
Oystercatcher	3.69	133	26%
Black-tailed Godwit	0.08	3	50%
Curlew	6.42	231	60%
Lesser Black-backed Gull	28.2	1,016	89%
Herring Gull	48.8	1,757	89%
Assemblage Species:			
Mallard	0.28	10	54%
Lapwing	1.53	55	47%
Whimbrel	1.11	40	54%

25. As in 2014, the most frequently recorded SPA species were herring gull and lesser black-backed gull, with most records being of birds moving to/from their breeding colonies on the prison. Their flight lines are shown in Figures 9 and 10. Flight lines of the only other SPA species recorded in higher numbers during these surveys, curlew, are shown in Figure 11.


Southfield Cottage
Kirksanton Moss
Green
Kirksanton
Hestham Quarry
A5093
Hestham Hall Farm
Duhes
Black Dub
Stoop
Cottage
6
9
Kilometers
0
0.25
0.5
1
THRIVE RENEWABLES
Haverigg II Wind Farm
Lifetime Extension
FIGURE 9
Vantage Point Survey
May-Jul 2019 Flight Lines:
Herring Gull
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines May-July 2019
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
Ecology Consulting
N
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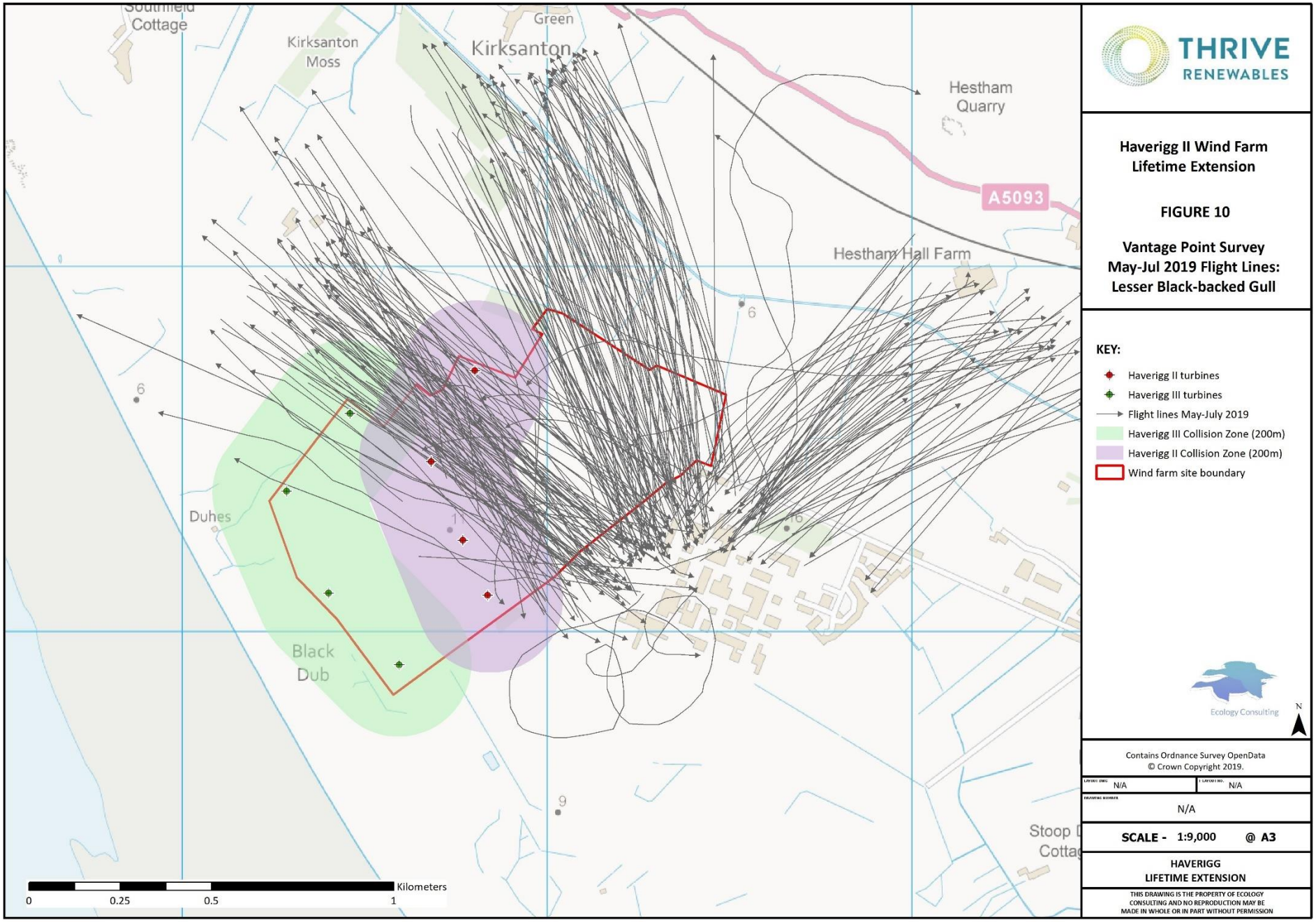
Southfield Cottage
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Hestham Hall Farm
Duhes
Black Dub
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Cottage
6
1
9
Kilometers
0
0.25
0.5
1
THRIVE RENEWABLES
Haverigg II Wind Farm
Lifetime Extension
FIGURE 10
Vantage Point Survey
May-Jul 2019 Flight Lines:
Lesser Black-backed Gull
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines May-July 2019
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
Ecology Consulting
N
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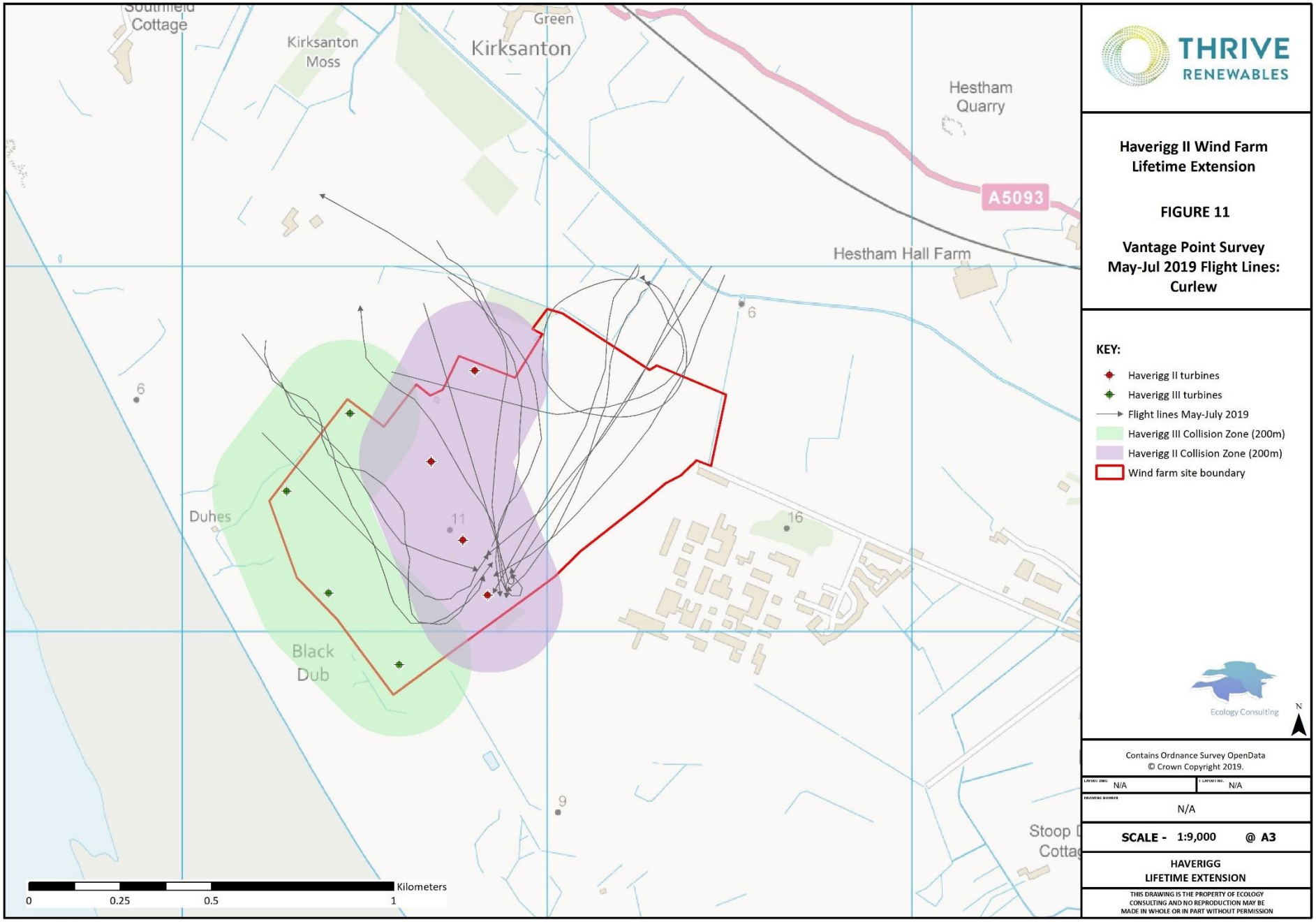
Southfield Cottage
Kirksanton Moss
Green
Kirksanton
Hestham Quarry
A5093
Hestham Hall Farm
6
6
Duhes
11
16
Black Dub
9
Stoop
Cottage
Kilometers
0
0.25
0.5
1
THRIVE RENEWABLES
Haverigg II Wind Farm
Lifetime Extension
FIGURE 11
Vantage Point Survey
May-Jul 2019 Flight Lines:
Curlew
KEY:
Haverigg II turbines
Haverigg III turbines
Flight lines May-July 2019
Haverigg III Collision Zone (200m)
Haverigg II Collision Zone (200m)
Wind farm site boundary
Ecology Consulting
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Nocturnal Activity

26. The peak counts and total numbers of SPA species recorded during the 2014-15 nocturnal surveys are summarised in Table 5. The Table also shows the percentage of birds that were recorded feeding and flying at night.

Table 5. SPA species (qualifying and assemblage) nocturnal activity during the 2014-15 surveys (8 surveys).

Species	Peak count in survey area at night	Total counted at night	% feeding	% flying
Qualifying Species:				
Oystercatcher	3	7	0%	43%
Ringed Plover	28	29	76%	14%
Golden Plover	38	136	81%	15%
Curlew	24	30	80%	7%
Herring Gull	35	97	0%	15%
Unidentified herring/lesser black-backed gulls	200	200	0%	0%
Assemblage Species:				
Lapwing	3	5	0%	40%

27. The results of the SPA species' activity at night were used to determine appropriate values to account for nocturnal activity (Band 2012). A value of 50% of daylight activity was used for waders, and 10% for gulls (the collision modelling uses only broad categories to take nocturnal activity into account given the difficulty in obtaining accurate flight data at night). The collision modelling has therefore assumed that wader flight activity at night is at a level of 50% of that during the day, and gull activity 10% (as this taxonomic group was clearly less active at night).

Collision Searches

28. A single SPA bird was found under the Haverigg III turbines during the April-July 2014 collision searches; a lesser black-backed gull. An additional four SPA birds were found under the Haverigg II turbines; three herring gulls and one lesser black-backed gull.

29. In 2019 herring gull and lesser black-backed gull were again the only SPA species found dead under the turbines. One lesser black-backed gull was located under the Haverigg III turbines during the surveys, four confirmed herring gulls and one unidentified large gull (assumed to be a herring gull as the most likely species given numbers present and as a worst case for the assessment) at Haverigg II. As in 2014, no other SPA species were recorded as collision victims.

30. The 2018-19 winter collision searches located one herring gull at Haverigg III, and one probable golden plover, another unidentified probable wader (assumed to be another golden plover as a worst case for this assessment) and two herring gulls under the Haverigg II turbines.

31. Further details of the collisions are given in the EIA screening report.

32. The search efficiency trials showed a very high rate of collision detectability over all of the surveys combined, with overall 93% of trials located (as would be expected given the ground conditions at the site, dominated by short grassland).

33. Field trials and monitoring of the collisions over time indicated that some carcasses were removed quickly but most left feather traces that were detectable over longer periods. Pooling all of the available data on carcass persistence, the overall mean time to disappearance was 54 days ($\pm$8.1SE). With a mean

daily persistence rate of 98.67% (i.e. on average 100% - 98.67% = 1.33% of carcasses disappeared each day) this gave a probability of 12% that carcasses disappeared before being found in the 2014 surveys (which were more frequent, about every 10 days) and 33% for the 2018-19 surveys (which were carried out on approximately a monthly visit frequency).

34. Taking into account the search efficiency and carcass removal for all of the available data from both Haverigg II and III, the five gull carcasses found in 2014 would equate to:

5 x 1.07 x 1.12 = 6.0 gulls

35. This value needs though to be adjusted further to take into account that these surveys only covered part (43%) of the breeding season (taken as April-July), so the overall total gull collision estimate was 14.1.

36. For the 2019 breeding season, the six gulls located would equate to 7.5 actual collisions.

6 x 1.07 x 1.33 = 7.5 gulls

37. For the 2018-19 winter, applying the same correction factors, the three herring gulls and two waders would equate to 7.5 gulls and 5 wader collisions in total.

Habitats Regulation Tests

38. This section provides an overview of the tests that need to be applied under the Habitats Regulations, drawing on the 'Managing Natura 2000 sites' document produced by the European Communities (European Commission 2018). After an initial discussion of the tests to be applied, the information relevant to each species is presented. The process for applying these tests, as summarised in Annex III of 'Managing Natura 2000 sites', is included in Appendix 3.

Test 1: Likely Significant Effect

39. The initial test that has to be considered is whether the development may result in a Likely Significant Effect. This "significance" differs from its definition under the EIA Regulations. In the context of the Habitats Regulations, it is usually used as a coarse filter to identify projects that require further assessment.

40. The potential effects need to be judged in relation to the features for which the European sites (SPAs) have been designated, and their nature conservation objectives.

41. A significant effect can result from off-site projects as well as those within the European site, so could potentially occur at Haverigg III even though the proposed wind farm is not located within any SPA. No part of the Proposed Development would directly affect any SPA.

42. Following PINS (2017) guidance, the sections below:

- identify the potential hazards to the SPA interests that may result from the proposed wind farm;
- provide information on the probability that those effects will affect the SPA populations and nature conservation objectives; and
- assess the likely magnitude of those potential effects.

43. These effects could potentially occur through the lifetime extension of the wind farm (15 years), after which it would be decommissioned and removed from the site (and hence would not be a permanent feature of the site).

44. Natural England has advised that it considers that a **Likely Significant Effect** cannot be ruled out for the Haverigg III Lifetime Extension for four species; lesser black-backed gull, herring gull, golden plover and curlew. These were the species identified from the surveys as interacting with the windfarm. Other species were screened out at this stage because there was no evidence of them being at risk from the

development. As a result, this assessment provides the information required to inform an Appropriate Assessment.

Test 2: Threat to Ecological Integrity

45. The Competent Authority will be required to decide whether the plan or project would adversely affect the integrity of the site(s), in the light of the relevant Conservation Objectives. Ecological integrity in this context has been defined as:

> *"the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified".*

46. An adverse effect on integrity is one that is likely to prevent the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation.

47. The Conservation Objectives for the Morecambe Bay and Duddon Estuary SPA/pSPA[2] are as follows:

> *"Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild 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 population of each of the qualifying features, and,*
> - *The distribution of the qualifying features within the site."*

48. The site-specific objectives for the qualifying SPA species that could be affected by the proposed development, redshank, have also been considered in this assessment. On the advice of Natural England this includes those for the Lesser Black-backed Gull and Herring Gull populations, both of which have been classed as 'unfavourable declining', and are well below the target population for the 'restore' objective (10,000 pairs). Although the source colonies for these species that is interacting with the windfarm site is outside the SPA boundary, Natural England advised that these colonies adjacent to the SPA should be treated as part of the functional meta-population, and assessed in this context.

Assessment of Ornithological Effects

49. There are three ways in which a proposed wind farm lifetime extension might have an adverse effect on bird species: collision risk leading to increased mortality rate, loss of habitat through disturbance and disruption to flight lines through a barrier effect. Following consultation with Natural England, this report focusses on collision risk to lesser black-backed gull, herring gull, golden plover and curlew as the key issue at this site for the lifetime extension. There would not be any direct loss of habitat as a result of the proposed lifetime extension.

Collision Risk

50. This potential effect will occur during the operational phase of the wind farm. There have been a number of wind farms that have caused bird mortalities through collision, but the characteristics of the development and the affected species are very different to those at the Haverigg site. Most notably, at Altamont Pass in California and Tarifa in southern Spain, large numbers of raptors have been killed (Orloff and Flannery 1992, Janss 1998, Thelander et al. 2003). Such problems have occurred where large numbers of sensitive species occur in close proximity to very large numbers (hundreds/thousands)

[2] http://publications.naturalengland.org.uk/publication/6242841537806336

of turbines, and usually also where the wind farm area provides a particularly attractive feeding resource. In wind farm sites in the UK collision rates have generally been very low and are not considered to be significant (Meek et al. 1993, Tyler 1995, Dulas 1995, EAS 1997, Bioscan 2001, Percival et al. 2008, Percival et al. 2009a, Percival et al. 2013).

51. In order to further inform the determination of the likelihood of adverse effects occurring, collision modelling has been carried out for all the SPA species recorded over-flying the collision risk zone and at rotor height in sufficient numbers (applying professional judgement) to possibly be at risk of a significant impact; golden plover, curlew, lesser black-backed gull and herring gull.

52. The collision risk model used in this assessment is the one developed by SNH and BWEA (Percival et al., 1999; Band, 2001; Band et al., 2007). Details of the model are given in these publications. The model runs as a two-stage process. Firstly, the risk is calculated making the assumption that flight patterns are unaffected by the presence of the wind turbines, i.e. that no avoidance action is taken. This is essentially a mechanistic calculation, with the collision risk calculated as the product of (i) the probability of a bird flying through the rotor swept area, and (ii) the probability of a bird colliding if it does so. This probability is then multiplied by the estimated numbers of bird movements through the wind farm rotors at the risk height (i.e. the height of the rotating rotor blades) in order to estimate the theoretical numbers at risk of collision if they take no avoiding action.

53. The second stage then incorporates the probability that the birds, rather than flying blindly into the turbines, will actually take a degree of avoiding action, as has been shown to occur in all studies of birds at existing wind farms. SNH has recommended a precautionary approach in the use of avoidance rates, using a value of 98% as a general default rate, but higher rates where there is evidence available from field studies. Higher recommended rates include 99% for several larger raptors, 99.8% for geese and 99.5% for gulls (SNH 2017b, Furness 2019). This precautionary approach is useful as an initial filter to identify sites where collision risk is clearly not an issue, but does not necessarily provide a realistic estimate of actual likely collision rates when compared with data from existing wind farms. Recent tracking work (including of birds from the Morecambe Bay and Duddon Estuary SPA) by Burton et al (2019) has shown that in lesser black-backed gulls much avoidance behaviour is exhibited at the turbine scale rather than the windfarm scale, and birds regularly fly through windfarms rather than avoid them outright (as found at Haverigg, see below).

54. The field studies of collision rates and flight activity at Haverigg have enabled site-specific avoidance rates to be calculated, using the collision model to compare predictions with actual collision rates. Avoidance rates were calculated as the proportionate difference between the actual number of collisions (taking into account observation detection and scavenger removal rates) and the predicted risk in the absence of any avoidance behaviour (see Appendix 4). Using this approach, avoidance rates of 99.2% were derived for gulls and 99.6% for waders. This is based only on post-construction data from the wind farm site itself, so this does not include macro-avoidance of the site (Cook et al. 2014) itself, which may increase the rates further. They do though provide an appropriate precautionary rate for this assessment that has an empirical basis and is based on evidence from this specific site.

55. Details of the input data and the collision risk calculations are given in Appendix 5. Body sizes and baseline mortality rates were taken from Robinson (2005), and flight speeds from Alerstam et al. (2007), as detailed in Appendix 5.

56. The flight rates of each of the key species though the collision risk zone are summarised in Table 6. This risk zone was defined as the wind farm plus a 200m buffer. These zones are shown in Figures 1-11. A 200m buffer was used as it was possible to map flights more accurately given the presence of the wind turbines at the site. Extending the buffer to cover a wider area would include other habitats that would be unrepresentative of the actual wind farm site.

Table 6. Flight rates of SPA species recorded through the Haverigg III collision risk zone at rotor height during the baseline vantage point surveys during the baseline surveys.

Species	Winter 2014-15	Breeding 2014	Breeding 2019
Golden Plover	9.1	0.0	0.0
Curlew	5.2	1.4	1.1
Lesser Black-backed Gull	0.8	3.9	5.1

Species	Winter 2014-15	Breeding 2014	Breeding 2019
Herring Gull	7.3	4.5	9.5

57. The magnitude of the potential population impact of the collision risk has been determined as a percentage increase in the existing baseline mortality (to put the potential wind farm mortality into the ecological context of the birds' population dynamics). Any more than a 1% increase (the upper threshold for a negligible magnitude effect, e.g. Percival 2007) in the background mortality rate would be considered as a potential adverse effect on integrity on any SPA population, though professional judgement was also applied in the assessment to examine the ecological context of that additional mortality.

Collision Risk Modelling Results

58. Table 7 summarises the collision risk analysis for each of the SPA species modelled. The Table gives the number of collisions predicted per year, applying a range of avoidance rates (from the collision risk model), the percentage increase that this would represent over the baseline mortality and whether such an impact would result in any adverse effect on integrity under the Habitats Regulations. The avoidance rates used in the further assessment, based on the empirical data from the Haverigg VP survey and collision searches (and with reference to other published values), are shown in bold (99.2% for gulls and 99.6% for waders). The results are presented separately for each season.

59. The baseline populations used to calculate the percentage increase in mortality were derived from the most recently published BTO Wetland Bird Survey five-year mean peak count for the SPA for the autumn/wintering populations(for golden plover, curlew and for non-breeding lesser black-backed gull and herring gulls), and (for breeding lesser black-backed and herring gulls), and data provided by Natural England during consultation from the Seabird Monitoring Programme[3]. Separate assessments have been made for the breeding and non-breeding seasons. Natural England requested that the assessment be made (on a precautionary basis) against the most recent breeding gull populations from the SPA, i.e. those from 2019 (856 pairs of lesser black-backed gulls and 1,568 pairs of herring gulls). If the five-year means were used, this would result in a reduced increase over the baseline mortality. These five-year means were approximately five-fold higher than in 2019 for lesser black-backed gull and 20% higher for herring gull (the South Walney colony had a major drop in lesser black-backed gull numbers in 2019 in comparison with previous years).

Table 7: Collision risk modelling predictions for the Haverigg III Wind Farm lifetime extension for SPA species.

Species	Estimated actual number of collisions	Predicted number of collisions per year applying the following avoidance rates:					Percentage increase in annual baseline mortality at empirical avoidance rate	Magnitude of impact	Potential adverse effect on integrity?
		98%	99%	99.2%	99.5%	99.6%			
Golden Plover									
Breeding 2014	0	0	0	0	0	**0**	**0%**	Negligible	No
Breeding 2019	0	0	0	0	0	**0**	**0%**	Negligible	No
Winter 2014-15	0	7.33	3.67	2.93	1.83	**1.47**	**0.19%**	Negligible	No

[3] http://archive.jncc.gov.uk/default.aspx?page=1550

Species	Estimated actual number of collisions	Predicted number of collisions per year applying the following avoidance rates:					Percentage increase in annual baseline mortality at empirical avoidance rate	Magnitude of impact	Potential adverse effect on integrity?
		98%	99%	99.2%	99.5%	99.6%			
Lesser Black-backed Gull									
Breeding 2014	0	2.38	1.19	**0.95**	0.60	0.48	**1.42%**	Low	No
Breeding 2019	1.3	2.64	1.32	**1.06**	0.66	0.53	**1.58%**	Low	No
Winter 2014-15	0	0.71	0.35	**0.28**	0.18	0.14	**0.09%**	Negligible	No
Herring Gull									
Breeding 2014	2.8	2.68	1.34	**1.07**	0.67	0.54	**0.67%**	Negligible	No
Breeding 2019	0	6.91	3.45	**2.76**	1.73	1.38	**1.73%**	Low	No
Winter 2014-15	2.5	6.17	3.08	**2.47**	1.54	1.23	**0.23%**	Negligible	No
Curlew									
Breeding 2014	0	0.85	0.42	0.34	0.21	**0.17**	**0.01%**	Negligible	No
Breeding 2019	0	0.51	0.26	0.20	0.13	**0.10**	**0.01%**	Negligible	No
Winter 2014-15	0	4.75	2.38	1.90	1.19	**0.95**	**0.03%**	Negligible	No

Note: bold indicates collision risk for each species used in further population analysis, based on empirical data from Haverigg. Seasonal impacts considered as additive apart from lesser black-backed gulls, as the large majority of the local breeding birds of that species move away in the winter period and any birds in the winter period are more likely to be migrant or wintering from elsewhere.

60. The predicted collision risks for the Haverigg III wind farm lifetime extension were negligible magnitude, apart from the two gull species during the breeding season, which were low magnitude impacts. Looking at the ecological context of this additional mortality, whilst a LSE was identified, it was concluded that the low magnitude impacts predicted would result in **no adverse effect on integrity** in relation to collision risk from the proposed Haverigg III lifetime extension, for the following reasons:

- Only a very low amount of additional mortality was predicted from the collision modelling, and the actual observed collision rates (lesser black-backed gull 1.0 predicted per breeding season, 1.4 observed - taking into account search efficiency and scavenger removal; herring gull 1.9 predicted, 3.1 observed);
- Previous population analyses for offshore wind farms have shown that a much higher level of mortality could be sustained by the populations (90 herring gull collisions and 300 lesser black-backed gull collisions, Dept of Energy and Climate Change 2014) albeit based on higher population estimates than in the latest data.

61. Notwithstanding the conclusion reached above, Natural England has advised that it considers that mitigation measures are required in order to ensure that there is no adverse effect on the integrity of the SPA breeding lesser black-backed and herring gull populations as a result of Haverigg III wind farm. These mitigation measures are set out below.

Barrier Effect

62. A further potential effect of the proposed wind farm could be disruption to important flight lines (barrier effect). Birds may see the wind farm and change their route to fly around (rather than through) it. This would reduce the risk of collision but could possibly have other effects, for example potentially

making important feeding areas less attractive (by acting as a barrier to the birds reaching them) and (if diversions were of a sufficient scale) resulting in increased energy consumption.

63. The distance needed to divert around the wind farm would be only small and would not be expected to act as a major barrier to movements. The flight lines plotted during the vantage point surveys (Figures 1-11) do not suggest that any of the SPA species exhibited any evidence of a significant barrier effect of the wind farm, with many flights continuing through and in close proximity to the wind farm (though largely avoiding the rotor swept area). Barrier effects would result in **no adverse effect on integrity.**

Cumulative Effects

64. The cumulative assessment of the ornithological effects of the proposed Haverigg III lifetime extension has been undertaken sequentially, in order to address issues with gaps in the assessment of other projects.

65. The first step was to consider cumulative assessment of Haverigg III lifetime extension with that also being proposed for Haverigg II, as directly comparable data are available for the two schemes (as the same baseline surveys have covered both). Table 8 shows the predicted collision risks for the four SPA species considered for Haverigg III in combination with the Haverigg II scheme.

Table 8: In-combination collision risk modelling predictions for the Haverigg II and III Wind Farm lifetime extension for SPA species.

Species	Estimated actual number of collisions	Predicted number of collisions per year applying the following avoidance rates:					Percentage increase in annual baseline mortality at empirical avoidance rate	Magnitude of impact	Potential adverse effect on integrity?
		98%	99%	99.2%	99.5%	99.6%			
Golden Plover									
Breeding 2014	0	0	0	0	0	0	**0%**	Negligible	No
Breeding 2019	0	0	0	0	0	0	**0%**	Negligible	No
Winter 2014-15	5.0	13.3	6.6	5.3	3.3	2.7	**0.34%**	Negligible	No
Lesser Black-backed Gull									
Breeding 2014	2.8	7.7	3.9	**3.1**	1.9	1.5	**4.63%**	Low	No
Breeding 2019	1.3	9.7	4.8	**3.9**	2.4	1.9	**5.77%**	Low	No
Winter 2014-15	0	2.7	1.4	**1.1**	0.7	0.5	**0.33%**	Negligible	No
Herring Gull									
Breeding 2014	11.3	11.3	5.7	**4.5**	2.8	2.3	**2.85%**	Low	No
Breeding 2019	6.3	21.0	10.5	**8.4**	5.3	4.2	**5.27%**	Low	No
Winter 2014-15	7.5	19.6	9.8	**7.8**	4.9	3.9	**0.72%**	Negligible	No
Curlew									
Breeding 2014	0	1.9	0.9	0.7	0.5	**0.4**	**0.03%**	Negligible	No
Breeding 2019	0	2.1	1.0	0.8	0.5	**0.4**	**0.03%**	Negligible	No
Winter 2014-15	0	12.6	6.3	5.0	3.1	**2.5**	**0.09%**	Negligible	No

Note: bold indicates collision risk for each species used in further population analysis, based on empirical data from Haverigg. Possible adverse effects on site integrity are considered further in the main text.

66. The predicted collision risks for the lifetime extensions of the two schemes in combination for golden plover and curlew were still of negligible magnitude, so would result in **no adverse effect on integrity** in

relation to collision risk from the proposed Haverigg II and III lifetime extensions for these species. The same conclusion was reached for lesser black-backed gull and herring gull outside the breeding season. The cumulative risks from the two wind farms for these two gull species in the breeding season were predicted to be of low magnitude, so further consideration has been given to these impacts below.

67. For the second step of the cumulative assessment, consideration has been given to the potential cumulative impacts of other onshore wind farm schemes within 20km of Haverigg III, and within the same buffer distance of the Morecambe Bay and Duddon Estuary SPA, as shown in Table 9. Reference was also made to the RSPB bird sensitivity mapping for wind farms for Cumbria and Lancashire (Youngs and Shackleton 2007, and Youngs and White 2008).

Table 9. Onshore wind farm developments and proposals in planning within a 20km buffer of the proposed lifetime extension, and the Morecambe Bay and Duddon Estuary SPA.

Wind Energy Development	Status	Distance from Haverigg III (km)	County	No. of turbines	Turbine capacity (MW)
Haverigg II	Operational	0.3	Cumbria	4	0.85
HMP Haverigg	Consented	0.3	Cumbria	5	3
Askam	Operational	10	Cumbria	7	0.66
Furness (Harlock Hill Repowering)	Operational	11	Cumbria	5	2.3
Kirkby Moor	Operational (lifetime extension consented)	13	Cumbria	12	0.4
Fanny House Farm	Operational	35	Lancashire	1	1.5
Heysham	Operational	35	Lancashire	1	2
Heysham South	Operational	35	Lancashire	3	2.5
Lancaster University	Operational	42	Lancashire	1	2
Armistead	Operational	45	Cumbria	6	2
Orchard End	Operational	45	Lancashire	2	2
Caton Moor Repowering	Operational	46	Lancashire	8	2
Lambrigg	Operational	47	Cumbria	5	1.3
Dewlay Cheese	Operational	50	Lancashire	1	2

68. Given the very low collision risk from the Haverigg III lifetime extension for golden plover and curlew (in terms of both absolute numbers and change to the baseline mortality), it is not likely to contribute materially to any significant cumulative risk. The HMP Haverigg wind farm (which has been consented but not built) did predict a similar negligible magnitude level of collision mortality for that scheme too (2.1 golden plover collisions per year, and 0.1 curlew collisions per year). The available evidence indicates that there would be **no adverse effect on integrity** in relation to cumulative collision risk for either golden plover or curlew.

69. Lack of quantitative assessment of collision risk for herring gull and for lesser black-backed gull at many of these schemes means that it is not possible to carry out a quantitative cumulative assessment. Gulls have often been overlooked in baseline surveys. The HMP Haverigg wind farm baseline surveys, for example, only treated gulls as a secondary species, so flight lines were not mapped, and no collision modelling was undertaken (despite that site being adjacent to a breeding colony). None of the projects listed in Table 9 predicted any significant ornithological effects, either alone or in combination.

70. In the third and final step of the cumulative assessment, consideration has been given to the offshore wind farms and other plans and projects that could affect the Morecambe Bay and Duddon Estuary SPA/Ramsar populations of the two gull species under consideration, including recent/ongoing management measures. During the consultation process Natural England requested that this include the annual licensing applications to manage large gulls in the region.

71. The offshore wind farms within 20km of the site/SPA are shown in Table 10. The most recent cumulative assessment for these sites (Walney Extension) concluded that a Likely Significant Effect of collision mortality on the Morecambe Bay and Duddon Estuary herring gull and lesser black-backed gull populations could not be ruled out, so an Appropriate Assessment was carried out. This concluded, with a predicted annual collision risk of 36 herring gulls and 17 lesser black-backed gulls from the Walney Extension site on its own (and a cumulative risk of 111 for lesser black-backed gull - no reliable cumulative value could be derived for herring gull) would not result in any adverse effect on site integrity. Population modelling carried out to inform the assessment indicated that 90 herring gull collisions and 300 lesser black-backed gull collisions could be sustainably removed annually from the population (Dept of Energy and Climate Change 2014). It should though be noted that, at that time, the Conservation Objectives for the site had not identified the 'restore' objective currently afforded to this feature.

72. These offshore collision risks were calculated applying a precautionary 98% avoidance rate. Subsequent studies have shown this to be any overly precautionary number, and a higher value of 99.5% is currently recommended (Cook et al. 2014, JNCC et al. 2014, Furness 2019). This would result in a 75% reduction in collision risk from these offshore sites, substantially increasing the gap between the predicted risk and the level at which a non-sustainable population impact might occur.

73. Both herring gull and lesser black-backed gulls have been culled in large numbers in this region and nationally over the last 50 years (Ross-Smith et al 2014, Coulson 2015). This has included a major cull of the Haverigg colony adjacent to the Haverigg III site. That colony had reached a peak of 1,700 breeding pairs of lesser black-backed gulls and 900 breeding pairs of herring gulls in 2007. Two years later, after a major control programme, those number were reduced to only 52 pairs of lesser black-backed gulls and 117 pairs of herring gulls (and numbers have remained low since that time, JNCC Seabird Monitoring Programme[4]). Nationally in the UK, there is now clear evidence that culling has been a major contributor to large gull population declines (Coulson 2015). The effect of the Haverigg III wind farm, is clearly trivial in comparison with this Natural England-approved management, and makes only a very small contribution to the cumulative impact.

74. Overall, even though the predicted cumulative mortality exceeded a 1% increase over the baseline mortality, it was concluded that the Haverigg III lifetime extension would result in no **adverse effect on integrity** for cumulative collision risk to the SPA herring gull and lesser black-backed gull breeding populations, for the following reasons:

- Only a very low amount of additional mortality was predicted from the collision modelling, and the actual observed collision rates (lesser black-backed gull 3.5 predicted per year, 2.0 observed; herring gull 6.5 predicted, 8.8 observed);
- Previous population analyses for offshore wind farms have shown that a much higher level of mortality could be sustained by the populations (90 herring gull collisions and 300 lesser black-backed gull collisions, Dept of Energy and Climate Change 2014) albeit based on higher population estimates than in the latest data;
- The contribution of the Haverigg III wind farm to the cumulative impact is trivial in comparison with previous and recent gull culling schemes (including removal of about 1,650 pairs of lesser black-backed gulls and 800 herring gulls between 2007 and 2009, as documented in the JNCC Seabird Monitoring Programme[4]) and it is the population declines as a result of other factors such as these which has led to the prediction of a LSE based on the mortality caused by Haverigg III wind farm.

75. Notwithstanding the conclusion reached above, Natural England has advised that it considers that mitigation measures are required in order to avoid the possibility of any adverse effect on the integrity of the SPA breeding lesser black-backed and herring gull populations. These mitigation measures are set out below. The implementation of these measures, to which the applicant has committed, means that the outcome will be the same whether a conclusion of adverse effect on integrity is reached or not by the determining authority. The mitigation measures will ensure that there is not any adverse effect on SPA integrity.

[4] http://archive.jncc.gov.uk/page-4460. Accessed 18/12/19.

Table 10. Offshore wind farm developments and proposals in planning within a 20km buffer of the proposed lifetime extension, and the Morecambe Bay and Duddon Estuary SPA.

Wind Energy Development	Status	Distance from Haverigg III (km)	County	No. of turbines	Turbine capacity (MW)
Ormonde Offshore	Operational	15	Cumbria	30	5
Walney 1	Operational	22	Cumbria	51	3.6
Walney 2	Operational	23	Cumbria	51	3.6
Barrow	Operational	24	Cumbria	30	3
West of Duddon Sands	Operational	26	Cumbria	108	3.6
Walney Extension (Walney 3)	Operational	30	Cumbria	110	6

Mitigation Measures

76. Natural England has advised that it considers mitigation should be implemented as a precautionary measure to ensure that the Haverigg III lifetime extension has no adverse effect on the integrity of the Morecambe Bay and Duddon Estuary SPA breeding lesser black-backed gull and herring gull populations.

77. Natural England advised that it considers "*an appropriate intervention would be to increase the number of birds that are able to safely breed at South Walney. Appropriate methods to predator fence seabird colonies are now well established. To be fully compliant with Habitat Regulations provision any predator fencing at South Walney should be additional to that already installed*." NE has recommended that this should provide for protection of at least 10 lesser black-backed gull nests and 25 herring gull nests for the Haverigg II and III lifetime extensions in combination, and that an area of 1 ha. should be sufficient (i.e. 500m of new fencing).

78. Therefore, in order to mitigate possible effects of the Haverigg III lifetime extension, Windcluster Ltd will fund the installation of 125m of new predator-proof fencing, sufficient to protect 0.3 ha. of the gull colony (Haverigg III constitutes about 25% of the combined collision risk, so this value represents 25% of the total).

79. This increased protection of the breeding colony would be expected to reduce the reliance of breeding lesser black-backed gulls on sites such as Haverigg Prison, and would be expected to increase the productivity of the local gull population to offset mortality associated with the development.

80. Windcluster Ltd will work with Cumbria Wildlife Trust (CWT) to ensure that the mitigation is in place prior to the first breeding season after the life extension period comes into force in 2025. Payment for these mitigation works will be secured prior to determination of the lifetime extension.

Conclusions

81. This report has provided baseline data and analysis to inform the Habitats Regulations Assessment required for the proposed lifetime extension.

82. Summarising the Habitats Regulations Assessment, potential effects the Morecambe Bay and Duddon Estuary SPA/Ramsar sites that are considered within this report are provided in Table 11 below. Effects have been grouped where appropriate for ease of presentation. On the advice of Natural England,

Likely Significant Effects were identified for four species that are qualifying features of the Morecambe Bay and Duddon Estuary SPA; lesser black-backed gull, herring gull, golden plover and curlew.

Table 11. Impacts considered within the Habitats Regulations Assessment for the Haverigg III wind farm lifetime extension

Designation	Potential Effects	Likely Significant Effect of Lifetime Extension
Morecambe Bay and Duddon Estuary SPA/Ramsar	• Disturbance and displacement of birds during the operation of the wind farm;	• No
	• Mortality through collision with the wind turbines during operation.	• Possible
	• Barrier effect of the wind farm on bird flight lines during operation	• No

83. There would be no direct loss of any SPA habitat or risk of environmental contamination within any SPA.

84. Table 12 summarises all of the potential impacts considered in this report relating to the Morecambe Bay and Duddon Estuary SPA/Ramsar sites.

Table 12. Summary of the potential effects of the Haverigg III wind farm lifetime extension on the Morecambe Bay and Duddon Estuary SPA/Ramsar sites

Name of European site/Ramsar: Morecambe Bay and Duddon Estuary SPA/Ramsar												
Distance to Haverigg III wind farm: 0.04 km												
European site features	**Likely Effects of wind farm**											
	Disturbance			***Collision Risk***			***Barrier Effect***			***In-combination effects***		
	C	***O***	***D***	***C***	***O***	***D***	***C***	***O***	***D***	***C***	***O***	***D***
Breeding:												
Lesser black-backed gull	✗[a]	✗[a]	✗[a]		✓		✗[e]	✗[e]	✗[e]	✗[c]	✓	✗[c]
Herring gull	✗[a]	✗[a]	✗[a]		✓		✗[e]	✗[e]	✗[e]	✗[c]	✓	✗[c]
Little tern	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Sandwich tern	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Common tern	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Winter/passage												
Whooper swan	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Pink-footed Goose	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Shelduck	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Pintail	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Little egret	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Oystercatcher	✗[a]	✗[a]	✗[a]		✗[f]		✗[e]	✗[e]	✗[e]	✗[c]	✗[c]	✗[c]
Ringed plover	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Golden plover	✗[a]	✗[a]	✗[a]		✓		✗[e]	✗[e]	✗[e]	✗[c]	✓	✗[c]
Grey plover	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Knot	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Sanderling	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Dunlin	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Ruff	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]

Name of European site/Ramsar: Morecambe Bay and Duddon Estuary SPA/Ramsar												
Distance to Haverigg III wind farm: 0.04 km												
European site features	**Likely Effects of wind farm**											
	Disturbance			***Collision Risk***			***Barrier Effect***			***In-combination effects***		
	C	***O***	***D***	***C***	***O***	***D***	***C***	***O***	***D***	***C***	***O***	***D***
Bar-tailed godwit	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Black-tailed godwit	✗[a]	✗[a]	✗[a]		✗[f]		✗[e]	✗[e]	✗[e]	✗[c]	✗[c]	✗[c]
Curlew	✗[a]	✗[a]	✗[a]		✓		✗[e]	✗[e]	✗[e]	✗[c]	✓	✗[c]
Redshank	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Turnstone	✗[a]	✗[a]	✗[a]		✗[b]		✗[b]	✗[b]	✗[b]	✗[c]	✗[c]	✗[c]
Mediterranean gull	✗[a]	✗[a]	✗[a]		✗[b]		✗[e]	✗[e]	✗[e]	✗[c]	✗[c]	✗[c]
Wintering waterfowl assemblage	✗[d]	✗[d]	✗[d]		✗[f]		✗[e]	✗[e]	✗[e]	✗[c]	✗[c]	✗[c]

Table Key:

✓ = Potential for likely significant effect **cannot** be excluded
✗ = Potential for likely significant effect **can** be excluded
C= construction
O = operation
D = decommissioning

- Where an impact is not considered relevant for a feature of the European site, the cell in the Table is shaded grey.
- There would be no collision risk for any species during construction or decommissioning as the turbine blades would not be rotating, so this would not be a relevant impact.
- There would be no disturbance risk for species that have no habitat available within the potential impact zone of wind farm, so this would not be a relevant impact.

Evidence supporting conclusions

- **a.** Disturbance effects of lifetime extension scoped out as possible Likely Significant Effect.
- **b.** Species not recorded within the potential collision risk zone of the wind farm flying at rotor height during baseline surveys.
- **c.** Impacts alone so low that could not possibly make any significant contribution to an in-combination risk.
- **d.** Collision modelling demonstrated negligible collision risk; Table 7.
- **e.** Barrier effect would not result in either reduced utilisation of an ecological resource (through birds no longer being able to reach it through the barrier) or significantly increased energy expenditure by the birds in flying around the barrier, so no LSE.
- **f.** Use of collision risk zone at rotor height so low that collision risk negligible.

85. Given that Likely Significant Effects could not be ruled out for lesser black-backed gull, herring gull, golden plover and curlew, this report has provided analysis to inform the assessment process should the Competent Authority determine that an Appropriate Assessment is required (as was concluded in this report).

86. The SPA Conservation Objectives (as set out above) against which this assessment needs to be made seek to maintain the habitats of the qualifying species in favourable condition.

87. The predicted effects of the Project on the relevant SPA qualifying and assemblage species in the context of the Habitats Regulations have been assessed above, and primarily related to collision risk from the operational wind turbines. The predicted effects of the Haverigg III lifetime extension have been assessed against the SPA Conservation Objectives, to determine whether there would be any

adverse effect pf the development on the ecological integrity of the Morecambe Bay and Duddon Estuary SPA/Ramsar site.

88. Though some very minor (negligible magnitude) effects may occur on the SPA golden plover and curlew populations, and on non-breeding populations of lesser black-backed gull and herring gull, none of these effects would have an adverse effect on the ecological integrity of the SPA.

89. Low magnitude collision risks were identified for breeding lesser black-backed gull and for breeding herring gull populations. On the advice of Natural England, mitigation measures will be implemented on a precautionary basis in order to ensure that there would be adverse effect on the integrity of either of these populations.

90. In summarising the likely effects on the qualifying bird populations for the SPA, the assessment process illustrated in the flow diagram in the IPC 10th Advice Note is undertaken as follows:

- "*Is the proposal directly connected with or necessary to site management for nature conservation?*" No.
- "*Is the project likely to have a significant effect on the internationally important interest features of the site, alone or in combination with other plans and projects?"*
  - For four qualifying species, lesser black-backed gull, herring gull, golden plover and curlew, this cannot, under the definition of likely significant effect under the Habitats Regulations, be ruled out, so the next stage is:
- "*Assess the implications of the effects of the proposal for the site's conservation objectives. Can it be ascertained that the proposal will not affect integrity of the site*?"
  - No qualifying or assemblage species has been identified as being significantly affected by the project either alone or in combination (with the agreed precautionary mitigation measures in place). In terms of the relevant tests under the Habitat Regulations, it can be safely concluded that the proposed lifetime extension would not threaten the ecological integrity of the Morecambe Bay and Duddon Estuary SPA/Ramsar site. Hence the end result is that "*consent may be granted*."

91. In conclusion, therefore, the proposed Haverigg III lifetime extension would not adversely affect the ecological integrity of the Morecambe Bay and Duddon Estuary SPA/Ramsar, either alone or in combination with any other plan or project, and therefore authorisation for the project may be granted.

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APPENDIX 1: Morecambe Bay and Duddon Estuary SPA Citation

Morecambe Bay and Duddon Estuary Site Citation

EC Directive 79/409 on the Conservation of Wild Birds

Special Protection Area (SPA)

Name: *Morecambe Bay and Duddon Estuary Special Protection Area*

Counties/Unitary Authorities: *Cumbria, Lancashire*

Boundary of the SPA:

The landward boundary of the SPA includes all of the intertidal and terrestrial areas covered by the former Morecambe Bay SPA and Duddon Estuary SPA. It includes areas of adjoining terrestrial coastal habitat at North and South Walney and at Haverigg Point on the Duddon Estuary and the lagoons at South Walney; Cavendish Dock, Barrow and Hodbarrow, Haverigg.

Where the landward boundary extends from Kirksanton Haws to Drigg Dunes, including the Ravenglass Estuary and the west side of Walney Island, it follows Mean High Water.

From Rossall Point to a defined point in central Morecambe Bay (54° 5.732' N 3° 1.325' W) the seaward boundary follows Mean Low Water. From central Morecambe Bay the seaward boundary runs offshore around Walney Island and along the south west Cumbria Coast, reaching a maximum of 8 km offshore opposite Kirksanton Haws, meeting the coast again at Drigg Dunes.

Morecambe Bay and Duddon Estuary SPA supersedes the original Morecambe Bay SPA and Duddon Estuary SPA.

Size of SPA: The SPA covers an area of 66,899.97 ha.

Site description:

The SPA extends between Rossall Point in Lancashire and Drigg Dunes in Cumbria. The site includes the former Morecambe Bay SPA and Duddon Estuary SPA and an extension to include the Ravenglass Estuary and intervening coast and the shallow offshore area off south west Cumbria coast.

Morecambe Bay is the second largest embayment in Britain after The Wash, at over 310 km^2, and has four estuaries – the Wyre, Lune, Kent and Leven. It contains the largest continuous area of intertidal mudflats and sandflats in the UK which supports a variety of infaunal communities including cockle beds. Morecambe Bay supports a wide range of other habitats including large areas of saltmarsh and transitional habitats as well as sand dune systems and coastal lagoons. Within the Bay there are areas of stony reef (known locally as scars or skears) which also support blue mussel beds and honeycomb worm *Sabellaria alveolata* reefs. Extensive eelgrass beds are present around Foulney Island and in the south Walney Channel, the only examples in the North West of England.

The Duddon and Ravenglass Estuaries support saltmarsh, intertidal mud and sand communities and sand dune systems with small areas of stony reef. The intermediate coast comprises extensive shingle and sand beaches.

The parts of the SPA away from the coast are sandy and shallow, mostly less than 15 metres deep.

Qualifying species:

SPA site selection guidelines have been applied to the most up to date information for the site. However, this contemporary data reveals that some species are no longer present in qualifying

numbers (either through declines or because the relevant threshold has increased). It is not clear whether anthropogenic influences have affected the populations at the site. Defra policy indicates that in these circumstances the feature should be retained until such time as the reasons for the reduction in population can be established. Natural England therefore considers that these species should be retained on the citation, and the level of ambition set out in the conservation objectives for these species maintained, until such time as we have evidence to support the conclusion that declines are a result of natural processes and that the SPA is no longer suitable for these species.

The site qualifies under **Article 4.1** of the Directive (2009/147/EC) as it is used regularly by 1% or more of the Great Britain populations of the following species listed in Annex I in any season:

Species	**Season**	**Count (Period)**	**% of population**
Whooper swan *Cygnus Cygnus*	Non-breeding	113 individuals (2009/10 – 2013/14)[1]	1.0% of GB population
Little egret *Egretta garzetta*	Non-breeding	134 individuals (2009/10 – 2013/14)[1]	3.0% of GB population
European golden plover *Pluvialis apricaria*	Non-breeding	1,900 individuals (Morecambe Bay SPA citation value 1991)[2]	1.0% of GB population (1991)
Bar-tailed Godwit *Limosa lapponica*	Non-breeding	3,046 individuals (2009/10 – 2013/14)[1]	8.0% of GB population
Ruff *Calidris pugnax*	Non-breeding	8 individuals (2009/10 – 2013/14)[1]	1.0% of GB population
Mediterranean gull *Larus melancephalus*	Non-breeding	18 individuals (2009/10 – 2013/14)[1]	1.0% of GB population
Little tern *Sternula albifrons*	Breeding	84 individuals (2010 – 2014)[3]	2.2% of GB population
Sandwich tern *Sterna sandvicensis*	Breeding	1,608 individuals (1988 - 1992)[4]	5.7% of GB population (1992)
Common tern *Sterna hirundo*	Breeding	570 individuals (Morecambe Bay SPA citation value 1991)[5]	2.0% of GB population (1991)

The site qualifies under **Article 4.2** of the Directive (79/409/EEC) as it is used regularly by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed in Annex I) in any season:

Species	**Season**	**Count (Period)**	**% of population**
Pink-footed goose *Anser brachyrhynchus*	Non-breeding	15,648 individuals (2009/10 – 2013/14)[6]	4.5% of biogeographic population
Common shelduck *Tadorna tadorna*	Non-breeding	5,878 individuals (2009/10 – 2013/14)[1]	2.0% of biogeographic population
Northern Pintail *Anas acuta*	Non-breeding	2,498 individuals (2009/10 – 2013/14)[1]	4.2% of biogeographic population
Eurasian oystercatcher *Haematopus ostralegus*	Non-breeding	55,888 individuals (2009/10 – 2013/14)[1]	6.8% of biogeographic population
Grey plover *Pluvialis squatarola*	Non-breeding	2,000 individuals (Morecambe Bay SPA citation value 1991)[7]	1.0% of biogeographic population (1991)

[1] Data from Wetland Bird Survey
[2] Current five year peak mean (2009/10 – 2013/14) = 3,494 (0.9% GB population)
[3] Data from RSPB
[4] Summed data from SMP relating to period of original classification for Morecambe Bay SPA and Duddon Estuary SPA (1988 – 1992). Current five year peak mean (2010-2014) = 40 pairs (0.4% GB population).
[5] Current five year peak mean (2010-2014) = 47 pairs (0.5% GB population).
[6] Data from Wetland Bird Survey and Icelandic-breeding Goose Census.
[7] Current five year peak mean (2009/10 – 2013/14) = 1,013 (0.4% biogeographic population).

Species	Season	Count (Period)	% of population
Common ringed plover *Charadrius hiaticula*	Non-breeding	1,049 individuals (2009/10 – 2013/14)[1]	1.4% of biogeographic population
Eurasian curlew *Numenius arquata*	Non-breeding	12,209 individuals (2009/10 – 2013/14)[1]	1.5% of biogeographic population
Black-tailed godwit *Limosa limosa*	Non-breeding	2,413 individuals (2009/10 – 2013/14)[1]	4.0% of biogeographic population
Ruddy turnstone *Arenaria interpres*	Non-breeding	1,359 individuals (2009/10 – 2013/14)[1]	1.0% of biogeographic population
Red knot *Calidris canutus*	Non-breeding	32,739 individuals (2009/10 – 2013/14)[1]	7.3% of biogeographic population
Sanderling *Calidris alba*	Non-breeding	3,600 individuals (Morecambe Bay SPA citation value 1991)[8]	3.0% of biogeographic population (1991)
Dunlin *Calidris alpina alpina*	Non-breeding	26,982 individuals (2009/10 – 2013/14)[1]	2.0% of biogeographic population
Common redshank *Tringa totanus*	Non-breeding	11,133 individuals (2009/10 – 2013/14)[1]	4.6% of biogeographic population
Lesser black-backed gull *Larus fuscus*	Non-breeding	9,450 individuals (2009/10 – 2013/14)[1]	1.7% of biogeographic population
Lesser black-backed gull *Larus fuscus graellsii*	Breeding	9,720 individuals (2011-2015)[9]	2.7% of biogeographic population
European herring gull *Larus argentatus argenteus*	Breeding	20,000 individuals (Morecambe Bay SPA citation value 1991)[10]	1.0% of biogeographic population (1991)

Assemblage qualification:

The site qualifies under **Article 4.2** of the Directive (2009/147/EC) as it used regularly by over 20,000 seabirds in any season:

At time of the 1997 citation of Morecambe Bay SPA, the area supported 40,672 individual seabirds including: herring gulls, lesser black-backed gulls, sandwich terns, common terns, and little terns.

The site qualifies under **Article 4.2** of the Directive (2009/147/EC) as it used regularly by over 20,000 waterbirds in any season:

During the period 2009/10 – 2013/14, the site held a five year peak mean value of 266,751 individual birds. The main components of the assemblage include all of the qualifying features listed above, as well as an additional 19 species present in numbers exceeding 1% of the GB total and / or exceeding 2,000 individuals: great white egret, Eurasian spoonbill, light-bellied brent goose (Nearctic origin), Eurasian wigeon, Eurasian teal, green-winged teal, mallard, ring-necked duck, common eider (non-breeding), common goldeneye, red-breasted merganser, great cormorant, northern lapwing, little stint, spotted redshank, common greenshank, black-headed gull, common (mew) gull and European herring gull (non-breeding).

Principal bird data sources:

Colony counts from JNCC Seabird Monitoring Programme and contributed by colony managers: RSPB (Hodbarrow) and Cumbria Wildlife Trust (Morecambe Bay). Non-breeding bird data from Wetland Bird Survey (WeBS) and WWT's Icelandic-breeding Goose Census ([11]Mitchell 2014).

[8] Current five year peak mean (2009/10 – 2013/14) = 849 (0.7% biogeographic population).
[9] Data from Seabird Monitoring Programme database, RSPB and Cumbria Wildlife Trust
[10] Current five year peak mean (2011-2015) = 3,192 individuals (0.5% biogeographic population).
[11] Mitchell, C. (2014). Status and distribution of Icelandic-breeding geese: results of the 2013 international census. Wildfowl & Wetlands Trust Report, Slimbridge. 20pp.

APPENDIX 2: Ramsar Citations for Morecambe Bay and the Duddon Estuary

des. 04.10.96.

RAMSAR INFORMATION SHEET

FOR WETLANDS OF INTERNATIONAL IMPORTANCE

Site reference number		7UK104	
1	**Compilation date**	Sept 1999	
2	**Country**	UK (England)	
3	**Name of wetland**	Morecambe Bay	
4	**Site centre location:**	Latitude: 54 07 19 N	Longitude: 02 57 21 W
5	**Altitude**	Not being submitted	0 (coast)
6	**Area (ha)**	37404.6	

7 Overview

Morecambe Bay lies between the coasts of South Cumbria and Lancashire, and represents the largest continuous intertidal area in Britain. Morecambe Bay comprises the estuaries of five rivers and the accretion of mudflats behind Walney Island. The area is of intertidal mud and sandflats, with associated saltmarshes, shingle beaches and other coastal habitats. It is a component in the chain of west coast estuaries of outstanding importance for passage and overwintering waterfowl (supporting the third largest number of wintering waterfowl in Britain), and breeding waterfowl, gulls and terns.

8 Wetland type Man-made wetland , Marine/coastal wetland

Code	Name	% Area
B	Marine beds (eg. sea grass beds)	0.4
E	Sand / shingle shores (including dune systems)	0.3
F	Estuarine waters	13
G	Tidal flats	77.7
H	Salt marshes	8.4
6	Reservoirs / barrages / dams	0.2

9 Ramsar Criteria 4, 5, 6

10 Map of the site √

11 Compiler

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
Cambridgeshire PE1 1JY
UK

Telephone/Fax : +44(0) 1733 562626 / +44(0) 1733 555948

12 Justification of criteria

Ramsar criterion 4

The site is a staging area for migratory waterfowl including internationally important numbers of passage *Charadrius hiaticula*.

Ramsar criterion 5

Internationally important waterfowl assemblage (greater than 20,000 birds)

Ramsar criterion 6

Over winter the site regularly supports internationally important populations of: Bar-tailed Godwit *Limosa lapponica*, Curlew *Numenius arquata*, Dunlin *Calidris alpina alpina*, Grey Plover *Pluvialis squatarola*, Knot *Calidris canutus*, Oystercatcher *Haematopus ostralegus*, Pink-footed Goose *Anser brachyrhynchus*, Pintail *Anas acuta*, Redshank *Tringa totanus*, Shelduck *Tadorna tadorna*, Turnstone *Arenaria interpres*

13 General location

Nearest town/city: Morecambe
Morecambe Bay is located within the counties of Cumbria and Lancashire in northwest England
Administrative Region: Cumbria, Lancashire

14 Physical Features

Soil & Geology	boulder, clay, cobble, gravel, limestone, limestone/chalk, mud, neutral, pebble, sand, sedimentary, shingle
Geomorphology and Landscape	coastal, enclosed coast (including embayment), estuary, floodplain, intertidal rock, intertidal sediments (including sandflat/mudflat), islands, lagoon, lowland, open coast (including bay), pools, shingle bar, sound/strait, subtidal rock (including rocky reefs), subtidal sediments (including sandbank/mudbank)
Nutrient status	mesotrophic
pH	circumneutral
Salinity	saline / euhaline
Soil	mainly mineral
Water permanence	usually permanent
Summary of main climatic features	Rainy, temperate climate with a mild winter and periodic frost. Mean minimum temperature approximately 7.4°C. Mean maximum temperature approximately 14.4°C. Mean annual precipitation approximately 6222.4mm, with a winter maximum.

15 Hydrological values

Shoreline stabilisation and dissipation of erosive forces

16 Ecological features

The main habitat types of the Morecambe Bay Ramsar site are: Intertidal mudflats and sandflats, saltmarsh, shingle, rocky scars, sand dunes.
A large shallow estuary, with extensive intertidal mudflats, saltmarshes, subtidal sediments and rocky shorelines.
There are small areas of eelgrass *Zostera* beds and vegetated shingle.
The saltmarshes are traditionally heavily grazed and provide important wildfowl habitat.

17 Noteworthy flora

None.

18 Noteworthy fauna

Birds

Species occurring at levels of international importance (as identified at designation):

On passage the area regularly supports:

Ringed Plover (*Charadrius hiaticula*) (Europe/Northern Africa (wintering))	693 individuals, representing an average of 1.5% of the population (5 year peak mean for 1991/92 to 1995/96)

Over winter the area regularly supports:

Bar-tailed Godwit, *Limosa lapponica* (Western Palearctic (wintering))	2611 individuals, representing an average of 2.6% of the population (5 year peak mean for 1991/92 to 1995/96)

Curlew, Numenius arquata (Europe (breeding))	13620 individuals, representing an average of 3.9% of the population (5 year peak mean for 1991/92 to 1995/96)
Dunlin, Calidris alpina alpina (Northern Siberia/Europe/Western Africa)	52671 individuals, representing an average of 3.8% of the population (5 year peak mean for 1991/92 to 1995/96)
Grey Plover, Pluvialis squatarola (Eastern Atlantic (wintering))	1813 individuals, representing an average of 1.1% of the population (5 year peak mean for 1991/92 to 1995/96)
Knot, Calidris canutus (Northeastern Canada/Greenland/Iceland/Northwestern Europe)	29426 individuals, representing an average of 8.5% of the population (5 year peak mean for 1991/92 to 1995/96)
Oystercatcher, Haematopus ostralegus (Europe & Northern/Western Africa)	47572 individuals, representing an average of 5.4% of the population (5 year peak mean for 1991/92 to 1995/96)
Pink-footed Goose, *Anser brachyrhynchus* (Eastern Greenland/Iceland/UK)	2475 individuals, representing an average of 1.1% of the population (5 year peak mean for 1991/92 to 1995/96)
Pintail, *Anas acuta* (Northwestern Europe)	2804 individuals, representing an average of 4.7% of the population (5 year peak mean for 1991/92 to 1995/96)
Redshank, Tringa totanus (Eastern Atlantic (wintering))	6336 individuals, representing an average of 3.6% of the population (5 year peak mean for 1991/92 to 1995/96)
Shelduck, Tadorna tadorna (Northwestern Europe)	6372 individuals, representing an average of 2.1% of the population (5 year peak mean for 1991/92 to 1995/96)
Turnstone, Arenaria interpres (Western Palearctic (wintering))	1583 individuals, representing an average of 2.4% of the population (5 year peak mean for 1991/92 to 1995/96)

Assemblages of international importance:

Over winter the area regularly supports:

210668 waterfowl (5 year peak mean for 1991/92 to 1995/96)

Species occurring at levels of national importance:

During the breeding season the area regularly supports:

Herring Gull, Larus argentatus (Northwestern Europe (breeding) and Iceland/Western Europe (breeding))	11000 pairs, representing an average of 6.9% of the GB population (5 year mean for 1992 to 1996)
Lesser Black-backed Gull, *Larus fuscus* (Western Europe/Mediterranean/Western Africa)	22000 pairs, representing an average of 26.5% of the GB population (5 year mean for 1992 to 1996)

Sandwich Tern, Sterna sandvicensis (Western Europe/Western Africa)	290 pairs, representing an average of 2.1% of the GB population (5 year mean for 1992 to 1996)
On passage the area regularly supports:	
Sanderling, *Calidris alba* (Eastern Atlantic/Western & Southern Africa (wintering))	2466 individuals, representing an average of 10.6% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Over winter the area regularly supports:	
Cormorant, *Phalacrocorax carbo* (Northwestern Europe)	879 individuals, representing an average of 6.7% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Eider, *Somateria mollissima* (Britain/Ireland)	6400 individuals, representing an average of 8.3% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Goldeneye, *Bucephala clangula* (Northwestern/Central Europe)	445 individuals, representing an average of 2.6% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Goldern Plover, *Pluvialis apricaria* (Northwestern Europe (breeding))	4097 individuals, representing an average of 1.6% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Great Crested Grebe, *Podiceps cristatus* (Northwestern Europe (wintering))	318 individuals, representing an average of 3.2% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Lapwing, *Vanellus vanellus* (Europe (breeding))	17669 individuals, representing an average of 1.2% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Red-breasted Merganser, *Mergus serrator* (Northwestern/Central Europe)	292 individuals, representing an average of 2.9% of the GB population (5 year peak mean for 1991/92 to 1995/96)
Wigeon, *Anas penelope* (Western Siberia/Northwestern/Northeastern Europe)	5838 individuals, representing an average of 2.1% of the GB population (5 year peak mean for 1991/92 to 1995/96)

19 Social and Cultural Values

Aesthetic
Aquatic vegetation (e.g. reeds, willows, seaweed)
Archaeological/historical site
Conservation education
Current scientific research
Fisheries production
Livestock grazing
Non-consumptive recreation
Sport fishing
Sport hunting
Subsistence fishing
Tourism
Traditional cultural
Transportation/navigation

20 Land tenure/ownership

Ownership category	On-Site	Off-Site
Non-governmental organisation	+	+
National/Crown estate	+	+
Private	+	+

21 Current land use

Activity	On-Site	Off-Site	Scale
Nature conservation	+	+	Large-Scale
Tourism	+	+	Large-Scale
Recreation	+	+	Large-Scale
Research	+	+	Small-Scale
Collection of non-timber natural products: commercial	+		Small-Scale
Commercial forestry		+	Small-Scale
Fishing: commercial	+	+	Small-Scale
Fishing: recreational/sport	+		Small-Scale
Marine/saltwater aquaculture	+		Small-Scale
Gathering of shellfish	+		Small-Scale
Bait collection	+		Small-Scale
Grazing (unspecified)	+	+	Large-Scale
Permanent pastoral agriculture	+	+	Large-Scale
Hunting: recreational/sport	+	+	Small-Scale
Industrial water supply	+		Large-Scale
Industry	+	+	Large-Scale
Sewage treatment/disposal	+	+	Large-Scale
Harbour/port	+	+	Small-Scale
Mineral exploration		+	Small-Scale
Oil/gas production		+	Large-Scale
Transport route	+	+	Large-Scale
Urban development		+	Large-Scale
Non-urbanised settlements		+	Large-Scale

22 Adverse factors affecting the ecological character of the site

Activity	On-Site	Off-Site	Scale
Overgrazing by domestic livestock	+		Small-Scale
Drainage/reclamation for agriculture		+	Large-Scale
Dredging	+		Small-Scale
Over fishing	+		Small-Scale
Pollution - unspecified	+		Large-Scale

23 Conservation measures taken

Conservation measure	On-site	Off-site
SSSI	+	
NNR	+	+
SPA	+	
Candidate SAC	+	
Land owned by a NGO for nature conservation	+	+
Site management statement/plan implemented	+	+

24 Conservation measures proposed but not yet implemented

see below

Site vulnerability and management statement

The site is subjected to a wide range of pressures such as reclamation for agriculture, over-grazing, dredging, over-fishing, industrial uses and unspecified pollution. However, overall the site is relatively robust and many of those pressures have only slight to local effects and are being addressed through Management Plans. The breeding tern interest is very vulnerable and the colony has recently moved to the adjacent Duddon Estuary. Positive management is being secured through management plans for non-governmental organisation reserves, English Nature Site Management Statements, European Marine Site Management Scheme, and the Morecambe Bay Partnership.

25 Current scientific research/survey/monitoring and facilities

Fauna.
Numbers of migratory and wintering wildfowl and waders are monitored annually as part of the national Wetland Birds Survey (WeBS) organised by the British Trust for Ornithology, Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee.

Habitat.
Baseline habitat review/survey being completed by English Nature for European Marine Site Management Scheme.

26 Current conservation education

None

27 Current recreation and tourism

Activities.
Angling, wildfowling, bait collection, walking sailing, windsurfing and birdwatching.
Facilities provided.
There are interpretative facilities at South Walney, Foulney and Leighton Moss reserves, and in the nearby town of Morecambe.
Seasonality.
Wildfowling occurs from1 September to 20 February.

28 Functional jurisdiction

28. *Jurisdiction* - territorial jurisdiction - England

Department of the Environment, Transport and the Regions

29 Management authority

English Nature
Northminster House
Peterborough PE1 1UA

Telephone +44 1733 455000
Fax +44 1733 568834

30 Bibliography

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Reference should also be made to Country Agencies Management Plans for sites that are within National Nature Reserves.

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

FOR OFFICE USE ONLY.

DD MM YY

Designation date | Site Reference Number

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
Cambridgeshire PE1 1JY
UK
Telephone/Fax: +44 (0)1733 – 562 626 / +44 (0)1733 – 555 948
Email: RIS@JNCC.gov.uk

2. Date this sheet was completed/updated:

Designated: 16 March 1998

3. Country:

UK (England)

4. Name of the Ramsar site:

Duddon Estuary

5. Designation of new Ramsar site or update of existing site:

This RIS is for: Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area:

** Important note: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site included:

Refer to Annex III of the *Explanatory Notes and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

i) **hard copy** (required for inclusion of site in the Ramsar List): *yes* ✓ -or- *no* □;
ii**) an electronic format** (e.g. a JPEG or ArcView image) Yes
iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** *yes* ✓ -or- *no* □;

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site boundary is the same as, or falls within, an existing protected area.

For precise boundary details, please refer to paper map provided at designation

8. Geographical coordinates (latitude/longitude):

54 10 39 N 03 15 24 W

9. General location:

Include in which part of the country and which large administrative region(s), and the location of the nearest large town.

Nearest town/city: Barrow-in-Furness

Duddon Estuary is situated in north-west England to the north-west of Morecambe Bay and to the north of Barrow-in Furness.

Administrative region: Cumbria

10. Elevation (average and/or max. & min.) (metres): 11. Area (hectares): 6806.3

Min. -2
Max. 16
Mean 0

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

Duddon Estuary is formed by the River Duddon and the smaller Kirkby Pool opening into the Irish Sea in south-western Cumbria. Most of the site consists of intertidal sand and mudflats, important for large numbers of wintering and passage waterfowl. A range of grazed and ungrazed saltmarsh habitats occur around the edge of the estuary, especially the sheltered inner section. The site is the most important in Cumbria for sand-dune communities including large areas of calcareous dunes at Sandscale and Haverigg Haws and contrasting acid dunes on North Walney. Artificial habitats include slag banks and a flooded mine working known as Hodbarrow Lagoon, the largest coastal lagoon in north-west England.

13. Ramsar Criteria:

Circle or underline each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11).

2, 4, 5, 6

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Ramsar criterion 2

Supports nationally important numbers of the rare natterjack toad *Bufo calamita*, near the north-western edge of its range (an estimated 18-24% of the British population). Supports a rich assemblage of wetland plants and invertebrates - at least one nationally scarce plant and at least two British Red Data Book invertebrates.

Ramsar criterion 4

The site supports nationally important numbers of waterfowl during spring and autumn passage.

Ramsar criterion 5

Assemblages of international importance:

Species with peak counts in winter:
26326 waterfowl (5 year peak mean 1998/99-2002/2003)

Ramsar criterion 6 – species/populations occurring at levels of international importance.

Qualifying Species/populations (as identified at designation):
Species with peak counts in winter:

Northern pintail , *Anas acuta*, NW Europe	687 individuals, representing an average of 1.1% of the population (5 year peak mean 1998/9-2002/3)
Red knot , *Calidris canutus islandica*, W & Southern Africa (wintering)	749 individuals, representing an average of 0.2% of the GB population (5 year peak mean 1998/9-2002/3)
Common redshank , *Tringa totanus totanus*,	2197 individuals, representing an average of 1.8% of the GB population (5 year peak mean 1998/9-2002/3)

Contemporary data and information on waterbird trends at this site and their regional (sub-national) and national contexts can be found in the Wetland Bird Survey report, which is updated annually. See www.bto.org/survey/webs/webs-alerts-index.htm.
See Sections 21/22 for details of noteworthy species
Details of bird species occuring at levels of National importance are given in Section 22

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:
Atlantic

b) biogeographic regionalisation scheme (include reference citation):
Council Directive 92/43/EEC

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Soil & geology	acidic, basic, shingle, sand, mud, alluvium, metamorphic, limestone, slate/shale, sandstone/mudstone, limestone/chalk
Geomorphology and landscape	lowland, coastal, barrier beach, intertidal sediments (including sandflat/mudflat), open coast (including bay), estuary, lagoon
Nutrient status	
pH	no information
Salinity	saline / euhaline
Soil	mainly mineral
Water permanence	usually permanent
Summary of main climatic features	Annual averages (Blackpool, 1971–2000) (www.metoffice.com/climate/uk/averages/19712000/sites/blackpool.html) Max. daily temperature: 12.9° C Min. daily temperature: 6.4° C Days of air frost: 40.3 Rainfall: 871.3 mm Hrs. of sunshine: 1540.3

General description of the Physical Features:

The Duddon Estuary is formed where the River Duddon and the smaller Kirkby Pool opens into the Irish Sea. It is a complex site, mostly consisting of intertidal sand and mudflats. A range of grazed and ungrazed saltmarsh habitats occurs around the edge of the estuary, especially the sheltered inner section. The site is the most important in Cumbria for sand-dune communities including large areas of calcareous dunes at Sandscale and Haverigg Haws and contrasting acid dunes on North Walney. There are a number of settlements and industrial areas on the periphery of the site. Artificial habitats include slag banks, and a flooded iron-ore working known as Hodbarrow Lagoon forms the largest coastal lagoon in north-west England.

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, general land use, and climate (including climate type).

The Duddon Estuary is formed where the River Duddon and the smaller Kirkby Pool opens into the Irish Sea. It is a complex site, mostly consisting of intertidal sand and mudflats. A range of grazed and ungrazed saltmarsh habitats occurs around the edge of the estuary, especially the sheltered inner section. The site is the most important in Cumbria for sand-dune communities including large areas of calcareous dunes at Sandscale and Haverigg Haws and contrasting acid dunes on North Walney. There are a number of settlements and industrial areas on the periphery of the site. Artificial habitats include slag banks, and a flooded iron-ore working known as Hodbarrow Lagoon forms the largest coastal lagoon in north-west England.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Shoreline stabilisation and dissipation of erosive forces

19. Wetland types:

Marine/coastal wetland

Code	Name	% Area
G	Tidal flats	90.4
H	Salt marshes	8

Other	Other	1.4
J	Coastal brackish / saline lagoons	0.2
Tp	Freshwater marshes / pools: permanent	0.01

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The majority of the site consists of intertidal sand and mudflats. These support invertebrate populations important for the large numbers of overwintering wildfowl and waders on the site. The mouth of the estuary forms an extensive flat sandplain, with highly mobile sands dissected by constantly-changing tidal channels. More sheltered areas in the inner part of the estuary are composed of finer sands and soft mud.

Extensive areas of saltmarsh occur around the outer edge of the site, especially in the more sheltered inner third of the estuary and around North Walney. There is considerable variation in the saltmarsh communities depending mainly on the intensity of grazing and degree of saltwater inundation. Pioneer saltmarsh occurs at the seaward edge of the marsh, with species such as *Salicornia europaea, Suaeda maritima* and *Spartina anglica*. The mid-marsh is dominated by species such as *Puccinellia maritima, Festuca rubra* and *Armeria maritima*. *Juncus maritimus* is frequent at the landward side of the marsh. Ungrazed saltmarsh on the east side of North Walney is richer in plant and invertebrate species and is dominated by *Limonium vulgare* and *Atriplex portulacoides.*

The estuary is one of the most important sites in Cumbria for sand dune communities, including areas of calcareous dunes at Sandscale and Haverigg Haws, and contrasting acid dunes at North Walney. A full range of dune types is present, from fore-dunes based on highly mobile sand dominated by *Ammophila arenaria,* to more fixed yellow and grey dunes and dune grasslands. The calcareous nature of the sand has given rise to a very diverse flora with species such as *Viola tricolor, Thymus praecox, Galium verum* and the local *Vulpia membranacea*. On each of the main dune systems there are areas of dune heath, a rare habitat, with *Calluna vulgaris, Erica cinerea, E. tetralix* and a mosaic of mosses and lichens. The dune slacks support a diverse flora including *Centaurium littorale, Epipactis palustris, Corallorhiza trifida*. The wetter slacks are important for natterjack toads.

The strandline communities at North Walney and Haverigg Haws support nationally rare shingle vegetation including species such as *Honkenya peploides, Cakile maritima, Crambe maritima*.

There are a variety of artificial habitats within the site, including slag banks at Askam Pier and Borwick Rails, which have developed a calcareous flora and are used by breeding terns. Hodbarrow lagoon, a flooded mine working, is used as a roost for wildfowl and for breeding birds. Associated habitats include carr, shingle beach, brackish pools and coastal grassland.

Ecosystem services

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Nationally important species occurring on the site.

Higher Plants.

Epipactis dunensis, Limonium humile, Centaurium littorale, Pyrola rotundifolia, Equisetum variegatum, Corallorhiza trifida, Coincya monensis ssp. *monensis.*

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Birds

Species currently occurring at levels of national importance:

Species regularly supported during the breeding season:

Sandwich tern , *Sterna* *(Thalasseus) sandvicensis sandvicensis*, W Europe	340 apparently occupied nests, representing an average of 3.2% of the GB population (Seabird 2000 Census)
Little tern , *Sterna albifrons albifrons*, W Europe	26 apparently occupied nests, representing an average of 1.3% of the GB population (Seabird 2000 Census)

Species with peak counts in spring/autumn:

Red-breasted merganser , *Mergus serrator*, NW & C Europe	205 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian oystercatcher , *Haematopus ostralegus ostralegus*, Europe & NW Africa -wintering	6460 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9-2002/3)

Species with peak counts in winter:

Sanderling , *Calidris alba*, Eastern Atlantic	498 individuals, representing an average of 2.4% of the GB population (5 year peak mean 1998/9-2002/3)
Dunlin , *Calidris alpina alpina*, W Siberia/W Europe	6176 individuals, representing an average of 1.1% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian curlew , *Numenius arquata arquata*, N. a. arquata Europe (breeding)	2408 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)

Species Information

Nationally important species occurring on the site.

Mammals.

Lutra lutra.

Amphibians.

Bufo calamita.

Invertebrates.

Colletes cunicularius, Psen littoralis, Hypocaccus rugiceps.

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23. Social and cultural values:

Describe if the site has any general social and/or cultural values e.g. fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values.

Aesthetic
Archaeological/historical site
Environmental education/ interpretation
Fisheries production
Livestock grazing
Non-consumptive recreation

Scientific research
Sport fishing
Sport hunting
Tourism
Transportation/navigation

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? No

If Yes, describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

Ownership category	On-site	Off-site
Non-governmental organisation (NGO)	+	
Local authority, municipality etc.	+	+
Private	+	
Public/communal	+	

25. Current land (including water) use:

Activity	On-site	Off-site
Nature conservation	+	
Tourism	+	+
Recreation	+	
Cutting of vegetation (small-scale/subsistence)	+	
Fishing: (unspecified)	+	
Fishing: recreational/sport	+	
Gathering of shellfish	+	
Bait collection	+	
Grazing (unspecified)	+	
Hunting: recreational/sport	+	
Industry		+
Sewage treatment/disposal	+	
Harbour/port	+	
Flood control	+	
Mineral exploration (excl. hydrocarbons)		+

Oil/gas exploration		+
Oil/gas production		+
Transport route		+
Urban development		+

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

Explanation of reporting category:

1. *Those factors that are still operating, but it is unclear if they are under control, as there is a lag in showing the management or regulatory regime to be successful.*
2. *Those factors that are not currently being managed, or where the regulatory regime appears to have been ineffective so far.*

NA = Not Applicable because no factors have been reported.

Adverse Factor Category	Reporting Category	Description of the problem (Newly reported Factors only)	On-Site	Off-Site	Major Impact?
No factors reported	NA				

For category 2 factors only. What measures have been taken / are planned / regulatory processes invoked, to mitigate the effect of these factors?
Is the site subject to adverse ecological change? NO

27. Conservation measures taken:

List national category and legal status of protected areas, including boundary relationships with the Ramsar site; management practices; whether an officially approved management plan exists and whether it is being implemented.

Conservation measure	On-site	Off-site
Site/ Area of Special Scientific Interest (SSSI/ASSI)	+	
National Nature Reserve (NNR)	+	
Special Protection Area (SPA)	+	
Land owned by a non-governmental organisation for nature conservation	+	
Management agreement	+	
Other	+	
Special Area of Conservation (SAC)	+	
Management plan in preparation	+	

b) Describe any other current management practices:
The management of Ramsar sites in the UK is determined by either a formal management plan or through other management planning processes, and is overseen by the relevant statutory conservation agency. Details of the precise management practises are given in these documents.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

No information available

29. Current scientific research and facilities:

e.g. details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Contemporary.

Fauna.

Numbers of migratory and wintering wildfowl and waders are monitored annually as part of the national Wetland Birds Survey (WeBS) organised by the British Trust for Ornithology, Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee.

Breeding birds: Site managers for the NNR, NT, RSPB reserves carry out monitoring.

Breeding natterjack *Bufo calamita*: Site managers and volunteers carry out monitoring of the breeding success of natterjacks annually.

Habitat.

Marine survey work currently underway for the marine habitats included within the Morecambe Bay candidate SAC.

Flora.

Scarce plants: Monitored by site managers on the reserves.

Completed.

Flora.

Vegetation: Sand dunes have been surveyed to NVC standard. Saltmarshes have been surveyed but not to NVC standard.

Fauna.

Invertebrates (terrestrial): Entomological records are detailed for parts of the site (Sandscale and North Walney) and less detailed for others.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitor centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

Existing Programmes: The National Trust, RSPB and English Nature wardens lead guided walks onto their respective sites (Sandscale, Hodbarrow, North Walney).

Interpretation facilities: The site is provided with fixed interpretation panels at Sandscale (NT) and North Walney NNR. Wardens also lead school visits.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Activities, Facilities provided and Seasonality.

Land-based recreation:

Walking, including dog-walking, bathing and beach recreation occurs throughout the site but particulary adjacent to the urban areas of Barrow-in-Furness, Askam, Millom and Haverigg. There is unauthorised mountain bicycle and motorbike access to some of the sand dune areas but particularly North Walney. Birdwatchers visit the site but mainly go to the nature reserves and where there is easy access. Adjacent to the SSSI at Barrow, derelict land is being developed for amenity. Most of the golf course at Dunnerholme near Askam is included within the site. All year.

Water-based recreation:

A water-skiing development occupies part of Hodbarrow Lagoon. Its operations are controlled. Otherwise power-boating, waterskiing, jet-skiing, wind surfing and canoeing are still relatively uncommon. There are several angling clubs activities in the estuary, mainly April to September.

Airborne recreation

There is a small airstrip used by light aircraft and commercial flights (BAE) adjacent to North Walney. At present usage (low) disturbance to waterfowl does not appear to be a problem. All year.

Wildfowling

Wildfowling is controlled by private agreement with estates and private owners. Clubs operate under strict rules.

Infrastructure developments

There are a number of caravan sites adjacent to the site at Haverigg and Askam and several non-marina moorings throughout the site, used mainly April to September.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept. of Agriculture/Dept. of Environment, etc.

Head, Natura 2000 and Ramsar Team, Department for Environment, Food and Rural Affairs, European Wildlife Division, Zone 1/07, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6EB

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Site Designations Manager, English Nature, Sites and Surveillance Team, Northminster House, Northminster Road, Peterborough, PE1 1UA, UK

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see **15** above), list full reference citation for the scheme.

Site-relevant references

Barne, JH, Robson, CF, Kaznowska, SS, Doody, JP & Davidson, NC (eds.) (1996) *Coasts and seas of the United Kingdom. Region 13. Northern Irish Sea: Colwyn Bay to Stranraer, including the Isle of Man*. Joint Nature Conservation Committee, Peterborough. (Coastal Directories Series.)

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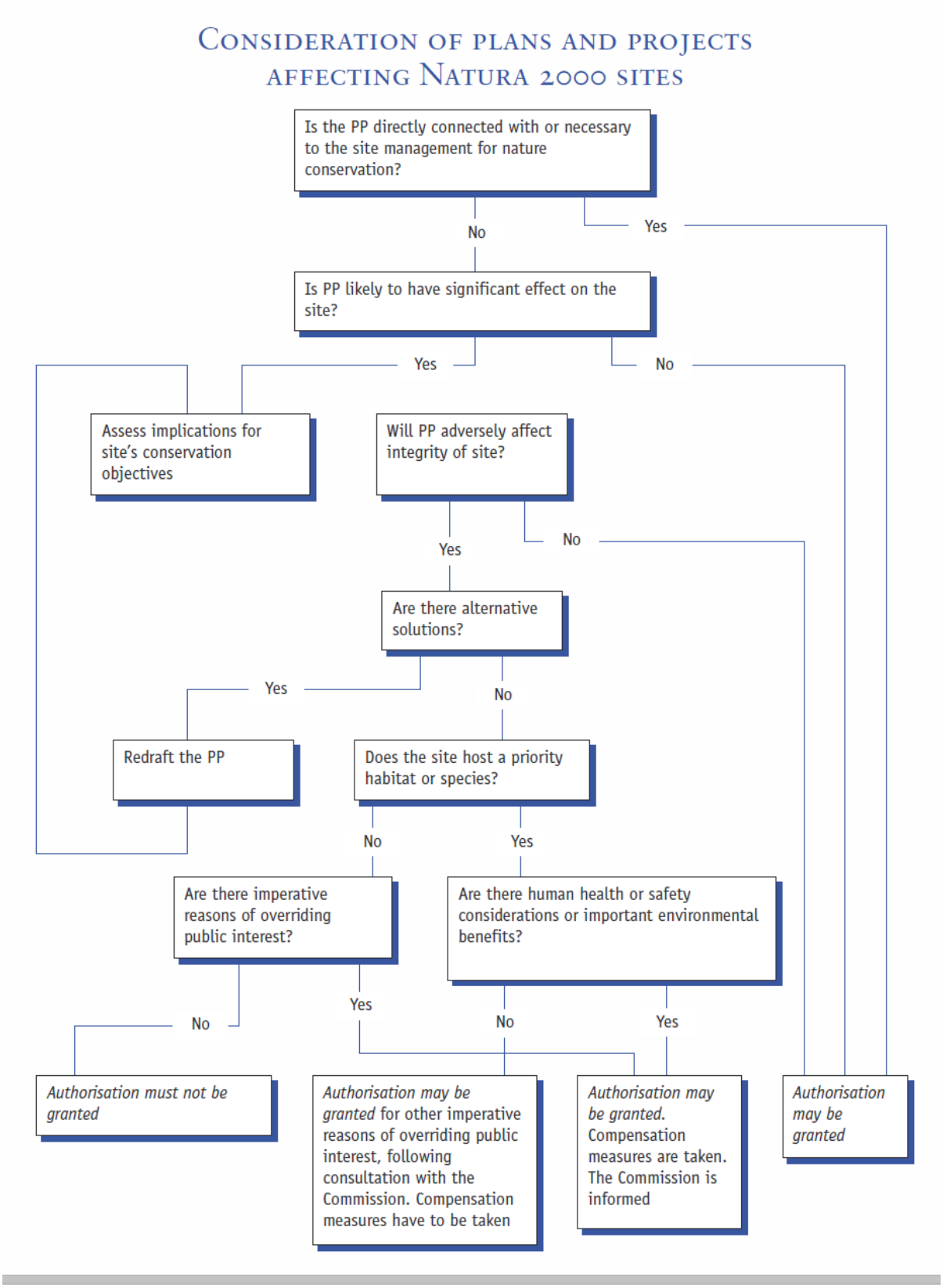
APPENDIX 3: Managing Natura 2000 Sites Annex III



APPENDIX 4. CALCULATION OF EMPIRICAL AVOIDANCE RATES

The collision searches, taking into account the search efficiency and carcass removal using all of the available data from both Haverigg II and III, gave estimates of the actual number of collisions with the Haverigg II and II wind turbines as follows (from paragraphs 28-37 of the main report):

- Breeding season 2014: 14.1 gull collisions
- Breeding season 2019: 7.5 gull collisions.
- Winter 2018-19 winter: 7.5 gull collisions and 5.0 wader collisions.

Empirical avoidance rates were calculated as the proportionate difference between the actual number of collisions (taking into account observation detection and scavenger removal rates) and the predicted risk in the absence of any avoidance behaviour using the Band collision model (Band et al. 2007). The model was run combining all of the available data to generate an overall annual risk without avoidance:

Number of collisions predicted in the absence of any avoiding behaviour = 2,360 gulls, 1,390 waders

Number of actual collisions recorded per year (taking into account the search efficiency and carcass removal) =

Average breeding season values + winter

For gulls = (14.1 + 7.5)/2 + 7.5 = 18.3

For waders = 5.0

Avoidance rate for gulls (herring gull and lesser black-backed gull combined) = 1 - (Actual number of collisions/Predicted number of collisions)

= 1 - (18.3 / 2,360) = 99.2%

Avoidance rate for waders (golden plover and curlew combined)

= 1 - (5.0 / 1,390) = 99.6%

Thus, using this approach, avoidance rates of 99.2% were derived for gulls and 99.6% for waders.

APPENDIX 5. COLLISON RISK MODELLING

This Appendix sets out the collision risk modelling that has been undertaken to support the ornithological assessment of the proposed Haverigg III wind farm lifetime extension.

Firstly, the standard Band model spreadsheets are presented for each species modelled in turn. These provide the information used to calculate the risk that individuals of each species would face if they flew through the Haverigg III wind farm rotor swept area. For the first species, for example, golden plover, this gives an overall 8.5% chance of collision.

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA												
Golden Plover												
Only enter input parameters in blue												
K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**									
NoBlades	3						Upwind:			Downwind:		
MaxChord	2.3	m	r/R	c/C	a	collide		contribution	collide		contribution	
Pitch (degrees)	16		radius	chord	alpha	length	p(collision)	from radius	length	p(collision)	from radius	
BirdLength	0.28	m	0.025	0.575	7.74	15.78	1.00	0.00125	15.05	1.00	0.00125	
Wingspan	0.72	m	0.075	0.575	2.58	5.50	0.52	0.00392	4.77	0.45	0.00340	
F: Flapping (0) or gliding (-	0		0.125	0.702	1.55	3.96	0.38	0.00470	3.07	0.29	0.00364	
			0.175	0.860	1.11	3.44	0.33	0.00572	2.35	0.22	0.00391	
Bird speed	13.7	m/sec	0.225	0.994	0.86	3.14	0.30	0.00671	1.88	0.18	0.00401	
RotorDiam	52	m	0.275	0.947	0.70	2.58	0.24	0.00673	1.38	0.13	0.00360	
RotationPeriod	2.31	sec	0.325	0.899	0.60	2.18	0.21	0.00673	1.04	0.10	0.00321	
			0.375	0.851	0.52	1.88	0.18	0.00670	0.80	0.08	0.00286	
			0.425	0.804	0.46	1.65	0.16	0.00664	0.63	0.06	0.00253	
			0.475	0.756	0.41	1.45	0.14	0.00655	0.50	0.05	0.00223	
Bird aspect ratio: b	0.39		0.525	0.708	0.37	1.31	0.12	0.00651	0.41	0.04	0.00203	
			0.575	0.660	0.34	1.19	0.11	0.00649	0.35	0.03	0.00192	
			0.625	0.613	0.31	1.09	0.10	0.00645	0.31	0.03	0.00184	
			0.675	0.565	0.29	1.00	0.09	0.00638	0.28	0.03	0.00179	
			0.725	0.517	0.27	0.91	0.09	0.00628	0.30	0.03	0.00208	
			0.775	0.470	0.25	0.84	0.08	0.00616	0.32	0.03	0.00234	
			0.825	0.422	0.23	0.77	0.07	0.00600	0.33	0.03	0.00257	
			0.875	0.374	0.22	0.70	0.07	0.00581	0.33	0.03	0.00278	
			0.925	0.327	0.21	0.64	0.06	0.00560	0.34	0.03	0.00295	
			0.975	0.279	0.20	0.58	0.05	0.00536	0.33	0.03	0.00309	
				Overall p(collision) =			**Upwind**	**11.7%**		**Downwind**	**5.4%**	
								Average	**8.5%**			

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA

Herring Gull

Only enter input parameters in blue

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	2.3	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	16		radius	chord	alpha	length	p(collision)	from radius	length	p(collision)	from radius
BirdLength	0.6	m	0.025	0.575	7.23	19.97	1.00	0.00125	19.24	1.00	0.00125
Wingspan	1.44	m	0.075	0.575	2.41	6.90	0.70	0.00526	6.17	0.63	0.00470
F: Flapping (0) or gliding (-	0		0.125	0.702	1.45	4.77	0.48	0.00606	3.88	0.39	0.00493
			0.175	0.860	1.03	4.00	0.41	0.00711	2.91	0.30	0.00517
Bird speed	12.8	m/sec	0.225	0.994	0.80	3.55	0.36	0.00812	2.29	0.23	0.00524
RotorDiam	52	m	0.275	0.947	0.66	2.92	0.30	0.00816	1.72	0.17	0.00481
RotationPeriod	2.31	sec	0.325	0.899	0.56	2.48	0.25	0.00818	1.34	0.14	0.00441
			0.375	0.851	0.48	2.14	0.22	0.00816	1.06	0.11	0.00405
			0.425	0.804	0.43	1.88	0.19	0.00811	0.86	0.09	0.00371
			0.475	0.756	0.38	1.72	0.17	0.00828	0.76	0.08	0.00365
Bird aspect ratio: b	0.42		0.525	0.708	0.34	1.59	0.16	0.00847	0.69	0.07	0.00368
			0.575	0.660	0.31	1.48	0.15	0.00863	0.64	0.07	0.00374
			0.625	0.613	0.29	1.38	0.14	0.00876	0.60	0.06	0.00383
			0.675	0.565	0.27	1.29	0.13	0.00886	0.62	0.06	0.00427
			0.725	0.517	0.25	1.21	0.12	0.00893	0.64	0.07	0.00473
			0.775	0.470	0.23	1.14	0.12	0.00897	0.66	0.07	0.00516
			0.825	0.422	0.22	1.07	0.11	0.00898	0.66	0.07	0.00556
			0.875	0.374	0.21	1.01	0.10	0.00896	0.67	0.07	0.00592
			0.925	0.327	0.20	0.95	0.10	0.00891	0.67	0.07	0.00626
			0.975	0.279	0.19	0.89	0.09	0.00882	0.66	0.07	0.00656
				Overall p(collision) =			**Upwind**	**15.7%**		**Downwind**	**9.2%**
								Average	**12.4%**		

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA

Lesser Black-backed Gull

Only enter input parameters in blue

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	2.3	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	16		radius	chord	alpha	length	p(collision)	from radius	length	p(collision)	from radius
BirdLength	0.58	m	0.025	0.575	7.40	20.29	1.00	0.00125	19.56	1.00	0.00125
Wingspan	1.42	m	0.075	0.575	2.47	7.00	0.70	0.00521	6.28	0.62	0.00467
F: Flapping (0) or gliding (-	0		0.125	0.702	1.48	4.84	0.48	0.00601	3.95	0.39	0.00490
			0.175	0.860	1.06	4.06	0.40	0.00705	2.97	0.29	0.00515
Bird speed	13.1	m/sec	0.225	0.994	0.82	3.61	0.36	0.00805	2.35	0.23	0.00524
RotorDiam	52	m	0.275	0.947	0.67	2.96	0.29	0.00809	1.76	0.18	0.00481
RotationPeriod	2.31	sec	0.325	0.899	0.57	2.51	0.25	0.00810	1.37	0.14	0.00442
			0.375	0.851	0.49	2.17	0.22	0.00807	1.09	0.11	0.00406
			0.425	0.804	0.44	1.90	0.19	0.00802	0.88	0.09	0.00372
			0.475	0.756	0.39	1.71	0.17	0.00806	0.75	0.07	0.00354
Bird aspect ratio: b	0.41		0.525	0.708	0.35	1.58	0.16	0.00824	0.68	0.07	0.00356
			0.575	0.660	0.32	1.47	0.15	0.00838	0.63	0.06	0.00360
			0.625	0.613	0.30	1.37	0.14	0.00849	0.59	0.06	0.00368
			0.675	0.565	0.27	1.28	0.13	0.00858	0.60	0.06	0.00399
			0.725	0.517	0.26	1.20	0.12	0.00863	0.62	0.06	0.00443
			0.775	0.470	0.24	1.13	0.11	0.00866	0.63	0.06	0.00484
			0.825	0.422	0.22	1.06	0.10	0.00865	0.64	0.06	0.00523
			0.875	0.374	0.21	0.99	0.10	0.00862	0.64	0.06	0.00558
			0.925	0.327	0.20	0.93	0.09	0.00855	0.64	0.06	0.00590
			0.975	0.279	0.19	0.87	0.09	0.00845	0.64	0.06	0.00619
				Overall p(collision) =			**Upwind**	**15.3%**		**Downwind**	**8.9%**
								Average	**12.1%**		

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA											
Curlew											
Only enter input parameters in blue											
K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	2.3	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	16		radius	chord	alpha	length	p(collision)	from radius	length	p(collision)	from radius
BirdLength	0.55	m	0.025	0.575	9.21	20.36	1.00	0.00125	19.63	1.00	0.00125
Wingspan	0.9	m	0.075	0.575	3.07	7.03	0.56	0.00421	6.30	0.50	0.00377
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.84	4.96	0.40	0.00494	4.07	0.32	0.00406
			0.175	0.860	1.32	4.23	0.34	0.00591	3.14	0.25	0.00438
Bird speed	16.3	m/sec	0.225	0.994	1.02	3.80	0.30	0.00682	2.54	0.20	0.00456
RotorDiam	52	m	0.275	0.947	0.84	3.11	0.25	0.00681	1.91	0.15	0.00418
RotationPeriod	2.31	sec	0.325	0.899	0.71	2.62	0.21	0.00678	1.48	0.12	0.00383
			0.375	0.851	0.61	2.25	0.18	0.00672	1.17	0.09	0.00349
			0.425	0.804	0.54	2.02	0.16	0.00685	1.00	0.08	0.00340
			0.475	0.756	0.48	1.84	0.15	0.00697	0.88	0.07	0.00334
Bird aspect ratio: b	0.61		0.525	0.708	0.44	1.69	0.13	0.00706	0.79	0.06	0.00330
			0.575	0.660	0.40	1.55	0.12	0.00712	0.72	0.06	0.00328
			0.625	0.613	0.37	1.44	0.11	0.00717	0.66	0.05	0.00329
			0.675	0.565	0.34	1.33	0.11	0.00718	0.62	0.05	0.00333
			0.725	0.517	0.32	1.24	0.10	0.00718	0.59	0.05	0.00338
			0.775	0.470	0.30	1.16	0.09	0.00715	0.56	0.04	0.00347
			0.825	0.422	0.28	1.08	0.09	0.00709	0.56	0.04	0.00367
			0.875	0.374	0.26	1.01	0.08	0.00701	0.57	0.05	0.00397
			0.925	0.327	0.25	0.94	0.07	0.00691	0.58	0.05	0.00426
			0.975	0.279	0.24	0.87	0.07	0.00678	0.58	0.05	0.00452
				Overall p(collision) =			**Upwind**	**12.8%**		**Downwind**	**7.3%**
								Average	**10.0%**		

The second section of this Appendix provides details of the calculations that have been made of the key species flight activity within the collision risk zone.

The first part of the Table below gives the survey effort (number of hours observation) from the single VP for each month in each survey year.

All of the key species (golden plover, lesser black-backed gull, herring gull and curlew) followed predictable direct routes so that variant of the model was used for those species (which required the number of flights through the collision risk zone as their bird activity input).

The numbers of flights observed through the collision risk zone in Section 2. These are converted into flight rates through the wind farm in section 3. The hours of activity per month are summarised in Section 4 (with daylight hours calculated using Band 2012), and the calculations of the overall numbers of flights per month through the collision risk zone are given in Section 5 (which feed into the following section of the modelling).

HAVERIGG III COLLISION RISK MODELLING DATA INPUT: BIRD USAGE

1. Hours observation

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014					8	9	10	9	4.5	13.5	9	9	7.5
2015		10.5	9	9									
2019						12	12	12					

2. Bird flights observed through collision risk zone (number of individuals)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Golden Plover	2014				0	0	0	0	0	0	284	0	215
	2015	2	110	0									
	2019					0	0	0					
Herring Gull	2014				56	40	41	23	5	128	71	95	24
	2015	36	59	149									
	2019					127	133	83					
Lesser Black-backed Gull	2014				18	7	37	81	1	58	2	3	0
	2015	0	0	9									
	2019					85	61	37					
Curlew	2014				0	0	1	50	0	0	0	1	0
	2015	249	162	0									
	2019					0	0	41					

3. Bird flights/hr through collision risk zone

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Breeding	NB
Golden Plover	2014				0	0	0	0	0	0	31.556	0	28.667	**0.0**	**9.1**
	2015	0.1905	12.222	0											
	2019					0	0	0						**0.0**	
Herring Gull	2014				7	4.4444	4.1	2.5556	1.1111	9.4815	7.8889	10.556	3.2	**4.5**	**7.3**
	2015	3.4286	6.5556	16.556											
	2019					10.587	11.121	6.8838						**9.5**	
Lesser Black-backed Gull	2014				2.25	0.7778	3.7	9	0.2222	4.2963	0.2222	0.3333	0	**3.9**	**0.8**
	2015	0	0	1											
	2019					7.0496	5.0517	3.0644						**5.1**	
Curlew	2014				0	0	0.1	5.5556	0	0	0	0.1111	0	**1.4**	**5.2**
	2015	23.714	18	0											
	2019					0	0	3.4167						**1.1**	

4. Number of hours for which birds were assumed to be potentially active over the time period that they were present

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Breeding	NB
Mean daylight hrs	7.7	9.5	11.8	14.2	16.3	17.5	17.0	15.1	12.8	10.5	8.3	7.1	**16.2**	**11.1**
Mean nocturnal hours	16.3	14.5	12.2	9.8	7.7	6.5	7.0	8.9	11.2	13.5	15.7	16.9		
No days birds present	31	28	31	30	31	30	31	31	30	31	30	31	**122**	**243**
Total hours day	237.7	266.9	365.6	424.5	504.7	524.9	526.2	468.1	384.7	325.1	249.9	219.5		
Total hours night	506	405	378	295	239	195	218	276	335	419	470	525		

5. Bird flights/month

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL FLIGHTS Breeding	NB
Golden Plover		2014				0	0	0	0	0	0	16868	0	13810	**0**	**36,509**
Nocturnal activity	50%	2015	93	5738	0											
		2019				0	0	0	0						**0**	
Herring Gull		2014				3178	2349	2232	1400	551	3966	2895	3134	870	**9,160**	**21,098**
Nocturnal activity	10%	2015	988	2015	6679											
		2019				8195	5596	6055	3772						**23,619**	
Lesser Black-backed Gull		2014				1022	411	2014	4932	110	1797	82	99	0	**8,379**	**2,491**
Nocturnal activity	10%	2015	0	0	403											
		2019				1133	3727	2750	1679						**9,289**	
Curlew		2014				0	0	62	3528	0	0	0	54	0	**3,591**	**20,144**
Nocturnal activity	50%	2015	11640	8450	0											
		2019				0	0	0	2170						**2,170**	

The next part of the Appendix shows the details of the collision risk modelling for each season for which each species was observed within the collision risk zone at rotor height, giving the predicted risk based on each period's survey data, and an overall best estimate of the annual risk (the winter risk added to the average breeding season risk).

HAVERIGG III WIND FARM							
BAND ET AL 2007 COLLISION MODEL (DIRECT FLIGHTS)							
	Golden Plover				**Herring Gull**		
	Winter 2014-15	**Breeding 2014**	**Breeding 2019**		**Winter 2014-15**	**Breeding 2014**	**Breeding 2019**
Collision risk height	52	52	52		52	52	52
Risk corridor Width	1,250	1,250	1,250		1,250	1,250	1,250
Risk corridor Area	65,000	65,000	65,000		65,000	65,000	65,000
Annual number of flights through collision zone	36,509	0	0		21,098	9,160	23,619
% at rotor height	100%	100%	100%		100%	100%	100%
Annual number flying through risk window	36,509	0	0		21,098	9,160	23,619
No turbines	4	4	4		4	4	4
Rotor diameter	52	52	52		52	52	52
Rotor swept area	2124	2124	2124		2124	2124	2124
Allowance for overlap	0%	0%	0%		0%	0%	0%
Proportion of risk window occupied by rotors	13%	13%	13%		13%	13%	13%
Annual no bird rotor passes	4771	0	0		2757	1197	3087
Band individual collision risk	8.5%	8.5%	8.5%		12.4%	12.4%	12.4%
Turbine downtime	10%	10%	10%		10%	10%	10%
Non-avoidance collisions	367	0	0		308	134	345
Avoidance rate	98.0%	98.0%	98.0%		98.0%	98.0%	98.0%
Predicted collisions per year	**7.33**	**0.00**	**0.00**		**6.17**	**2.68**	**6.91**
Total annual collision risk	Winter	**2014-15**	**7.33**		Winter	**2014-15**	**6.17**
	Breeding	**2014**	**0.00**		Breeding	**2014**	**2.68**
		2019	**0.00**			**2019**	**6.91**
		Overall	***7.33***			***Overall***	***10.96***

HAVERIGG III WIND FARM							
BAND ET AL 2007 COLLISION MODEL (DIRECT FLIGHTS)							
	LBB Gull				**Curlew**		
	Winter 2014-15	**Breeding 2014**	**Breeding 2019**		**Winter 2014-15**	**Breeding 2014**	**Breeding 2019**
Collision risk height	52	52	52		52	52	52
Risk corridor Width	1,250	1,250	1,250		1,250	1,250	1,250
Risk corridor Area	65,000	65,000	65,000		65,000	65,000	65,000
Annual number of flights through collision zone	2,491	8,379	9,289		20,144	3,591	2,170
% at rotor height	100%	100%	100%		100%	100%	100%
Annual number flying through risk window	2,491	8,379	9,289		20,144	3,591	2,170
No turbines	4	4	4		4	4	4
Rotor diameter	52	52	52		52	52	52
Rotor swept area	2124	2124	2124		2124	2124	2124
Allowance for overlap	0%	0%	0%		0%	0%	0%
Proportion of risk window occupied by rotors	13%	13%	13%		13%	13%	13%
Annual no bird rotor passes	326	1095	1214		2633	469	284
Band individual collision risk	12.1%	12.1%	12.1%		10.0%	10.0%	10.0%
Turbine downtime	10%	10%	10%		10%	10%	10%
Non-avoidance collisions	35	119	132		238	42	26
Avoidance rate	98.0%	98.0%	98.0%		98.0%	98.0%	98.0%
Predicted collisions per year	**0.71**	**2.38**	**2.64**		**4.75**	**0.85**	**0.51**
Total annual collision risk	Winter	**2014-15**	**0.71**		Winter	**2014-15**	**4.75**
	Breeding	**2014**	**2.38**		Breeding	**2014**	**0.85**
		2019	**2.64**			**2019**	**0.51**
		Overall	***3.22***			***Overall***	***5.43***