Goole Fields II Wind Farm, East Yorkshire: Post-construction Year 1 Bird Surveys 2017-18

Golden Plover © Steve Percival

Report to Innogy UK Renewables Ltd

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INTRODUCTION

1. A bird monitoring programme has been agreed for the Goole Fields II Wind Farm, to compare the bird distribution and abundance during the baseline studies (reported in the ES) with that during and following construction of the wind farm. This involves repeating the surveys undertaken to establish the pre-construction baseline, and an additional programme of collision monitoring. It comprises:

    - Breeding Bird Surveys - Common Birds Census walkover mapping of the site plus a 500m buffer - construction (2016) and operation (2017, 2018 and 2019);

    - Wintering Birds – field count mapping of the site plus a 1km buffer - construction (2015/16 and 2016/17) and operation (2017/18, 2018/19 and 2019/20, 2021/22, 2026/27, 2031/32 and 2036/37);

    - Vantage point surveys – to quantify bird flight activity through and around the wind farm site to determine how the wind farm has affected local bird flight routes and activity, to commence when the wind turbines are operational (2017/18, 2018/19 and 2019/20, 2021/22, 2026/27, 2031/32 and 2036/37); and

    - Collision monitoring – to compare the predicted collision mortality with that which actually occurs, to commence when the wind turbines are operational, for three winters (2017/18, 2018/19 and 2019/20).

2. This report presents the results of the first year of the post-construction phase bird surveys that have been undertaken as part of the bird monitoring programme, during the 2017 breeding season and the autumn/winter of 2017-18.

3. Construction works at the site commenced in August 2015. No works were undertaken on the southern array between 1st May and 31st August, to reduce potential effects on breeding nightjars. The 17 wind turbines were installed during September-December 2016. De-snagging the electrical and civil works continued through to May 2017. Reinstatement of the site was complete by May 2017, when the wind farm became fully operational.

4. Goole Fields II wind farm lies immediately adjacent to the Goole Fields I wind farm. Construction works for the site infrastructure at the Goole Fields I wind farm took place between January and June 2013. De-snagging the electrical and civil works continued through to September 2013. Two of the 16 wind turbines (turbines #3 and #8) were erected in early August 2013 and were operational in early September 2013. The other 14 wind turbines were installed during March-June 2014 and reinstatement of the Site was complete by August 2014, when that wind farm became fully operational.

5. A Habitat Management Plan (HMP) has been developed and agreed to offset the potential adverse effects of the Goole Fields II wind farm through disturbance and collision risk to key bird species including marsh harrier, hen harrier, golden plover, lapwing and pink-footed goose. The agreed area for the delivery of this plan is located on arable land approximately 10km NE from the Goole Fields II wind farm. The post-construction phase monitoring work included surveys of the HMP Site.

Breeding Bird Survey Methods 2017

Breeding Bird Survey

6. The breeding bird survey method followed the standard principles of the Common Birds Census; a walkover survey mapping all of the birds encountered (to 1:10,000 scale), recording their behaviour and location using the standard Common Birds Census notation. All species were recorded. The survey area is shown in Figure 1. Three survey visits were made during the first year's post-construction period in 2017, the first on 13 April, the second on 10/11 May and the last visit on 14/15 June 2017. The surveys were carried out throughout daylight hours, avoiding strong winds, heavy rain, fog and low cloud. Birds were located by walking, listening and scanning by eye and with binoculars.

Analysis Methods: Effects of the Wind Farm Operation on Breeding Birds

7. An initial analysis was carried out to compare the breeding bird numbers within the 300m and 500m potential disturbance zones during the pre-construction (2008, 2009, 2012 and 2013), construction (2016) and the post-construction phase (2017) surveys.

8. Further analysis was undertaken to examine key species (for which there were sufficient numbers in the survey area for that analysis to be meaningful) distributions in relation to proximity to the wind farm. This further analysis took the form of a gradient analysis to determine whether bird density was related to distance from the development (as well as taking into account other factors including crop and other habitat features).

9. A 200 x 200m grid was overlaid onto the core survey area, to determine the number of records of each species in each square, and this value was used as the response variable in the further analysis. This was then analysed in relation to the following explanatory variables:

    - Crop type (the predominant one within the grid square);
    - Length of ditch (from OS Open Data Vector Map);
    - Distance of field (central point) to nearest part of wind farm.

10. The easting and northing of the central point of each grid square were also included as explanatory variables in order to take into account any spatial auto-correlation in the data.

Breeding Bird Survey Results

Breeding Bird Survey

11. The survey data were used to obtain population estimates for all of the bird species breeding within the core survey area (Table 1), i.e. the area that was covered in all of these survey years and that was closer to the Goole Fields II wind farm than Goole Fields 1 (see Figure 1). Maps were produced of the breeding pairs recorded during each visit and these were combined to produce an estimate of the overall breeding population for each species. Pairs were considered separate from each other if greater than 1km (waterfowl and raptors), 500m (pigeons, gamebirds and crows) or 200m (all other species) apart, with this distance reflecting

the relative distance that birds might move between survey visits. A record in potentially suitable breeding habitat on a single visit was considered sufficient to indicate a potential breeding attempt. Data are also given for 2008, 2009, 2012, 2013 (pre-construction) and 2016 (construction phase) for comparison.

Table 1. Breeding bird population estimates at Goole Fields II core breeding bird survey area during the pre-construction (2008, 2009 and 2013), construction (2016) and post-construction (2017) phases.

Species	Estimated number of breeding pairs in 2008	Estimated number of breeding pairs in 2009	Estimated number of breeding pairs in 2012	Estimated number of breeding pairs in 2013	Estimated number of breeding pairs in 2016 (construction)	Estimated number of breeding pairs in 2017 (post-construction)
Greylag Goose	0	1	0	2	0	0
Shelduck	1	0	0	0	0	0
Teal	0	0	2	0	0	0
Mallard	13	18	13	13	8	4
Shoveler	0	0	0	1	0	0
Red-legged Partridge	3	5	1	0	0	2
Grey Partridge	3	7	5	2	2	2
Quail	0	1	1	0	0	0
Pheasant	7	13	6	6	18	9
Sparrowhawk	0	0	0	1	0	1
Buzzard	0	0	1	1	2	2
Kestrel	1	1	3	4	1	2
Hobby	0	1	0	0	0	0
Moorhen	2	3	0	1	1	1
Lapwing	3	8	7	4	7	4
Redshank	0	0	0	0	2	0
Black-headed Gull	0	1	0	0	0	0
Feral Pigeon	0	1	0	0	0	0
Stock Dove	8	21	3	17	4	12
Woodpigeon	44	34	56	45	54	50
Collared Dove	0	0	1	0	1	0
Cuckoo	0	0	2	1	1	0
Barn Owl	0	1	1	0	0	0
Little Owl	0	0	0	1	1	0
Nightjar	0	0	0	3	0	0
Green Woodpecker	1	1	0	0	0	0
Great Spotted Woodpecker	1	0	0	0	1	0
Skylark	108	86	97	84	109	113
Swallow	0	2	4	2	6	5
Meadow Pipit	27	33	27	32	49	50
Yellow Wagtail	47	49	51	55	65	64
Pied Wagtail	3	11	5	9	16	12
Wren	10	12	7	13	19	22
Dunnock	1	2	2	2	4	4
Robin	6	13	6	6	15	13
Blackbird	3	12	7	5	9	14
Song Thrush	3	5	1	1	1	1
Mistle Thrush	0	0	0	1	0	6
Sedge Warbler	1	3	0	0	0	7
Reed Warbler	0	0	0	1	0	0

Species	Estimated number of breeding pairs in 2008	Estimated number of breeding pairs in 2009	Estimated number of breeding pairs in 2012	Estimated number of breeding pairs in 2013	Estimated number of breeding pairs in 2016 (construction)	Estimated number of breeding pairs in 2017 (post-construction)
Blackcap	3	8	7	3	9	9
Garden Warbler	1	0	4	3	2	1
Whitethroat	22	22	17	14	24	22
Chiffchaff	2	2	3	1	6	4
Willow Warbler	9	26	11	14	11	21
Goldcrest	0	0	1	0	0	0
Spotted Flycatcher	0	0	0	0	1	0
Long-tailed Tit	0	0	3	0	1	1
Blue Tit	3	4	5	1	4	3
Great Tit	1	4	1	4	6	6
Coal Tit	0	1	0	0	0	0
Willow Tit	0	0	0	0	1	0
Marsh Tit	0	1	0	0	0	0
Treecreeper	0	0	0	1	0	0
Jay	0	1	0	0	1	0
Magpie	1	1	2	1	1	0
Jackdaw	1	0	0	0	0	0
Carrion Crow	5	8	3	6	9	9
Starling	2	1	1	0	0	0
House Sparrow	1	0	0	2	2	2
Tree Sparrow	1	2	2	1	1	2
Chaffinch	8	18	14	11	22	23
Greenfinch	0	0	0	0	1	1
Goldfinch	2	5	3	6	9	4
Linnet	32	13	23	30	22	17
Lesser Redpoll	0	0	0	1	1	0
Yellowhammer	4	16	7	5	5	3
Reed Bunting	11	12	13	11	24	25
Corn Bunting	15	30	16	13	14	17

12. The breeding bird populations within the core survey area were generally consistent across all six survey years, with no major changes apparent in the first post-construction year (2017) in comparison with the pre-construction baseline, though numbers of mallard were rather lower in 2017 than had been recorded previously. The more abundant open farmland species have continued to generally maintain their populations at pre-construction levels though the first breeding season of operation of the wind farm, including skylark, meadow pipit, yellow wagtail, reed bunting and corn bunting.

13. The distributions of the breeding birds of conservation importance within the survey area are shown on Figures 2 to 9. Distributions from the most recent pre-construction survey year (2013) are also given for comparison. The more abundant species (i.e. 10 or more breeding pairs) have been presented separately for clarity. Distribution patterns were generally similar to those found in previous years.

    - Skylark (Figure 2) was the most abundant species, being found throughout the survey area.

- Meadow pipit (Figure 3) was not as numerous as skylark but had a similar widespread distribution.

- Yellow wagtail (Figure 4) was another widely distributed species over all of the survey area.

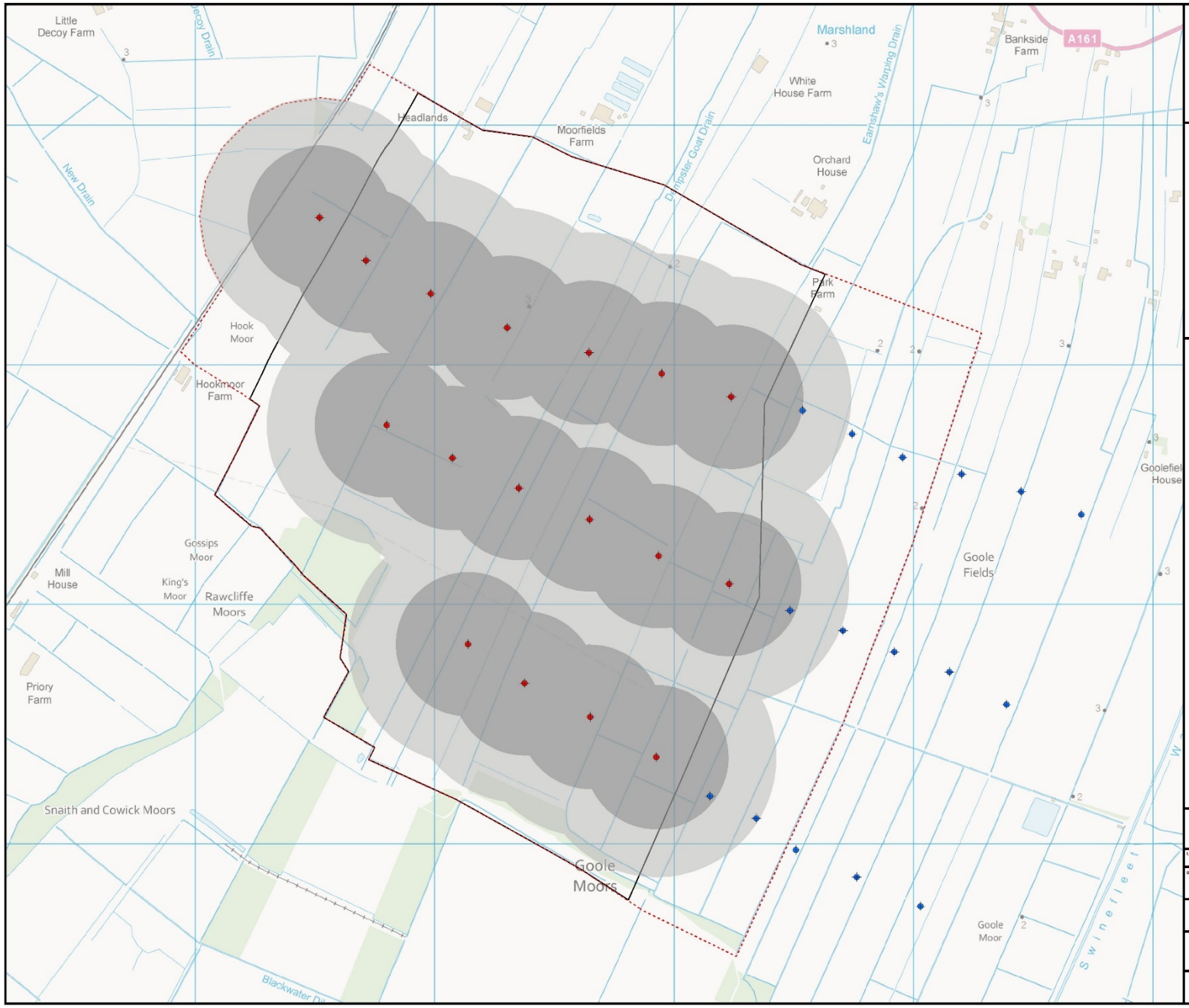
- Willow warblers (Figure 5) were largely restricted to the more wooded habitat along the moor edge in the southern part of the survey area.

- Linnet (Figure 6) were scattered across most of the survey area.

- Reed bunting (Figure 7) was another species widely distributed over most of the survey area.

- Corn buntings (Figure 8) were frequently encountered in the northern part of the survey area, but with fewer records in the southern part.

14. Of the less abundant species (Figure 9), most were mainly located on the moor edge and around farm buildings. Overall there were no notable concentrations of breeding birds seen anywhere within the Goole Fields II monitoring survey area and particularly within the farmland, as was found in the pre-construction surveys in 2008, 2009, 2012 and 2013.



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Goole Fields II Wind Farm Post-construction Year 1

FIGURE 1

Bird monitoring survey areas

KEY:

- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- Goole Fields II Turbines
- Goole Fields I Turbines
- GF2 300m buffer
- GF2 500m buffer

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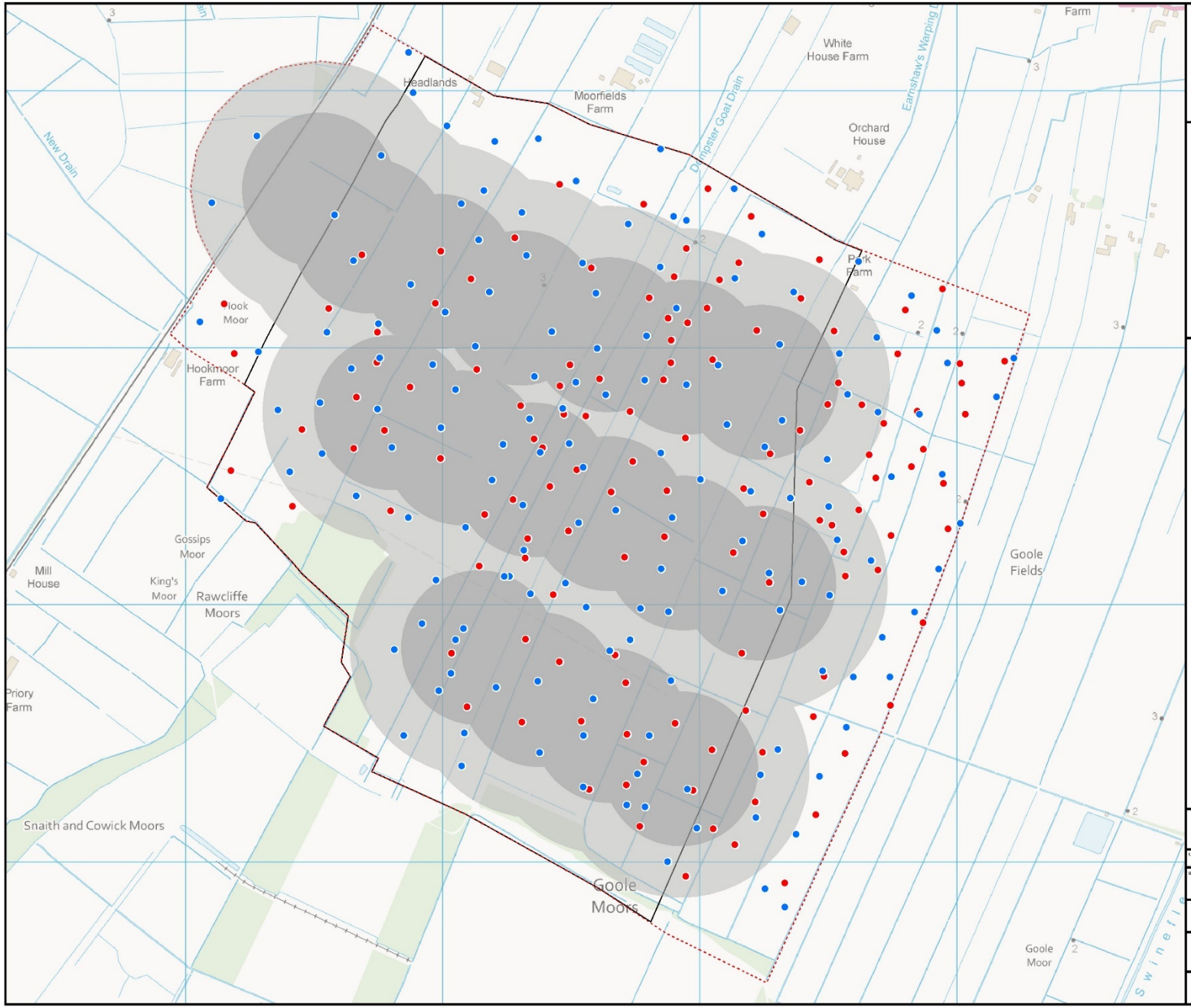

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 2

Distribution of breeding skylark in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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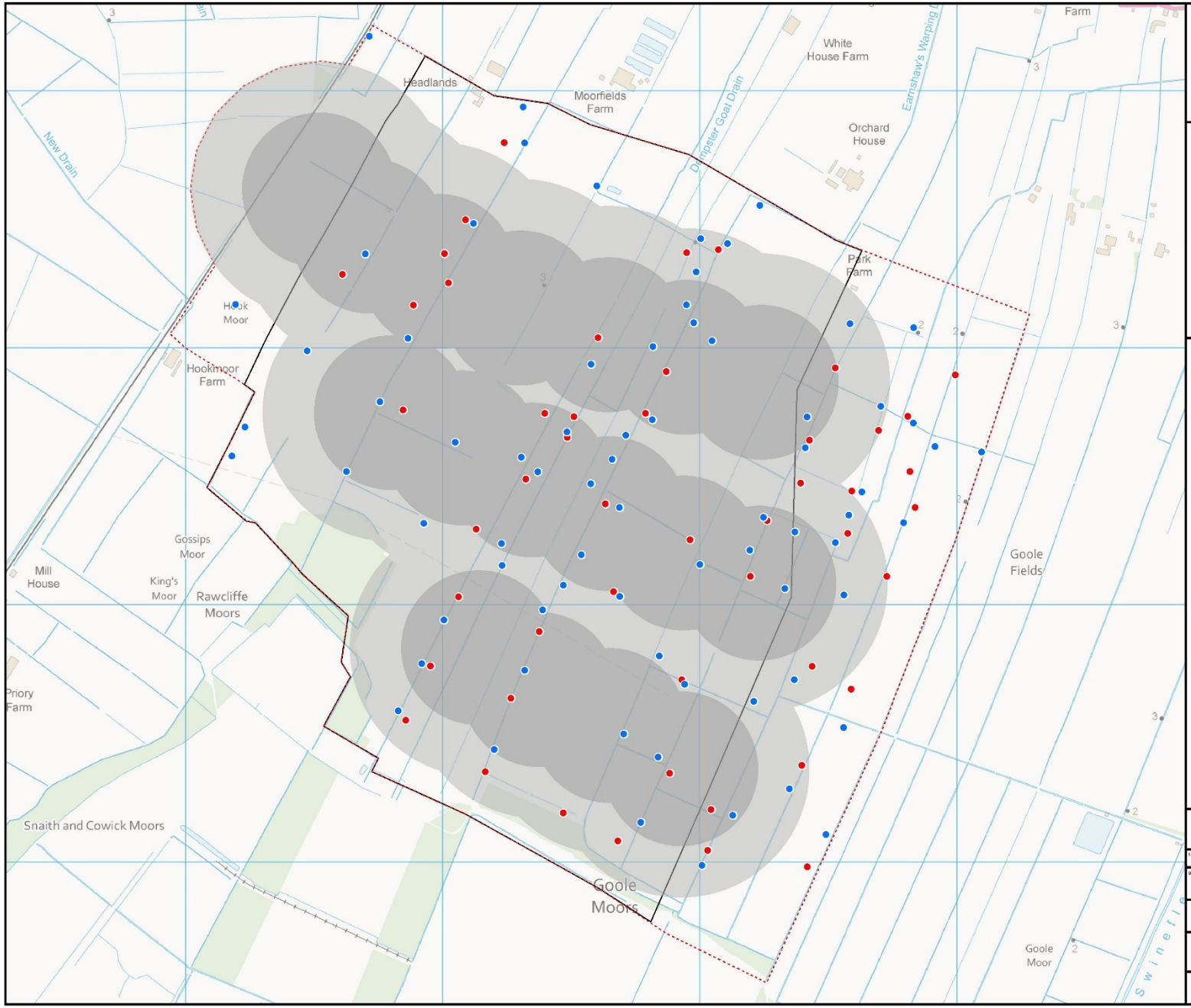

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 3

Distribution of breeding meadow pipit in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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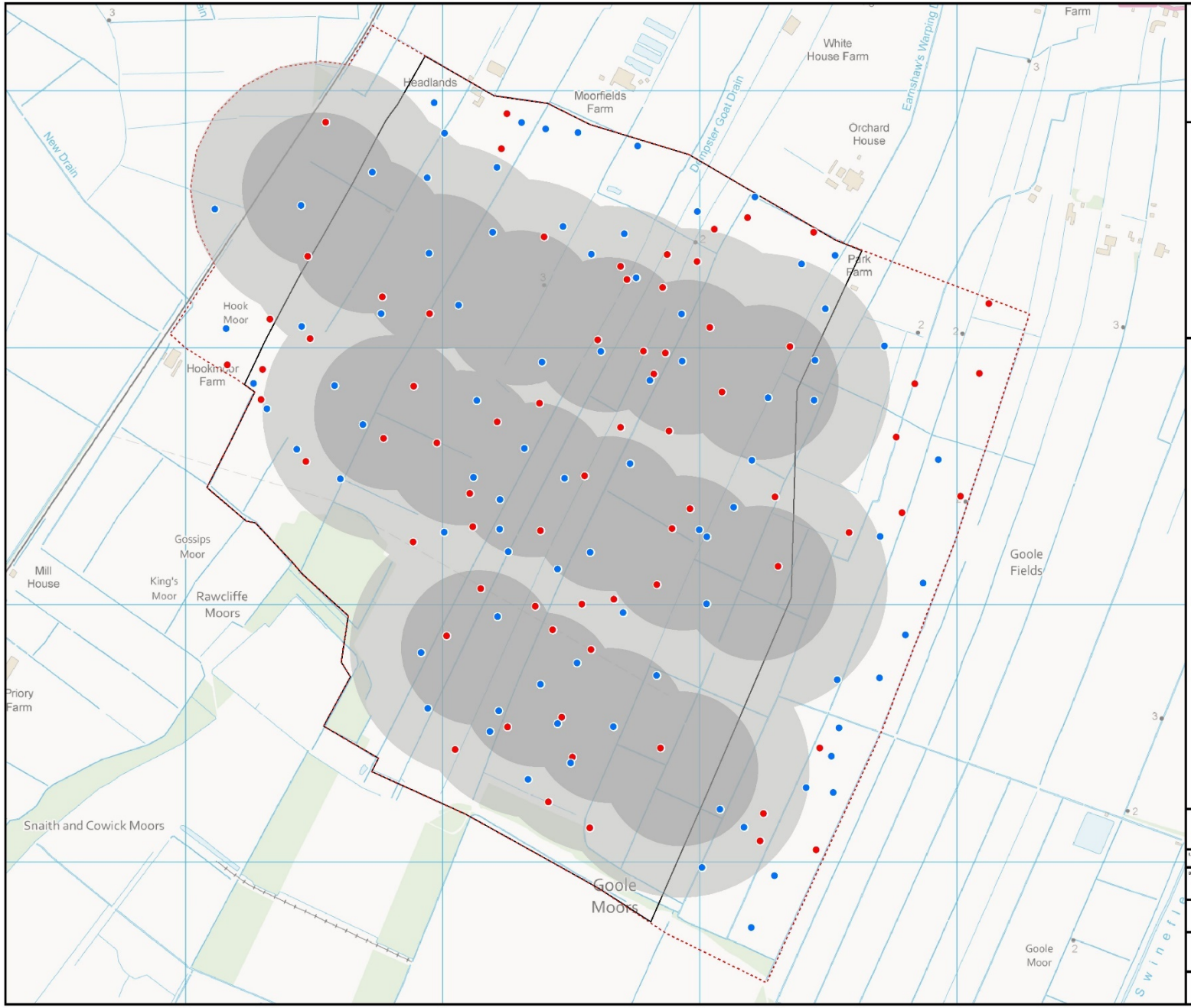

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 4

Distribution of breeding yellow wagtail in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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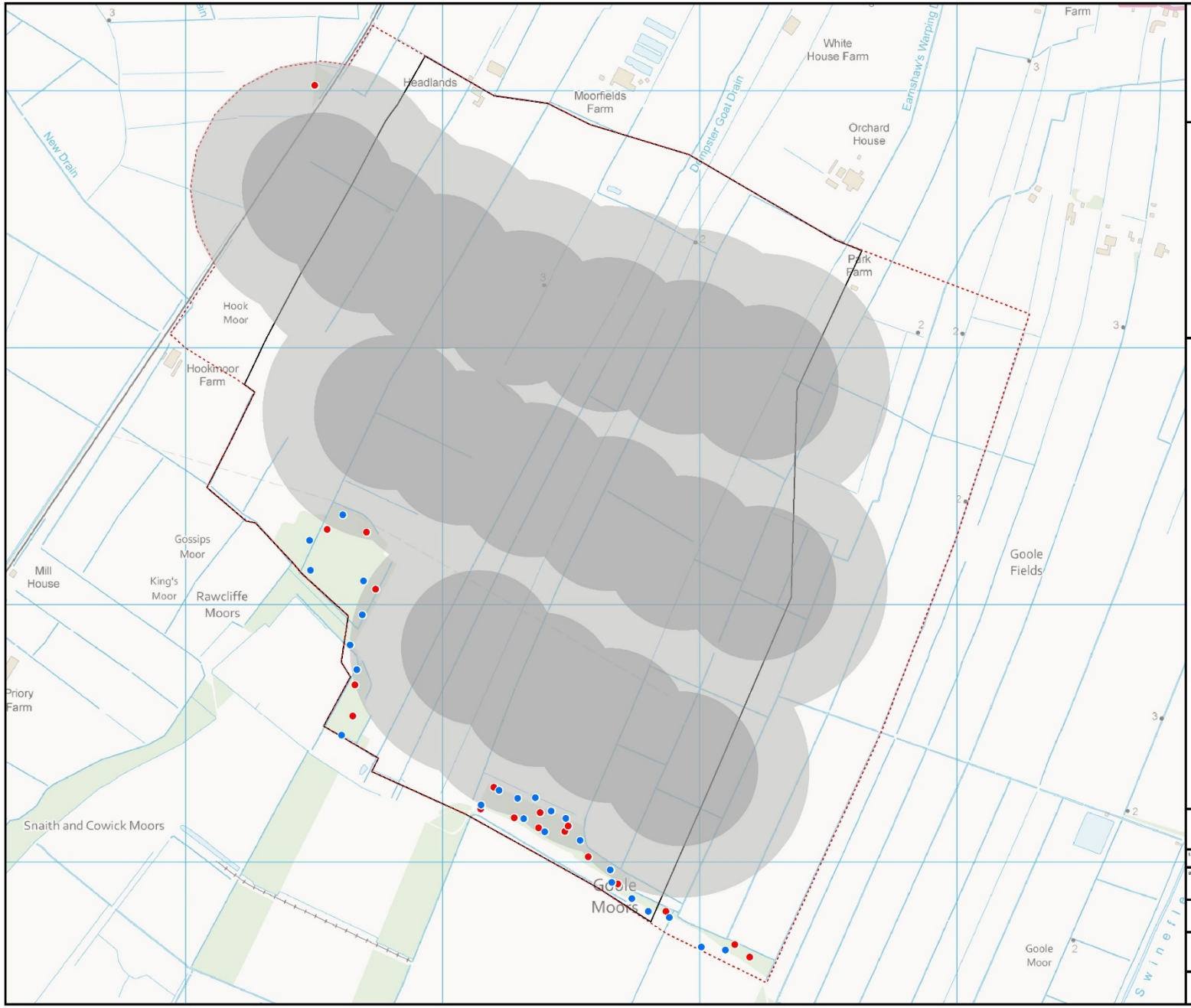

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 5

Distribution of breeding willow warbler in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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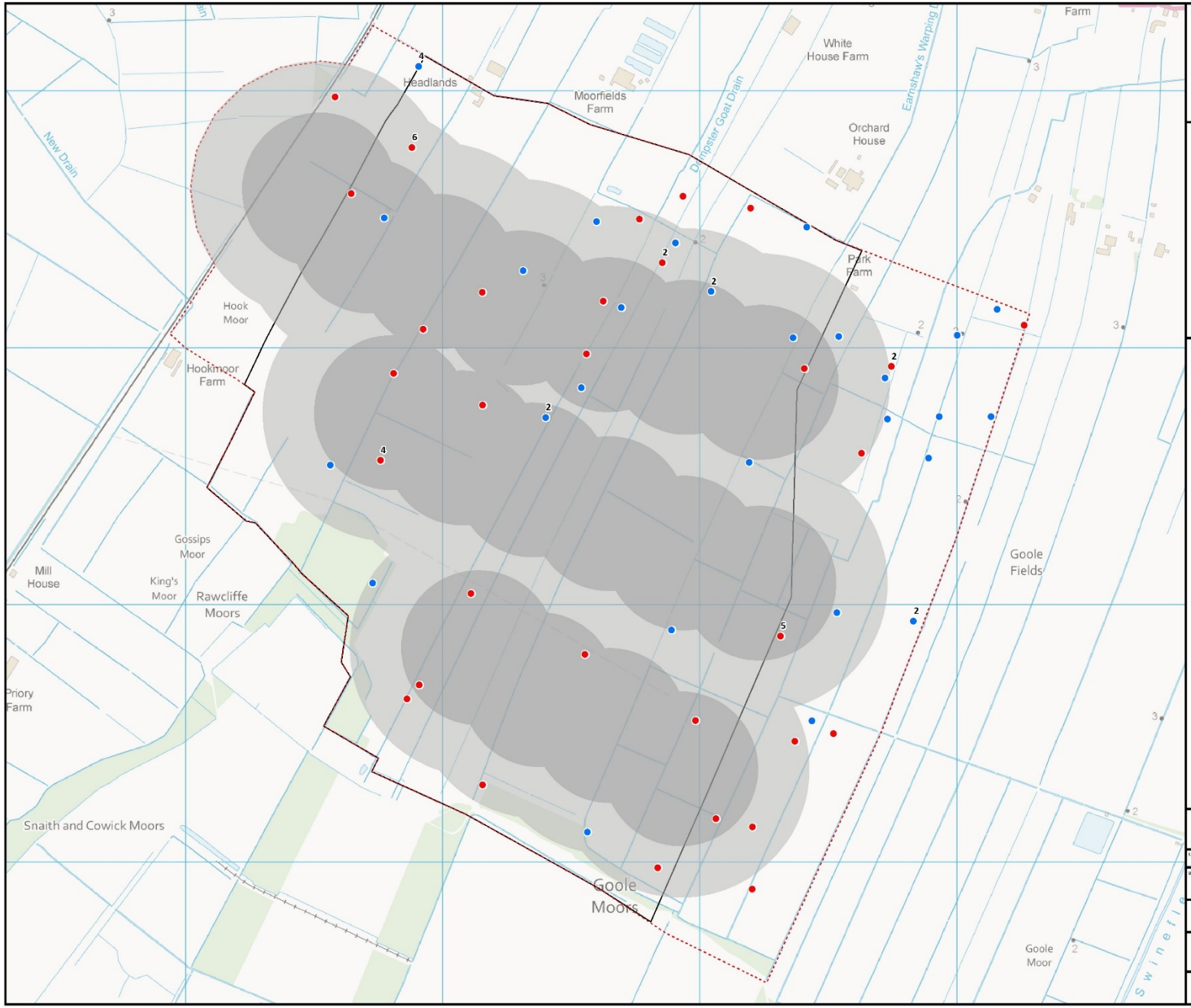

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 6

Distribution of breeding linnet in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

Numbers = multiple pairs at single location

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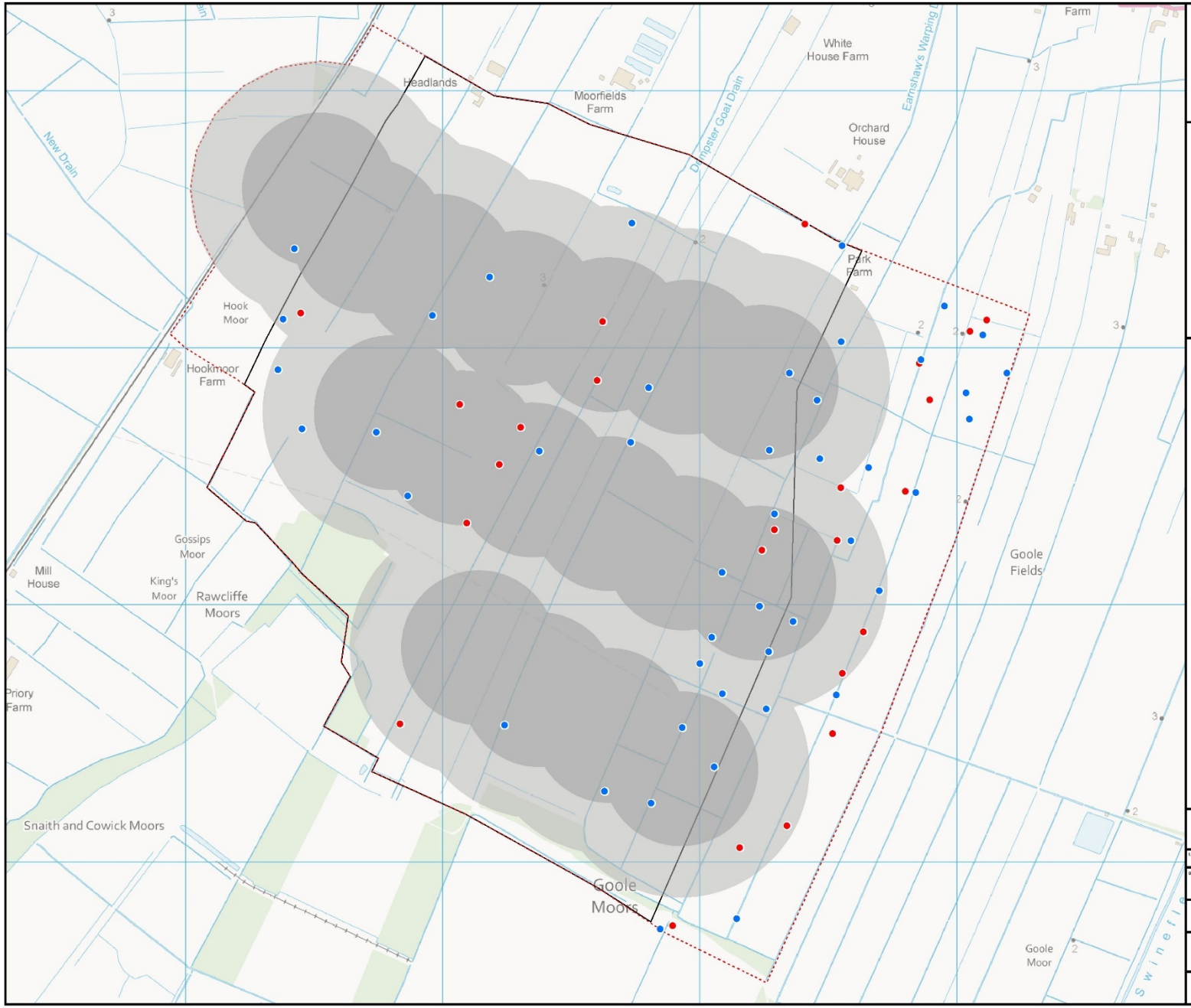

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 7

Distribution of breeding reed bunting in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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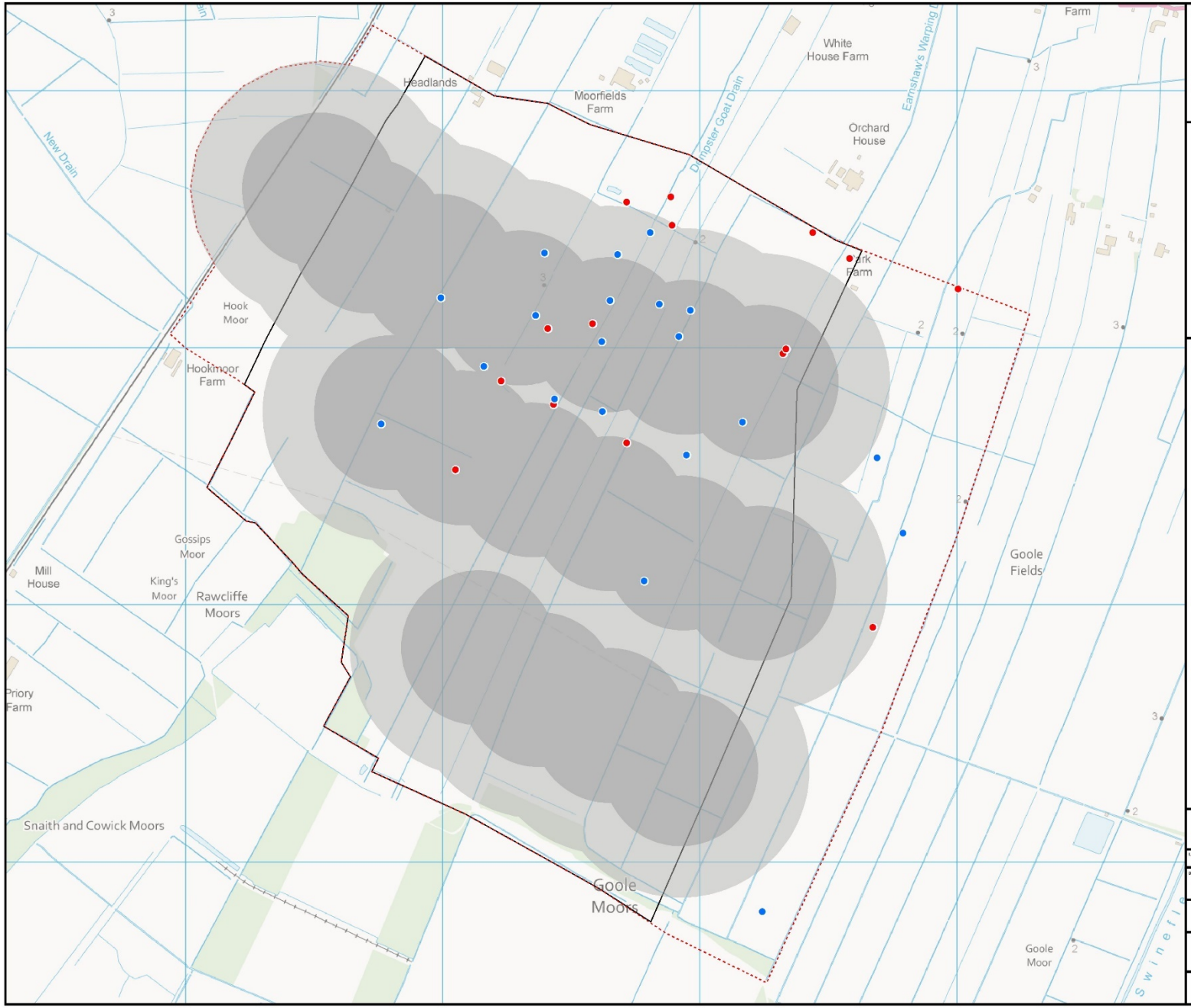

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 8

Distribution of breeding corn bunting in pre-construction (2013) and post- construction (2017) phases

KEY:

Year: approx breeding locations

- 2013
- 2017
- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

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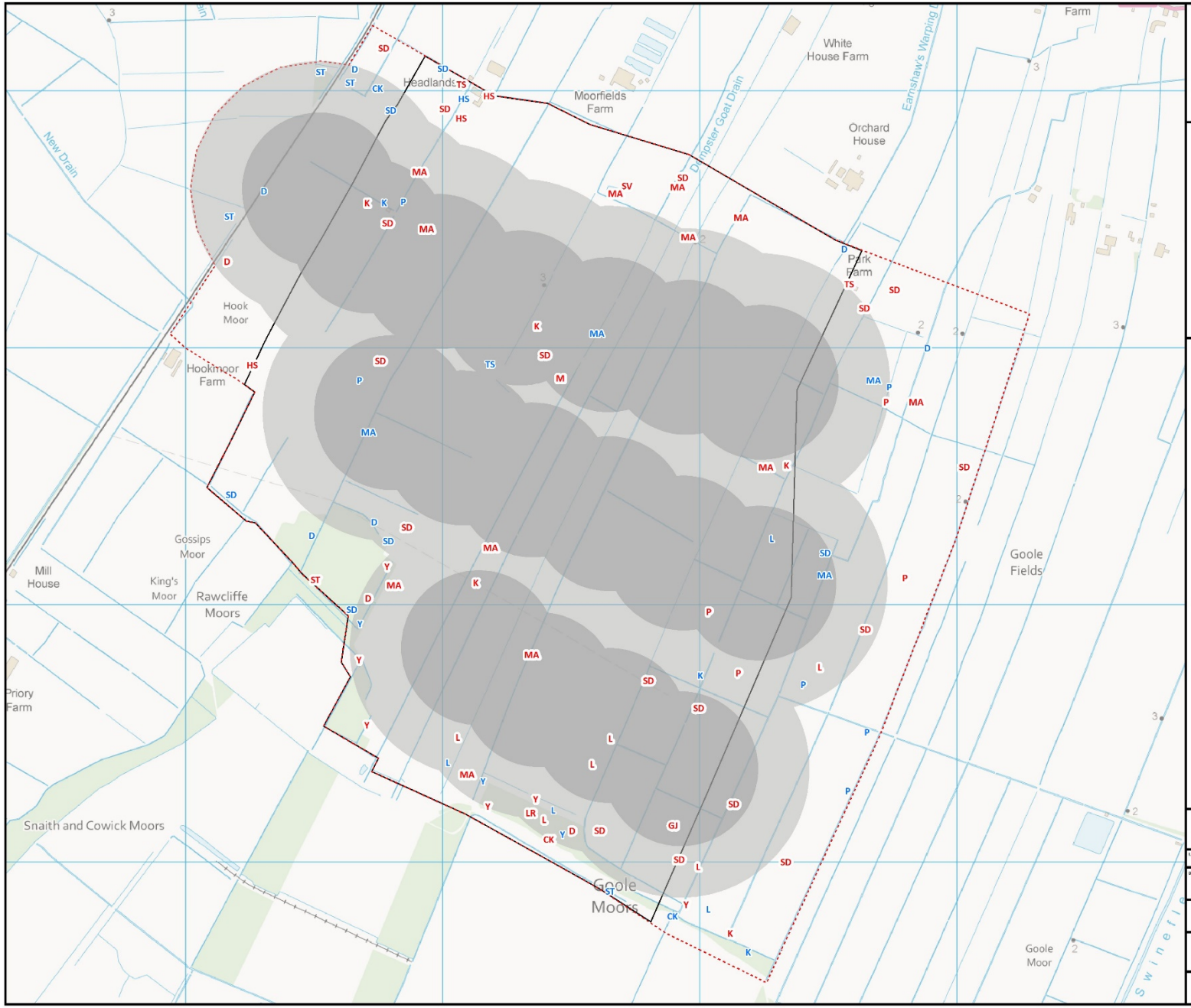

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 9

Distribution of other breeding species in pre-construction (2013) and pre-construction (2017) phases

KEY:

- GF2 monitoring breeding survey area
- GF2 core breeding bird survey area
- GF2 500m buffer
- GF2 300m buffer

GJ - Greylag Goose (red = 2013 blue = 2017)
MA - Mallard
SV - Shoveler
P - Grey Partridge
K - Kestrel
L - Lapwing
SD - Stock Dove
CK - Cuckoo
D - Dunnock
ST - Song Thrush
M - Mistle Thrush
HS - House Sparrow
TS - Tree Sparrow
LR - Lesser Redpoll
Y - Yellowhammer

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Conservation Evaluation of Breeding Birds

15. The conservation importance of the bird populations using the survey area during the breeding season was assessed under the criteria as set out in Table 2. This includes the criteria adopted by Natural England in Guidelines for Selection of Biological SSSIs (JNCC 1995), using 1% of the resource to define international and national importance (Frost et al. 2018). An additional category of regional importance was assigned for species approaching the threshold for national importance and those for which the survey area held a notable concentration in a county context. A further category of 'local importance' was used for species that did not reach regional importance but were still of some ecological value. This included all species on the red or amber lists of the 'Birds of Conservation Concern' (Eaton et al. 2015) that did not reach national or regional importance at the development site. National (GB) and International wintering waterfowl baseline populations have been taken from the most recently published population figures (Frost et al. 2018) from the national Wetland Birds Survey. The national breeding bird populations were taken from Musgrove et al. (2013). In addition, listing on Annex 1 of the EU Birds Directive, Schedule 1 of the Wildlife and Countryside, UK Biodiversity Action Plan [BAP] priority species and local BAP species were all considered in the evaluation process.

Table 2. Definition of terms relating to the sensitivity of the ornithological components of the site.

Sensitivity	Definition
VERY HIGH	Cited interest of SPAs, SACs and SSSIs. Cited means mentioned in the citation text for the site as a species for which the site is designated (SPAs/SACs) or notified (SSSIs).
HIGH	Other species that contribute to the integrity of an SPA or SSSI. A local population of more than 1% of the national population of a species. EU Birds Directive Annex 1, EU Habitats Directive priority habitat/species and/or W&C Act Schedule 1 species. Ecologically sensitive species, e.g. large birds of prey or rare birds (<300 breeding pairs in the UK).
MEDIUM	Regionally important population of a species, either because of population size or distributional context. UK BAP priority species (if not covered above).
LOW	Any other species of conservation interest, e.g. species listed on the Birds of Conservation Concern not covered above. Local BAP species (if not covered above).

16. The conservation importance of the bird populations using the survey area during the breeding season is summarised in Table 3. One very high sensitivity species was breeding in the survey area in all six years, nightjar (an EU Birds Directive Annex 1 species that is a qualifying feature of the adjacent Thorne and Hatfield Moors SPA). Three high sensitivity species have been recorded breeding; quail, hobby and barn owl. One (barn owl) was breeding within 300m of the Goole Fields II wind turbine locations in 2017. All are species specially protected from disturbance under Schedule; 1 of the Wildlife and Countryside Act. Eighteen medium sensitivity species have been recorded breeding in the survey area (all UK BAP priority species), and twelve low sensitivity (red/amber listed Birds of Conservation Concern, Eaton et al. 2015).

Table 3. Conservation evaluation of the breeding bird populations at Goole Fields II, 2008 - 2017.

Species	Breeding pairs within 300m						EU Birds Directive Annex 1	W and C Act Schedule 1	Red[R]/ Amber [A] List	UK BAP priority species	Sensitivity
	2008	2009	2012	2013	2016	2017					
Greylag Goose	0	0	0	2	0	0			A		Low
Shelduck	0	0	0	0	0	0			A		Low
Teal	0	0	0	0	0	0			A		Low
Mallard	6	8	8	2	5	2			A		Low
Shoveler	0	0	0	0	0	0			A		Low
Red-legged Partridge	3	2	0	0	0	2					Nil
Grey Partridge	1	3	2	1	1	2			R	✓	Medium
Quail	0	1	1	1	0	0		✓	A		High
Pheasant	3	4	3	2	5	3					Nil
Sparrowhawk	0	0	0	0	0	0					Nil
Buzzard	0	0	0	0	1	1					Nil
Kestrel	1	1	1	3	1	1			A		Low
Hobby	0	0	0	0	0	0		✓			High
Moorhen	0	2	0	0	0	0					Nil
Lapwing	2	4	3	2	3	1			R	✓	Medium
Redshank	0	0	0	0	1	0			A		Low
Black-headed Gull	0	0	0	0	0	0			A		Low
Feral Pigeon	0	1	0	0	0	0					Nil
Stock Dove	2	13	2	13	2	6			A		Low
Woodpigeon	12	6	0	31	14	1					Nil
Collared Dove	0	0	1	0	0	0					Nil
Cuckoo	0	0	0	0	0	0			R	✓	Medium
Barn Owl	0	1	1	0	0	1		✓			High
Little Owl	0	0	0	0	1	0					Nil
Nightjar	0	0	0	0	0	0	✓		A	✓	Very high
Green Woodpecker	0	0	0	0	0	0					Nil
Great Spotted Woodpecker	0	0	0	0	0	0					Nil
Skylark	71	61	67	64	83	73			R	✓	Medium
Swallow	0	1	3	0	2	0					Nil
Meadow Pipit	18	24	16	26	38	33			A		Low
Yellow Wagtail	28	35	35	38	48	38			R	✓	Medium
Pied Wagtail	0	5	3	5	13	5					Nil
Wren	0	0	0	0	3	3					Nil
Dunnock	0	0	0	0	0	0			A	✓	Medium
Robin	0	0	0	0	0	0					Nil
Blackbird	0	0	0	0	0	1					Nil
Song Thrush	0	0	0	0	0	0			R	✓	Medium
Mistle Thrush	0	0	0	1	0	0			R		Low
Sedge Warbler	0	1	1	0	0	2					Nil
Reed Warbler	0	0	0	0	0	0					Nil
Blackcap	0	0	0	0	0	0					Nil
Garden Warbler	0	0	0	0	0	0					Nil
Whitethroat	10	7	9	8	12	8					Nil
Chiffchaff	0	0	0	0	0	0					Nil
Willow Warbler	0	0	0	0	0	0			A		Low
Goldcrest	0	0	0	0	0	0					Nil
Spotted Flycatcher	0	0	0	0	0	0			R	✓	Medium
Long-tailed Tit	0	0	0	0	0	0					Nil

Species	Breeding pairs within 300m						EU Birds Directive Annex 1	W and C Act Schedule 1	Red[R]/ Amber [A] List	UK BAP priority species	Sensitivity
	2008	2009	2012	2013	2016	2017					
Blue Tit	0	0	0	0	0	0					Nil
Great Tit	0	0	0	0	0	1					Nil
Coal Tit	0	0	0	0	0	0					Nil
Willow Tit	0	0	0	0	1	0			R	✓	Medium
Marsh Tit	0	0	0	0	0	0			R	✓	Medium
Treecreeper	0	0	0	0	0	0					Nil
Jay	0	0	0	0	0	0					Nil
Magpie	0	0	0	0	0	0					Nil
Jackdaw	1	0	0	0	0	0					Nil
Carrion Crow	3	5	3	2	4	4					Nil
Starling	2	0	1	0	0	0			R	✓	Medium
House Sparrow	0	0	0	0	0	0			R	✓	Medium
Tree Sparrow	1	0	0	0	0	1			R	✓	Medium
Chaffinch	0	1	2	0	1	2					Nil
Greenfinch	0	0	0	0	0	0					Nil
Goldfinch	1	3	0	2	1	2					Nil
Linnet	18	7	19	22	12	9			R	✓	Medium
Lesser Redpoll	0	0	0	0	0	0			R	✓	Medium
Yellowhammer	0	4	1	0	0	0			R	✓	Medium
Reed Bunting	5	11	10	8	12	18			A	✓	Medium
Corn Bunting	12	19	10	7	9	12			R	✓	Medium

17. Overall the breeding bird community was very similar in 2017 during the first year of operation to that recorded in all four of the pre-construction survey years (2008, 2009, 2012 and 2013) and during construction in 2016.

18. There has been a continuing increase in scarce breeding species in the wider area around the main survey area, with 8-9 breeding pairs of marsh harrier and increasing common crane activity. Three pairs of the latter species were recorded in 2017, which were birds from the small breeding population that has recently become established on Thorne and Hatfield Moors (Stanbury et al. 2011, Stanbury and Sills 2012, Holling et al. 2017).

Wintering Bird Survey 2017-18 Methods

19. The aim of the winter field survey work was to obtain data on the importance of the wind farm site and its surrounds outside the breeding season, and on the feeding areas of potentially sensitive species.

20. The surveys comprised a field survey based on a simple 'look-see' method, counting the bird numbers within a pre-defined survey area (Gilbert et al. 1998). The wintering bird survey area was chosen to include all areas within the potential zone of ornithological influence of the proposed wind farm. This included the wind farm site, plus a 1km buffer around this where access/viewing was possible. This distance was chosen as it exceeds the greatest distance at which wintering birds have been shown in any reliable studies to be affected by existing wind farms; 600m (Percival 2005, Drewitt and Langston 2006). This survey area covered a total area of 10.9km^2. It is predominantly open arable farmland, with the southern edge including part of the old peat workings of Thorne Moors. The analysis for the post-construction phase monitoring presented in this report has focussed on the core part of that survey area that was covered in all of the surveys years, and also excluded areas that were closer to the Goole

Fields 1 wind farm than Goole Fields II (and hence more likely to be affected by that site). This core area covered 6.3km^2 of arable land. Its extent is shown in Figure 1.

21. The survey work comprised regular counts of the birds within the wintering bird survey area (covering the wind farm site and an additional buffer zone of 1km around that). Fourteen of these surveys were undertaken at approximately fortnightly intervals between September 2017 and March 2018. The counts were carried out as instantaneous counts, recording a snapshot of the birds present in each field at the time it was surveyed. One such count of each field was made each survey day, recording the numbers of all the key species present. Any additional records made outside this time were noted as supplementary records. These snapshot counts were organised to ensure that the full range of times of day were covered in each part of the survey area. The following species were recorded:

    - All ducks, geese, swans, cormorants, herons, coot and grebes;
    - All waders (including lapwing and golden plover);
    - All birds of prey and owls;
    - Large flocks (>100 birds) of other species (except woodpigeon and rook);
    - Any other notable species.

22. As well as counting each species, the behaviour of each flock was also recorded, e.g. feeding/roosting. Birds in flight over-flying the field during the snapshot were also recorded, together with an estimate their height and direction.

23. Additional counts were also made of the HMP Site during September - March 2017-18, to provide information on any changes in bird numbers using this area in relation to the results of the post-construction phase wind farm surveys.

24. **Vantage point surveys**: these were carried out to quantify the numbers that may be at risk of collision with the wind turbines, or that may be disrupted by the presence of the wind farm. A vantage point was selected to observe bird movements through the wind farm site and its surrounds (at SE 730 193), the same VP as used for the previous surveys. The vantage point survey methodology followed the same standard SNH-recommended survey method (Madders, in Whitfield et al. 2010 and SNH 2014) as used in the pre-construction surveys. That methodology was refined to record flight height estimates as accurately as possible rather than just summarising them to height classes. Target species for these surveys were the same as those listed above for the field counts. All target species flight lines were mapped, and the flight height of each flock recorded. When birds were observed over an extended period, estimates of flight height were recorded every minute. The activity during each flight (e.g. flying to roost, foraging) was also recorded. Overall a total of 72 hours of vantage point surveys were carried out (36 hours during autumn, Sep-Nov, and 36 hours during winter, Dec-March), with the timing of these observations made to cover dawn/dusk roost flights as well as general daytime movements.

25. **Habitat/crop mapping**: mapping of the habitats and crop types available in the survey area was carried out during the first visit and then again at approximately 2-month intervals through the season, so that habitat availability could be determined and any changes during the study period taken into account.

26. **Weather**: weather conditions during all observations were recorded, and visits were made to cover a representative range of visibilities, wind speeds and directions (though avoiding extreme conditions where visibility is severely limited (i.e. fog, continuous heavy rain)).

27. **Nocturnal survey**: seven night surveys were carried out to provide additional information on bird activity in the survey area at night. During each night visit the fields around the potential wind farm site were surveyed using an image intensifier, using an infra-red lamp to assist viewing without disturbing the birds (Gillings 2003). The survey method was essentially the same as that used during the daylight field surveys, instantaneous counts of bird numbers in each field, recording also the behaviour of each flock seen and any flying birds. This covered a range of moon conditions, including bright moonlight under the full moon. Limitations to the visibility distance (usually up to 300m) and Health and Safety considerations meant that it was not possible to cover the whole survey area but the aim was rather to sample the wind farm site and any areas that might hold higher numbers of birds at night. A total of 22 points were surveyed on each visit, giving coverage of approximately 35% of the wintering bird survey area. Night surveys, following same methodology, were also undertaken on the HMP area.

28. **Collision searching**: the collision monitoring methodology followed that developed in the USA for bird collision monitoring at wind farms (Morrison 1998) and that adopted by SNH (2009). A core area of 130m radius around each turbine was carefully searched on foot. The 130m distance has been adopted from NE guidance (which recommends that the search distance should be equivalent to the height to tip of the turbines (Drewitt 2010). Sectors around the turbine were searched slowly, taking particular care to search any taller clumps of vegetation, and openings of animal burrows. In addition, a further area 250m around each turbine was checked for larger bird carcasses by scanning the ground with binoculars. The precise location of any dead birds found was recorded and mapped (by reference to the distance and direction to the nearest wind turbine, and using a GPS). Searches were carried out weekly through the September 2017 – March 2018 survey period (28 surveys in total), with all turbines checked on all surveys. All carcasses were photographed, and their details recorded as follows; species, sex, age, date and time collected, location, distance (measured by laser rangefinder) and direction (degrees) to nearest turbine, condition, and any comments regarding possible causes of death. The condition of each carcass found was recorded using the following condition categories:

    - Intact - carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.

    - Scavenged - entire carcass that shows signs of being fed upon by a predator or scavenger or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, legs, pieces of skin, etc.).

    - Feather Spot - 10 or more feathers at one location indicating predation or scavenging.

29. Carcasses were left in situ in order to provide further information on decay rates and detectability.

30. **Sampling validation – search efficiency and scavenger removal**: as there were only a small number of dead birds found during the collision searches in 2017-18, these were supplemented by a sample of birds shot by a gamekeeper to study the rate of carcass removal and to test observer search efficiency. The main trial commenced on 8/11/17, with 33 carcasses (11 jackdaws, 9 rooks and 13 woodpigeons) scattered within the search areas

around the wind turbines and recorded as part of the corpse monitoring. All were intact whole carcasses.

31. Further investigation of scavenger removal of carcasses was undertaken using automated trail cameras, in a study linked with work on the adjacent Goole Fields 1 wind farm. A total of 20 carcasses (9 pheasants, 2 carrion crows, 2 rooks, 2 jackdaws, 3 woodpigeons, a red-legged partridge and a starling) were put out at Goole Fields II during November-March, and monitored using a trail camera until the carcass disappeared.

32. The agreed Goole Fields II Bird Monitoring Programme set out that an adaptive strategy would be implemented for the collision monitoring, informed by the findings of the collision monitoring programme at the adjacent Goole Fields Wind Farm. The results from that and from the Goole II collision monitoring are being reviewed annually to determine whether further surveys would be likely to contribute further useful scientific knowledge. That review forms part of this report.

Analysis Methods: Effects of the Wind Farm Operation on Wintering Birds

Disturbance – Effect on Bird Use of Terrestrial Habitats within Survey Area

33. An initial analysis was carried out to compare the wintering bird numbers within the 600m potential disturbance zone during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phase (2015-16 and 2016-17) and post-construction (2017-18) surveys.

34. Further analysis was undertaken to examine field use by key species (for which there were sufficient numbers in the survey area for that analysis to be meaningful) in relation to proximity to the construction site (for both construction winters). This main analysis took the form of a gradient analysis for each construction year to determine whether bird density was related to distance from the development (as well as taking into account other factors including crop and field size).

35. The field count data were used to estimate number of bird-days in each field in each winter (the mean count multiplied by the length of the Sep-Mar survey period; 212 days), which was converted to density to standardise for field area. This bird density value was used as the response variable in the further analysis. This was then analysed in relation to the following explanatory variables:

- Field crop;
- Field size;
- Distance of field (central point) to nearest part of wind farm.

Disturbance – Flights

36. Further analysis was undertaken to determine whether key species flight activity (again focussing on the key species for which there was sufficient numbers to draw meaningful conclusions) was related to distance from the wind turbines in 2017-18. The flight lines recorded during the VP surveys were analysed using GIS (ArcGIS) to determine the length of flights in 100m bands from the turbines and hence flight density (length of track recorded per unit area), for flights within 2km of the vantage point (the SNH-recommended viewing distance, SNH 2014).

Collision Risk

37. The predicted collision rates from the precautionary ES collision risk modelling were compared with the actual numbers of collisions observed during the monitoring, including allowance for observer search efficiency, scavenger removal and survey effective coverage.

Wintering Bird Survey Results

Core Survey Area Wintering Bird Total Counts

38. The wintering bird populations recorded within the core survey area (see Figure 10) during the pre-construction and construction phase field surveys are summarised in Tables 4 (mean counts) and 5 (peak counts).

Table 4. Wintering bird populations recorded in the Goole Fields II core survey area field counts during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction (2015-16 and 2016-17) and post-construction phases (2017-18): mean counts within the core survey area (covered in all survey years; n=14 surveys in each winter).

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Mute Swan	0	0.3	0	0.3	0	0	0	0
Whooper Swan	0.1	0	0	0.1	0	0	0	0
Pink-footed Goose	0	13.6	92.9	0	6.9	77.4	175.1	36.0
White-fronted Goose	0	0	0	0	0.1	0	0	0
Greylag Goose	4.6	0	9.4	0.1	4.9	1.7	3.1	9.1
Canada Goose	0	0	0	0	0.3	0.1	0	0
Shelduck	0	0	0	0	0	0	0	0.4
Teal	0.6	0	0	0	0.1	0	0	0
Mallard	3.2	1.9	1.6	4.6	0.4	0.6	1.8	12.4
Shoveler	0	0	0	0	0	0	0	0.3
Little Grebe	0	0.2	0	0	0	0	0	0
Cormorant	0.1	0	0	0	0	0.4	0.1	0.1
Little Egret	0	0	0	0	0	0	0.1	1.1
Grey Heron	0.2	0.5	0.2	0.2	0.2	0.2	0.1	0.1
Marsh Harrier	0	0.1	0.1	0.1	0.8	0.4	0.3	0.4
Hen Harrier	0	0	0.1	0	0.1	0.1	0	0
Sparrowhawk	0.2	0	0.2	0.1	0.1	0.1	0	0.1

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Buzzard	0	0	0.2	0.9	2.1	1.0	0.8	1.1
Kestrel	0.9	1.3	1.4	3.6	1.6	1.2	1.9	2.1
Merlin	0	0	0	0	0.2	0	0.2	0.1
Hobby	0	0	0	0.2	0	0	0	0
Peregrine	0.1	0.1	0.2	0.3	0.3	0.2	0	0.3
Common Crane	0	0	0	0.3	0	0.1	0.9	0
Golden Plover	40.8	29.4	25.9	26.4	111.6	13.2	39.2	18.3
Lapwing	12.9	32.7	0	44.4	16.7	3.6	3.9	6.0
Jack Snipe	0	0	0	0.1	0	0	0	0
Snipe	0	0	0	0	0	0	0.1	0.1
Woodcock	0	0	0	0	0.1	0	0	0
Green Sandpiper	0	0	0	0	0	0	0	0.2
Redshank	0	0	0	0	0	0	0.4	0.3
Mediterranean Gull	0	0	0	0.1	0	0	0	0
Common Gull	29.2	33.8	36.1	89.6	19.4	32.3	31.4	29.6
Caspian Gull	0	0	0	0.1	0	0.1	0.1	0.4
Lesser Black-backed Gull	1.9	6.1	5.6	44.9	1.4	54.4	34.1	47.8
Yellow-legged Gull	0	0.4	0	1.3	0.4	3.6	2.5	2.1
Herring Gull	3.9	4.1	0.9	1.4	2.0	2.9	6.4	3.8
Great Black-backed Gull	0.2	0.6	0.4	0.1	0.1	0.4	0.9	0.4
Black-headed Gull	13.5	105.4	28.6	207.6	93.7	107.9	92.2	67.5
Barn Owl	0	0.1	0	0	0.1	0.1	0	0
Little Owl	0	0.1	0.1	0.1	0.1	0.3	0.2	0.1

Table 5. Wintering bird populations recorded in the Goole Fields II core survey area field counts during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction (2015-16 and 2016-17) and post-construction phases (2017-18: peak counts within the core survey area (covered in all survey years; n=14 surveys in each winter).

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Mute Swan	0	2	0	4	0	0	0	0
Whooper Swan	1	0	0	2	0	0	0	0
Pink-footed Goose	0	190	1300	0	81	581	977	504
White-fronted Goose	0	0	0	0	1	0	0	0
Greylag Goose	60	0	131	2	53	22	44	91
Canada Goose	0	0	0	0	3	2	0	0
Shelduck	0	0	0	0	0	0	0	3
Teal	4	0	0	0	2	0	0	0
Mallard	18	8	15	39	2	4	12	157
Shoveler	0	0	0	0	0	0	0	4
Little Grebe	0	3	0	0	0	0	0	0
Cormorant	1	0	0	0	0	5	1	1
Little Egret	0	0	0	0	0	0	1	15
Grey Heron	1	3	2	2	1	1	1	1
Marsh Harrier	0	1	1	1	6	2	1	4
Hen Harrier	0	0	1	0	1	1	0	0

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Sparrowhawk	1	0	1	1	1	1	0	1
Buzzard	0	0	1	4	6	3	3	4
Kestrel	2	3	5	7	5	3	6	7
Merlin	0	0	0	0	1	0	2	1
Hobby	0	0	0	3	0	0	0	0
Peregrine	1	1	2	2	2	2	0	3
Common Crane	0	0	0	4	0	2	6	0
Golden Plover	130	344	204	237	760	38	480	56
Lapwing	91	347	0	446	165	46	45	62
Jack Snipe	0	0	0	1	0	0	0	0
Snipe	0	0	0	0	0	0	2	1
Woodcock	0	0	0	0	1	0	0	0
Green Sandpiper	0	0	0	0	0	0	0	3
Redshank	0	0	0	0	0	0	6	4
Mediterranean Gull	0	0	0	1	0	0	0	0
Common Gull	110	178	195	387	75	85	145	168
Caspian Gull	0	0	0	1	0	1	1	3
Lesser Black-backed Gull	19	49	58	470	13	280	320	404
Yellow-legged Gull	0	4	0	10	4	17	23	18
Herring Gull	30	53	8	15	8	14	75	27
Great Black-backed Gull	2	8	3	2	1	2	6	3
Black-headed Gull	65	838	146	908	765	595	312	497
Barn Owl	0	1	0	0	1	1	0	0
Little Owl	0	2	1	1	1	2	1	1
Mute Swan	0	2	0	4	0	0	0	0

Night Surveys

39. A total of seven night surveys were undertaken during each winter. The target species recorded are summarised in Tables 6 and 7 which given the mean and peak counts recorded respectively.

40. The species found active feeding at night most frequently was golden plover, with lapwing also frequently encountered. Numbers of both these species seen at night were comparable, and in some years exceeded, those recorded during the day (including, for golden plover, in 2017-18). Pink-footed geese were seen on several occasions during these night surveys. Other SPA species seen at night included wigeon, teal and mallard, but generally only in small numbers.

Table 6. Mean nocturnal bird survey totals recorded at Goole Fields II during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction (2015-16 and 2016-17) and post-construction phases (2017-18); n=7 surveys in each winter.

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Pink-footed Goose	0	0	0.7	0	10.9	48.7	3.7	0.6
Greylag Goose	0	23.9	2.3	41.0	30.3	56.7	3.4	1.0
Canada Goose	0	0	18.6	2.3	29.6	0	0.7	0
Wigeon	0	0	0	0.1	49.9	4.6	7.1	0
Teal	0.8	0	0.3	0	0	0.1	0	0
Mallard	1.2	0	3.6	2.7	2.3	1.3	0.7	13.0
Buzzard	0	0	0	0	0	0.1	0	0
Kestrel	0	0	0	0	0	0.1	0.1	0
Ringed Plover	0	0	0	0	1.1	0	0	0
Golden Plover	26.7	8.1	96.7	93.0	223.7	100.1	53.6	89.0
Lapwing	8.5	4.7	8.7	8.0	35.4	34.4	16.3	2.6
Jack Snipe	0	0	0	0	0	0.1	0	0
Snipe	0.7	0	0	0.1	0.6	0.4	0.4	0.7
Woodcock	0	0.3	0.4	0.3	1.0	3.3	0.6	0
Black-tailed Godwit	0	0	0	0	0	0	0	0
Green Sandpiper	0	0	0	0	0.1	0	0	0
Redshank	0	0	0	0	0.1	0	0	0
Common Gull	0	0	0	0.1	0	0	0	0
Lesser Black-backed Gull	0	0	0	0	0	0	0.3	0
Herring Gull	4.3	0	0	0	0	0	0.1	0
Great Black-backed Gull	0.2	0	0	0	0	0	0	0
Barn Owl	0.3	0	0	0.1	0.1	0.4	0.9	1.0
Little Owl	0	0.4	1.3	1.4	0.3	0.6	0.1	0.6
Tawny Owl	0	0	0.3	0.3	0.1	0.3	1.0	0.1
Long-eared Owl	0	0.3	0.1	0	0	0	0	0
Short-eared Owl	0	0	0.4	0.3	0	0	0	0

Table 7. Peak nocturnal bird survey totals recorded at Goole Fields II during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction (2015-16 and 2016-17) and post-construction phases (2017-18); n=7 surveys in each winter.

2017-18Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Pink-footed Goose	0	0	5	0	76	310	26	2
Greylag Goose	0	130	10	165	130	394	9	5
Canada Goose	0	0	80	14	130	0	5	0
Wigeon	0	0	0	1	343	32	48	0
Teal	5	0	2	0	0	1	0	0
Mallard	4	0	6	8	10	4	3	85
Buzzard	0	0	0	0	0	1	0	0
Kestrel	0	0	0	0	0	1	1	0
Ringed Plover	0	0	0	0	8	0	0	0

2017-18Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Golden Plover	51	23	173	258	1163	180	215	307
Lapwing	30	24	37	35	136	204	84	12
Jack Snipe	0	0	0	0	0	1	0	0
Snipe	3	0	0	1	3	2	2	5
Woodcock	0	2	2	1	3	8	3	0
Black-tailed Godwit	0	0	0	0	0	0	0	0
Green Sandpiper	0	0	0	0	1	0	0	0
Redshank	0	0	0	0	1	0	0	0
Common Gull	0	0	0	1	0	0	0	0
Lesser Black-backed Gull	0	0	0	0	0	0	2	0
Herring Gull	26	0	0	0	0	0	1	0
Great Black-backed Gull	1	0	0	0	0	0	0	0
Barn Owl	1	0	0	1	1	1	3	3
Little Owl	0	2	3	4	1	1	1	2
Tawny Owl	0	0	1	1	1	1	4	1
Long-eared Owl	0	1	1	0	0	0	0	0
Short-eared Owl	0	0	1	1	0	0	0	0

Bird Flight Rates over the Wind Farm Site

41. The observed bird flight rates over the survey area are summarised in Table 8, which gives the mean over-flying rate per hour during the September 2017 –March 2018 survey period. This includes all the observations of target species flying over the wind farm site and its surrounds. The Table also gives the percentage of flights of each species that were recorded at rotor height (taken conservatively as 21-150m above ground level to allow for errors in flight height estimation and maintain consistency with the pre-construction baseline; the actual rotor height is 33-125m).

Table 8. Bird flight rates recorded over the Goole Fields II wintering bird survey area during September 2017– March 2018 vantage point surveys. N = 72 hours total observation from the single vantage point.

Species	Flight rate (no birds/hr)	Total no. flocks	% flocks at rotor height
Whooper Swan	0.6	4	100%
Pink-footed Goose	328.4	83	72%
Greylag Goose	3.7	34	62%
Canada Goose	1.8	6	67%
Teal	0.03	1	100%
Mallard	0.5	9	67%
Cormorant	0.03	2	100%
Grey Heron	0.06	4	25%
Marsh Harrier	1.3	79	58%
Hen Harrier	0.04	3	0%
Sparrowhawk	0.07	4	50%

Species	Flight rate (no birds/hr)	Total no. flocks	% flocks at rotor height
Buzzard	0.6	43	56%
Kestrel	1.6	112	3%
Merlin	0.04	3	33%
Peregrine	0.1	9	33%
Common Crane	0.3	9	33%
Golden Plover	7.6	12	75%
Lapwing	19.5	20	55%
Curlew	0.01	1	100%
Redshank	0.01	1	100%
Common Gull	17.6	105	24%
Caspian Gull	0.04	3	33%
Lesser Black-backed Gull	45.3	118	49%
Yellow-legged Gull	1.7	50	54%
Herring Gull	2.5	62	66%
Great Black-backed Gull	1.3	26	69%
Black-headed Gull	62.1	75	33%
Barn Owl	0.01	1	0%

Habitats/crop availability within the survey area

42. The survey area was predominantly arable farmland. The areas of each of the main crops within the core survey area in each winter is summarised in Table 9. Winter cereals (predominantly wheat with a small area of barley) were the more widespread crops, with rape, potatoes, sugar beet, linseed and peas also grown. There was little variation in the crops grown over the survey years, with no clear trends apparent.

Table 9. Areas of crop/habitat types within the Goole Fields wintering bird survey area, 2007-08 - 2017-18.

Crop	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Winter cereal	52%	69%	45%	70%	43%	63%	50%	54%
Rape	12%	2%	11%	5%	16%	12%	17%	11%
Potatoes	6%	8%	6%	6%	8%	6%	2%	4%
Sugar beet	7%	2%	2%	4%	3%	8%	7%	9%
Plough	24%	19%	36%	13%	29%	7%	20%	18%
Other	0%	0%	1%	1%	1%	4%	4%	3%

Key Species Use of Refuge Area

43. The results of the field count surveys of the HMP Site (i.e. the refuge area) are summarised in Table 10, which gives the mean and peak counts recorded over the three years in which surveys have been undertaken (2014-15, 2015-16, 2016-17 and 2017-18). Table 11 gives the mean and peak counts from the night surveys of the refuge over the same period.

Table 10. Annual mean and peak counts recorded in the HMP Site, 2014-15, 2015-16, 2016-17 and 2017-18: daylight counts

Species	Annual mean count	Annual peak count

	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18
Mute Swan	0.0	9.8	0.0	0.0	0	30	0	0
Whooper Swan	0.0	0.3	0.0	0.1	0	4	0	2
Bean Goose	0.0	0.0	0.0	0.1	0	0	0	1
Pink-footed Goose	0.4	0.0	6.4	183.6	5	0	77	1206
Greylag Goose	11.1	29.9	41.6	96.1	97	263	454	365
Canada Goose	0.0	0.0	5.2	1.9	0	0	73	13
Barnacle Goose	0.0	2.6	0.0	0.0	0	36	0	0
Teal	0.1	0.0	0.6	0.7	2	0	8	10
Mallard	0.0	0.0	0.2	0.6	0	0	3	6
Cormorant	0.0	0.0	0.0	0.1	0	0	0	2
Little Egret	0.0	0.0	0.1	0.0	0	0	1	0
Grey Heron	0.1	0.1	0.4	0.1	1	1	3	1
Marsh Harrier	1.8	1.4	1.4	1.1	7	7	3	3
Hen Harrier	0.0	0.1	0.0	0.0	0	1	0	0
Sparrowhawk	0.0	0.1	0.1	0.0	0	1	1	0
Buzzard	0.3	0.0	0.1	0.2	2	0	1	2
Kestrel	1.2	0.3	1.1	0.3	4	1	3	1
Merlin	0.0	0.1	0.0	0.1	0	1	0	1
Peregrine	0.2	0.0	0.1	0.1	2	0	1	1
Golden Plover	18.9	0.0	134.7	19.4	138	0	860	170
Lapwing	139.4	0.1	275.4	1.4	1950	2	2550	19
Dunlin	1.6	0.0	9.6	0.0	22	0	86	0
Ruff	0.0	0.0	2.2	0.7	0	0	27	10
Redshank	0.1	0.1	0.2	0.1	1	1	2	2
Common Gull	0.9	0.0	1.9	0.6	8	0	17	9
Lesser Black-backed Gull	0.1	0.0	0.0	0.0	1	0	0	0
Herring Gull	0.3	0.0	0.0	0.0	2	0	0	0
Great Black-backed Gull	0.0	0.0	0.0	0.1	0	0	0	1
Black-headed Gull	0.1	0.0	0.1	0.0	2	0	1	0
Barn Owl	0.0	0.1	0.0	0.1	0	1	0	2

Table 11. Annual mean and peak counts recorded in the HMP Site, 2014-15, 2015-16, 2016-17 and 2017-18: nocturnal counts

	Annual mean count				Annual peak count			
Species	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Pink-footed Goose	0	0	0.1	0	0	0	1	0
Greylag Goose	0	0	0.3	0	0	0	2	0
Shelduck	0	0	0.1	0	0	0	1	0
Wigeon	0	0.3	1.0	0	0	2	7	0
Golden Plover	2. 7	0.4	0	0.6	15	3	0	4
Lapwing	41.0	7.3	1.4	0.1	243	50	6	1
Snipe	0.2	0	0	0	1	0	0	0
Barn Owl	0	0.4	0	0	0	2	0	0
Tawny Owl	0	0.1	0.1	0	0	1	1	0

44. All five of the HMP key species have been recorded using the HMP Site over the four survey years (marsh harrier, hen harrier, golden plover, lapwing and pink-footed goose). Numbers of most of these species have, however, been highly variable between years, particularly lower numbers of golden plover and lapwing in 2015-16. This was coincident with the whole of the

HMP area being under rape in that winter (it was all winter wheat in the three other survey years). Number of pink-footed geese have been low in all three years but more were recorded in 2017-18. The area has held high numbers of greylag geese throughout. Apart from a single larger flock of lapwing in 2014-15, only low numbers of all key species have been recorded on the refuge during the night surveys.

Conservation Evaluation of Wintering Bird Populations

45. The sensitivity of the non-breeding bird populations was determined using the criteria specified in Table 2 above (from Percival 2007). The conservation value of the non-breeding bird populations observed at Goole Fields during all of the surveys to date has been summarised in Table 12. This included:

- Twelve very high sensitivity species (Humber SPA qualifying/assemblage species): pink-footed goose, shelduck, wigeon, teal, mallard, cormorant, marsh harrier, hen harrier, ringed plover, golden plover, lapwing and redshank;
- Eight high sensitivity species (through their listing on Annex 1 of the Birds Directive and/or Schedule 1 of the Wildlife and Countryside Act);
- Two medium sensitivity species (one, long-eared owl, present in regionally important numbers and one, herring gull, a UK BAP priority species); and
- Fourteen low sensitivity species (Birds of Conservation Concern red/amber species).

Table 12. Conservation evaluation of the non-breeding bird populations in the Goole Fields II core survey area, 2007 - 2018. SPA species: Q = qualifying species, A = assemblage species.

Species	Mean peak annual count	SPA species	>1% regional population (core survey area)	EU Birds Directive Annex 1	W and C Act Schedule 1	Red [R]/ Amber [A] List	Sensitivity
Mute Swan	1					A	Low
Whooper Swan	0.4			✓	✓	A	High
Pink-footed Goose	454	(Q)*	✓			A	Very high
White-fronted Goose	0.1					R	Low
Greylag Goose	143					A	Low
Canada Goose	29						Nil
Shelduck	0.5	Q				A	Very high
Wigeon	53	A				A	Very high
Teal	1	A				A	Very high
Mallard	33	A				A	Very high
Shoveler	1					A	Low
Little Grebe	0.4						Nil
Cormorant	1	A					Very high
Little Egret	2			✓			High
Grey Heron	2						Nil
Marsh Harrier	2	Q	✓	✓	✓	A	Very high
Hen Harrier	0.4	Q	✓	✓	✓	R	Very high
Sparrowhawk	1						Nil
Buzzard	3						Nil
Kestrel	5					A	Low

Species	Mean peak annual count	SPA species	>1% regional population (core survey area)	EU Birds Directive Annex 1	W and C Act Schedule 1	Red [R]/ Amber [A] List	Sensitivity
Merlin	1		✓	✓	✓	R	High
Hobby	0.4		✓		✓		High
Peregrine	2		✓	✓	✓		High
Common Crane	2		✓	✓		A	High
Ringed Plover	1	A				R	Very high
Golden Plover	383	Q	✓	✓			Very high
Lapwing	180	A	✓			R	Very high‡
Jack Snipe	0.3						Nil
Snipe	2					A	Low
Woodcock	2					R	Low
Green Sandpiper	0.5						Nil
Redshank	1	Q				A	Very high
Mediterranean Gull	0.1			✓	✓	A	High
Common Gull	168		✓			A	Low
Caspian Gull	1		✓			A	Low
Lesser Black-backed Gull	202		✓			A	Low
Yellow-legged Gull	10		✓			A	Low
Herring Gull	29					R	Medium‡
Great Black-backed Gull	3					A	Low
Black-headed Gull	516		✓			A	Low
Barn Owl	1				✓		High
Little Owl	2						Nil
Tawny Owl	1					A	Low
Long-eared Owl	0.3		✓				Medium
Short-eared Owl	0.3		✓	✓		A	High

* *on basis of current numbers recorded on the SPA – not mentioned though on SPA Review citation as qualifying or assemblage species.*
‡ *UK BAP priority species.*

Pink-footed geese

46. Pink-footed goose is not specifically listed on the SPA review citation for the Humber Estuary as either a qualifying or an assemblage species, though the numbers recorded there recently are sufficient to reach the threshold for a qualifying species. Recent counts from the SPA show that the pink-footed goose population has returned to international importance, with a peak of 7,200 counted there during 2012-13 (Mitchell 2013), 10,580 in 2013-14, 14,900 in 2014-15, 12,922 in 2015-16 (Mitchell 2016) and 15,400 in 2016-17 (Mitchell and Brides 2017). The threshold for international importance (and hence qualifying as an SPA population) is currently 3,500. Therefore, it has been treated here as a very high sensitivity SPA species.

47. Pink-footed goose flocks were only occasionally recorded feeding within the survey area in the pre-construction surveys, though did include some larger flocks (peak 1,300). Records of flocks feeding in the survey area at night were rare, with only four in total (peak count 290). Pink-footed geese were seen more frequently during the two construction phases and the first post-construction winters, with higher mean counts in those years. Numbers were high again in the first post-construction year, though most activity was to the SE of the Goole Fields II wind farm, in closer proximity to Goole Fields 1. Their distribution (ground counts) and flight activity recorded during the 2017-18 surveys is shown in Figure 11. The increase in the survey area has coincided with an increase in the use of Thorne Moors as a night roost for this species in recent years, with a peak of 2,490 recorded in 2015-16 and 1,700 in 2016-17, though there was also interchange with the Humber Estuary roost to the north-east as well.

Marsh harrier

48. This is another SPA species that is increasing in the region, and that increase has been reflected at Goole Fields II, with an increased use of the site over the earlier pre-construction baseline surveys, which has continued into the post-construction phase. Their flight lines recorded during the Goole Fields II VP survey in autumn/winter 2017-18 are shown in Figure 12.

Common Crane

49. This species had not been recorded in the baseline surveys prior to 2013-14 but has been seen regularly since then. It has recently colonised the Thorne and Hatfield Moors and a small breeding population has become established (Stanbury et al. 2011, Stanbury and Sills 2012, Holling et al. 2017), and it is likely that the birds observed were from that population.

Golden Plover

50. Golden plover use of the survey area has been regular through the survey period, and, as for pink-footed goose, this tended to be a pattern of intermittent visits by larger flocks. This species was often seen at night, with a higher peak count recorded then than during the day in some winters (including 2017-18). The mean annual peak count for the survey area (383) has continued to be very small (1.1%) in relation to the most recently published SPA 5-year mean peak (33,994; Frost *et al*. 2018). This species has continued to use the survey area during the first post-construction winter, in lower numbers than the 2014-15 peak but comparable to the previous pre-construction numbers. The distribution of golden plover flocks on the ground and their flight activity are summarised in Figure 13. Flocks were widely scattered with no particular concentration or preferred area apparent, though with less records in the NW part of the survey area.

Lapwing

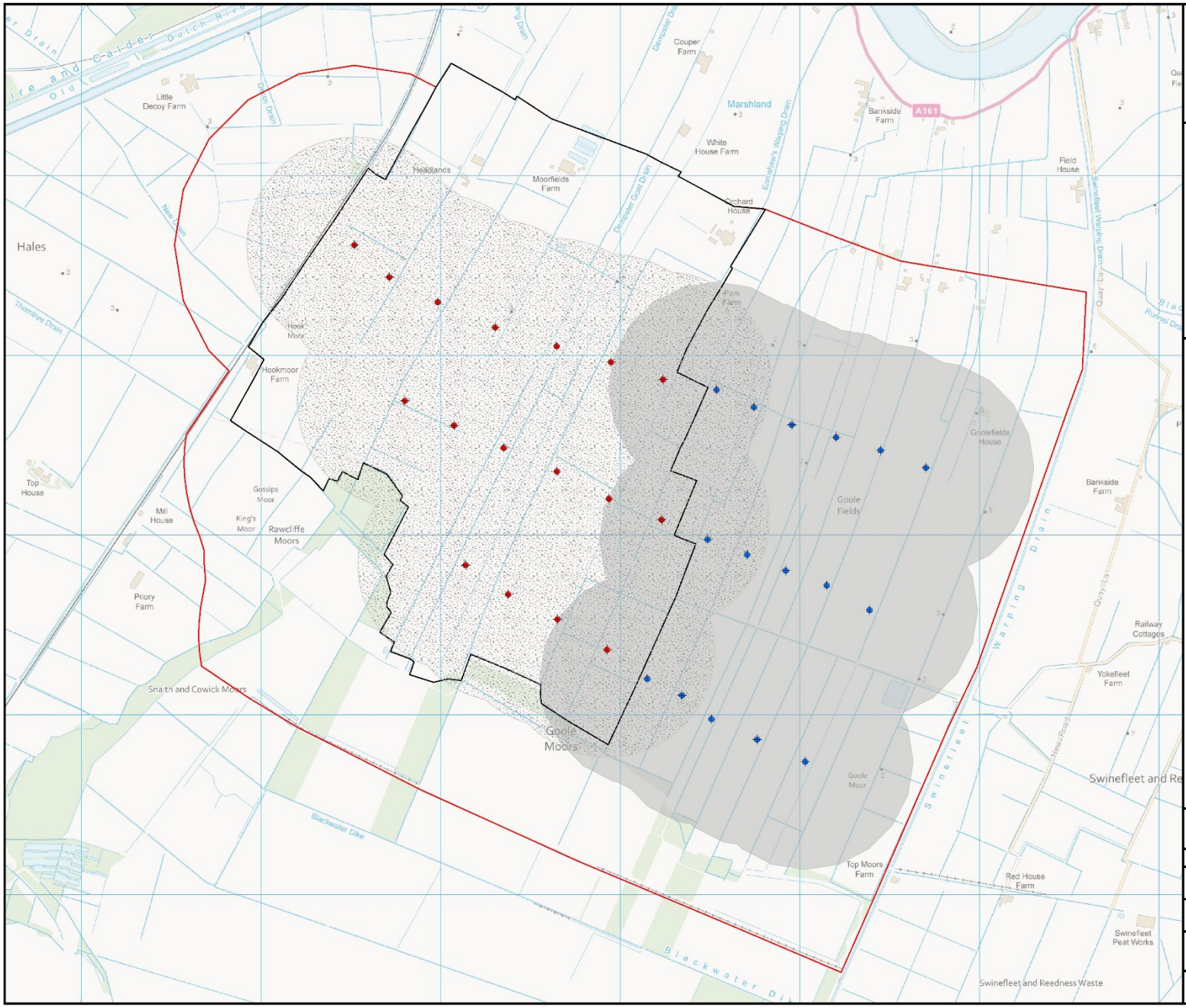
51. Numbers of lapwings recorded have been highly variable between survey years, though were relatively low during both construction years (numbers have also declined recently on the SPA as a whole, Frost et al. 2018, though were higher in 2016-17 than in other recent years). Lapwing was another species seen regularly during the night surveys. The mean annual peak count for the survey area (180) has continued to be very small (1.5%) in relation to the most recently published SPA 5-year mean peak (11,702; Frost *et al*. 2018). The distribution of lapwing flocks on the ground and their flight activity are summarised in Figure 14. As for golden plover, flocks were widely scattered over the survey area with no particular concentration or preferred area.

Other SPA species

52. A further eight SPA species were observed during the pre-construction, construction and post-construction phase surveys; cormorant, shelduck, wigeon, teal, mallard, hen harrier, ringed plover and redshank. All were recorded within the survey area were seen infrequently/in only very small numbers in the context of their SPA populations.

Other species

53. Eight additional high sensitivity species have been recorded during the surveys; whooper swan, little egret, merlin, hobby, peregrine, Mediterranean gull, barn owl and short-eared owl. The numbers of sightings of these was, however, low. Other species seen in important number (sufficient to be classed as regionally important) included lesser black-backed gull, Caspian gull, yellow-legged gull, black-headed gull and common gull.



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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 10

Wintering bird monitoring survey areas

KEY:

- Wintering Bird Survey Area
- Goole Fields II Turbines
- Goole Fields I Turbines
- Goole Fields II Buffer 600m
- Goole Fields I Buffer 600m
- Goole Fields II Core Survey Area

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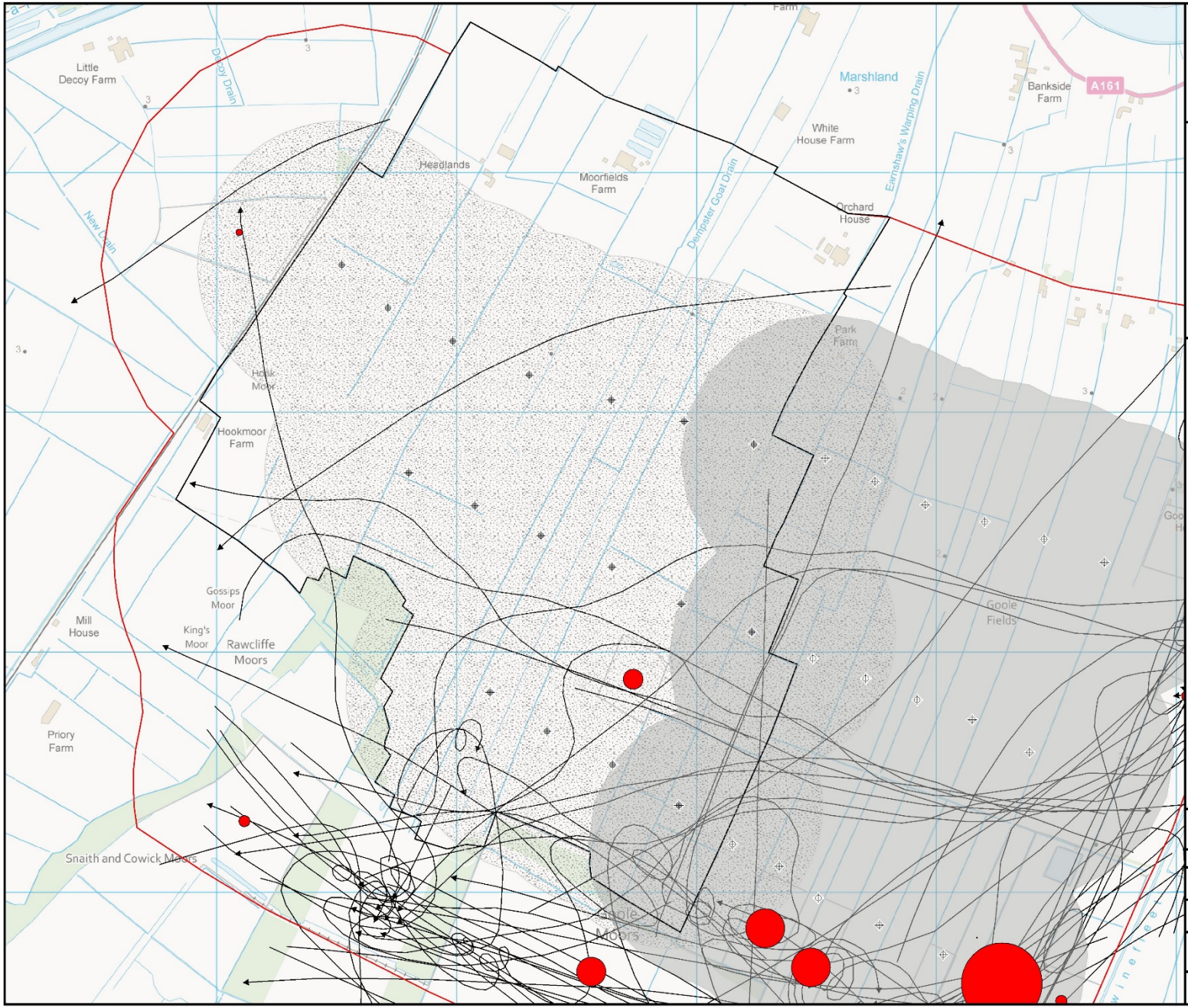

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 11

Pink-footed goose ground counts and flight activity, 2017-18

KEY:

- Wintering Bird Survey Area
- Goole Fields II Turbines
- Goole Fields I Turbines
- Goole Fields II Buffer 600m
- Goole Fields I Buffer 600m
- Goole Fields II Core Survey Area
- Flight lines post-construction

Field peak counts 2017-18

- 1
- 10
- 1,000

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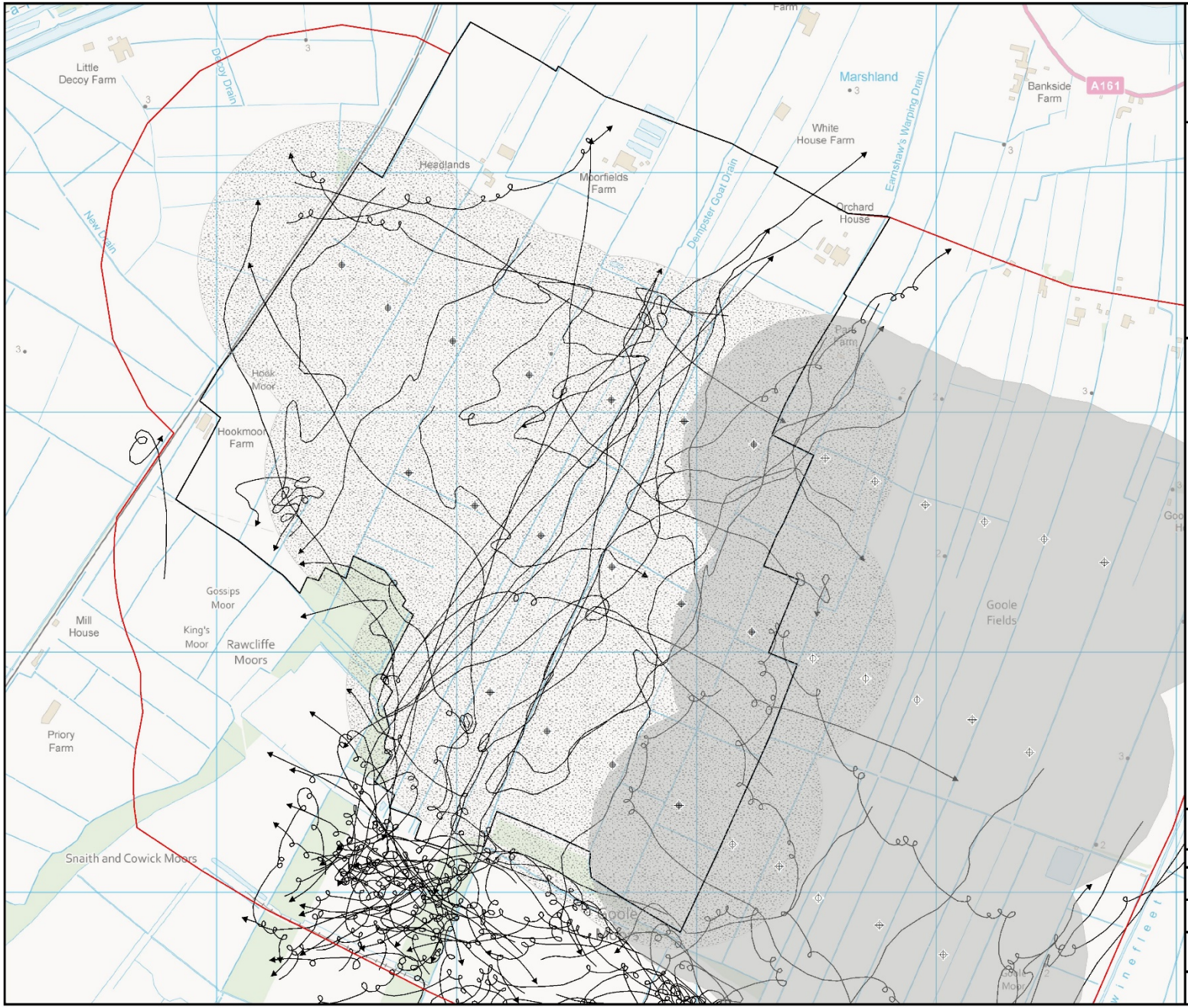

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 12

Marsh harrier flight lines: 2017-18 post-construction year 1

KEY:

- Wintering Bird Survey Area
- Goole Fields II Turbines
- Goole Fields I Turbines
- Goole Fields II Buffer 600m
- Goole Fields I Buffer 600m
- Goole Fields II Core Survey Area
- Flight lines post-construction

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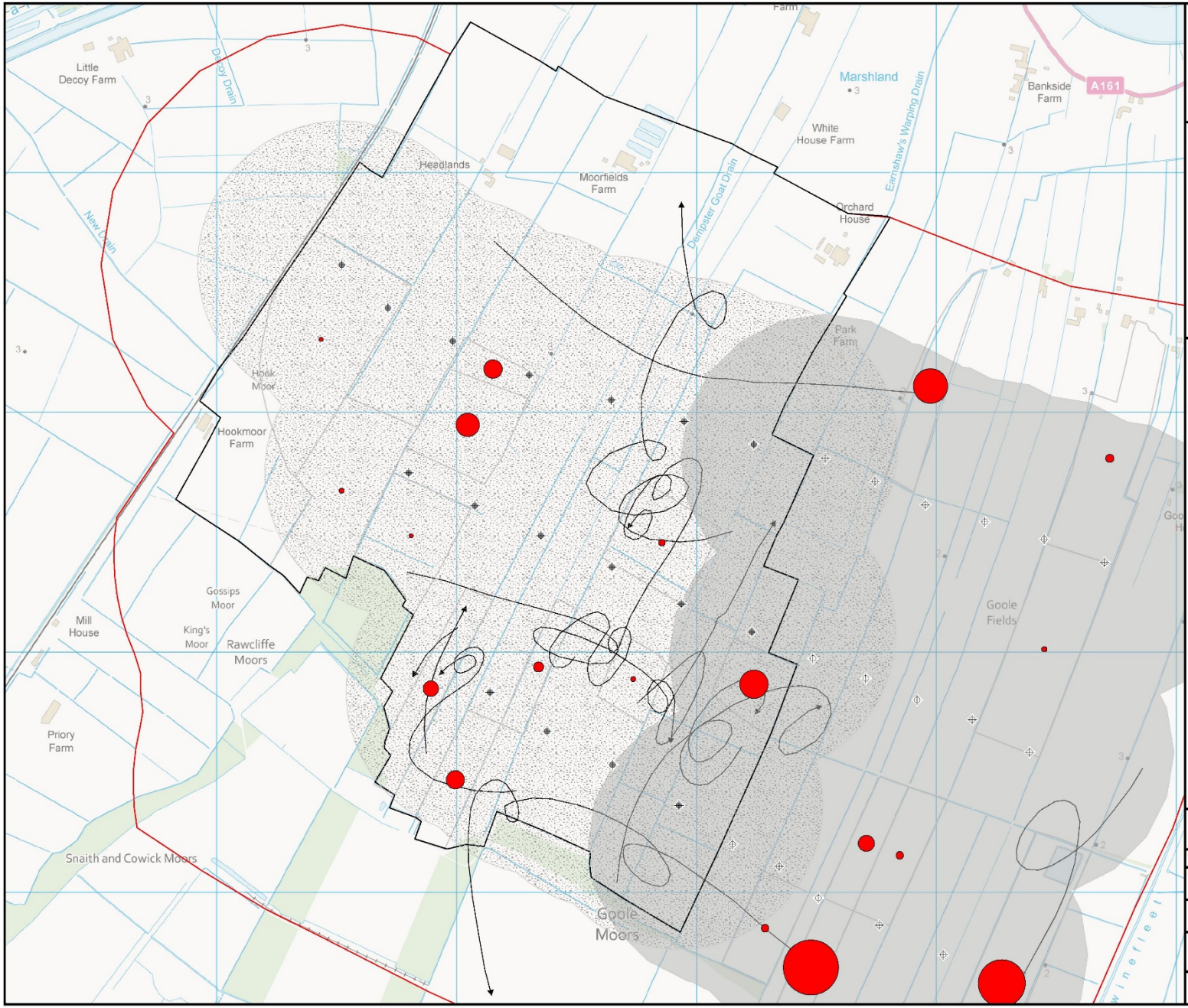

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 13

Golden Plover ground counts and flight activity, 2017-18

KEY:

- Wintering Bird Survey Area
- Goole Fields II Turbines
- Goole Fields I Turbines
- Goole Fields II Buffer 600m
- Goole Fields I Buffer 600m
- Goole Fields II Core Survey Area
- Flight lines post-construction

Field peak counts 2017-18

- 1
- 10
- 100

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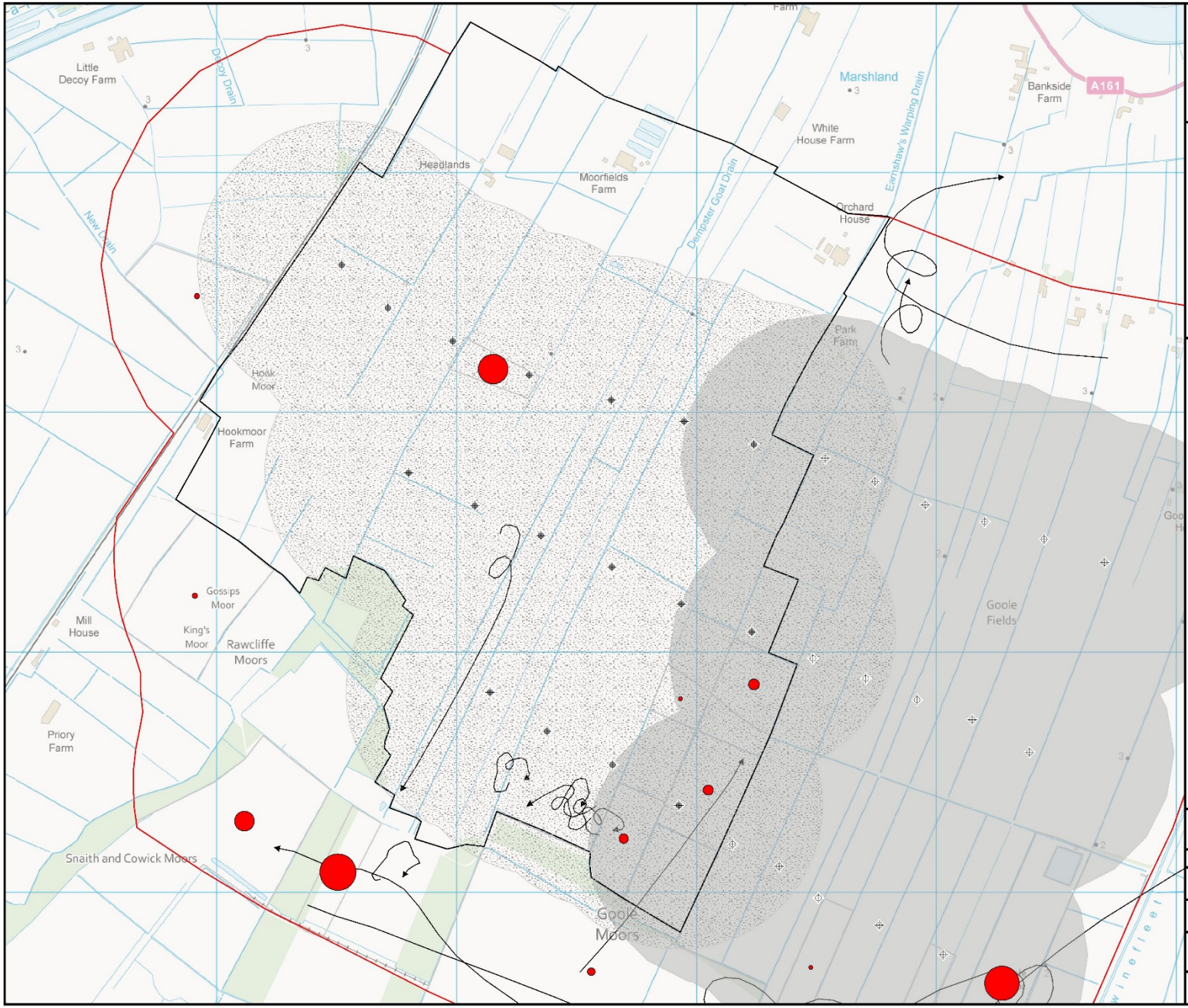

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Goole Fields II Wind Farm
Post-construction Phase

FIGURE 14

Lapwing ground counts and flight activity, 2017-18

KEY:

- Wintering Bird Survey Area
- Goole Fields II Turbines
- Goole Fields I Turbines
- Goole Fields II Buffer 600m
- Goole Fields I Buffer 600m
- Goole Fields II Core Survey Area
- Flight lines post-construction

Field peak counts 2017-18

- 1
- 10
- 100

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Collision Monitoring Results

54. The dead birds recorded during the collision victim searches between September 2017 and March 2018 are detailed in Table 13. This comprised 15 individuals of 9 species (plus an unidentified small bat and a pipistrelle bat). This included a single individual of one Humber Estuary SPA species, golden plover.

55. The most frequently recorded species found dead was woodpigeon (6 of the 15 individuals), with 2 black-headed gulls and single individual buzzard, kestrel, pheasant, golden plover, woodcock, lesser black-backed gull and goldcrest. A precautionary approach has been adopted with regard to attributing cause of death, assuming that all birds found could potentially have been collision victims.

Table 13. Dead birds found during the collision victim monitoring surveys, September 2017 – March 2018.

Date first found	Species/ID	Condition	Turbine number	Distance from turbine (m)	Notes
07/09/2017	Woodpigeon [1]	feather spot	402	57	
07/09/2017	Kestrel [2]	headless, decomposing	401	8	
07/09/2017	Buzzard [3]	decomposed	401	24	
07/09/2017	Lesser Black-backed Gull [4]	feather spot	503	39	
07/09/2017	Black-headed Gull [5]	wing	505	15	
20/09/2017	Woodpigeon [6]	heavily scavenged	504	11	Possible peregrine kill, picked clean below transformer building - eaten on roof?
20/09/2017	Woodpigeon [7]	feather spot	505	63	
20/09/2017	Woodpigeon [8]	wing	502	35	
20/09/2017	Woodpigeon [9]	feather spot	405	99	
11/10/2017	Black-headed Gull [10]	intact except wing	404	77	
27/09/2017	Goldcrest [11]	decomposing	505	3	
11/10/2017	Golden Plover [12]	intact, broken wing	508	51	
11/10/2017	Pheasant [13]	feather spot	406	65	female
14/03/2018	Woodcock [14]	feather spot	408	15	
10/01/2018	Woodpigeon [15]	feather spot	506	66	

56. The dates on which each of the dead birds were located are summarised in Table 14. Longevity of the bird remains was high, with most being located repeatedly over many weeks. Survival analysis (Kaplan-Meier) gave a mean time to disappearance of the corpses of 72 days (±15 days SE), well in excess of the 7-day survey interval, indicating that the chance of a corpse being found was high (a similar result was found on the adjacent Goole Fields 1 site). No birds were missed during any of the visits either (there were no gaps when a bird was not seen then reappeared). The high re-locating rates shows that observer search efficiency was high.

Table 14. Dates on which dead birds located, September 2017 – March 2018.

Species/ ID no.	07/09/17	13/09/17	20/09/17	27/09/17	04/10/17	11/10/17	20/10/17	30/10/17	08/11/17	15/11/17	22/11/17	29/11/17	07/12/17	13/12/17	19/12/17	27/12/17	03/01/18	10/01/18	17/01/18	25/01/18	01/02/18	08/02/18	13/02/18	26/02/18	08/03/18	14/03/18	21/03/18	28/03/18
Woodpigeon [1]	1	1	1																									
Kestrel [2]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Buzzard [3]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
Lesser Black-backed Gull [4]	1																											
Black-headed Gull [5]	1	1	1	1	1	1	1	1																				
Woodpigeon [6]		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [7]			1																									
Woodpigeon [8]			1	1	1																							
Woodpigeon [9]			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Black-headed Gull [10]			1	1	1	1	1																					
Goldcrest [11]						1	1	1	1	1	1	1	1	1	1	1	1	1	1									
Golden Plover [12]				1	1	1	1	1	1	1	1	1	1	1														
Pheasant [13]						1																						
Woodcock [14]						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
Woodpigeon [15]																										1	1	1

Scavenger/Observer Efficiency Trial

57. The dates on which each of the scavenging trial birds were located are summarised in Table 15. Longevity of the first trial birds was slightly lower than for the non-trial birds (mean time to disappearance 51 days $\pm$ 9SE). The high re-locating rate provided further evidence that observer search efficiency was high, with few gaps in records of individual corpses. There were, though, clearly some carcasses that disappeared quickly, whilst others lasted through the whole trial period.

Table 15. Dates on which trial corpse birds re-located, November 2017 – March 2018.

Species/ ID no.	08/11/17	15/11/17	22/11/17	29/11/17	07/12/17	13/12/17	19/12/17	27/12/17	03/01/18	10/01/18	17/01/18	25/01/18	01/02/18	08/02/18	13/02/18	26/02/18	08/03/18	14/03/18	21/03/18	28/03/18
Rook [T1]	1																			
Rook [T2]	1																			

Species/ ID no.	08/11/17	15/11/17	22/11/17	29/11/17	07/12/17	13/12/17	19/12/17	27/12/17	03/01/18	10/01/18	17/01/18	25/01/18	01/02/18	08/02/18	13/02/18	26/02/18	08/03/18	14/03/18	21/03/18	28/03/18
Rook [T3]	1																			
Rook [T4]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rook [T5]	1																			
Rook [T6]	1																			
Rook [T7]	1																			
Rook [T8]	1																			
Rook [T9]	1	1	1	1																
Jackdaw [T10]	1																			
Jackdaw [T11]	1																			
Jackdaw [T12]	1																			
Jackdaw [T13]	1																			
Jackdaw [T14]	1																			
Jackdaw [T15]	1																			
Jackdaw [T16]	1																			
Jackdaw [T17]	1																			
Jackdaw [T18]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jackdaw [T19]	1																			
Jackdaw [T20]	1													1	1	1	1	1		
Woodpigeon [T21]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [T22]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [T23]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Woodpigeon [T24]	1																			
Woodpigeon [T25]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [T26]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [T27]	1																			
Woodpigeon [T28]	1																			
Woodpigeon [T29]	1																			
Woodpigeon [T30]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Woodpigeon [T31]	1	1	1	1	1	1	1	1	1	1	1	1	1							
Woodpigeon [T32]	1	1	1	1	1	1	1	1	1											
Woodpigeon [T33]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

58. As concluded for the GF1 surveys, it is clear that scavengers are active in this area, and that whole birds could be quickly removed (though where any remains such as feather spots were left these usually stayed in situ for a much longer period). As a result, caution must be applied to the results of the collision searches, and the possibility of birds colliding but then being removed by scavengers before being located by the surveyor cannot be excluded. Further trials are planned for 2018-19 to further test the overall validity of the collision monitoring, test observer efficiency, quantify search coverage and determine how rapidly dead birds may be being removed (and the factors affecting removal rates such as bird size and type), to inform a quantitative analysis of the collision rates.

59. The main trials were undertaken blind, with a different observer putting the birds out, to test the initial finding was. In this test 30 of the 33 carcasses (91%) were found on a search later the same day. This provides further evidence of the reliability of the corpse searching.

Trial carcass monitoring by camera trap

60. The fates of the 20 carcasses that were monitored with camera traps are summarised in Table 16. As with the main monitoring and trials there was a wide range of disappearance times, with some being removed quickly but others detectable over much longer periods. Fox was the main scavenger, though badgers, mice, a farm dog and a buzzard were also confirmed by the camera traps. Longevity of these trial birds was lower than for the non-trial and main scavenger trial birds (mean time to disappearance 20 days $\pm$ 3.8SE), though still well in excess of the weekly survey interval.

Table 16. Fates of carcasses monitored by camera traps, Goole Fields II, 2017-18.

ID	Species	Date put out	Turbine Number	Distance from turbine (m)	Notes
C1	Carrion Crow	22/11/2017	505	70	Untouched after 2 days then disappeared.
C2	Carrion Crow	18/12/2017	405	13	Scavenged by 2 badgers and 2 mice after 9 days, visited but not touched by fox. Feather spot last another 41 days
C3	Rook	11/01/2018	506	17	Disappeared after 3 days, no image
C4	Rook	17/01/2018	508	49	Only feather spot left after 8 days (lasted 42 days), no image
C5	Jackdaw	17/01/2018	403	77	Removed by fox after 5 days
C6	Jackdaw	17/01/2018	505	16	Removed by buzzard after 1 day, feather spot lasted to end of trial (69 days)
C7	Woodpigeon	07/03/2018	402	43	Scavenged by farm dog after 1 day, feather spot lasted to end of trial (20 days)
C8	Woodpigeon	07/03/2018	407	14	Disappeared after 1 day, no image
C9	Woodpigeon	14/03/2018	406	10	Only feather spot left after 4 days (lasted 14 days to end of trial), no image
C10	Starling	11/01/2018	504	14	Disappeared after 6 days, no image
C11	Pheasant	25/01/2018	408	63	Untouched for 14 days then moved into ditch (no image)
C12	Red-legged Partridge	25/01/2018	401	43	Disappeared after 5 days, no image
C13	Pheasant	08/02/2018	502	58	Untouched for 5 days, then feather spot left for further 30 days
C14	Pheasant	08/02/2018	406	30	Untouched for 5 days, then feather spot left for further 42 days
C15	Pheasant	13/02/2018	504	87	Removed by fox after 3 days, feather spot left for another 26 days
C16	Pheasant	07/03/2018	509	98	Disappeared after 5 days, no image
C17	Pheasant	14/03/2018	501	83	Removed by fox after 1 day, feather spot left for another 14 days
C18	Pheasant	21/03/2018	506	94	Untouched for 7 days
C19	Pheasant	21/03/2018	405	97	Heavily scavenged by badger and fox after 2 days, feather spot lasted to end of trial (7 days)
C20	Pheasant	13/02/2018	404	13	Disappeared after 6 days, no image

Assessment of the Ornithological Effects of the Operation of the Wind Farm

61. This section of the report presents an examination of the bird population changes in proximity to the wind farm for any evidence of any disturbance effects during the first year of operation.

Effects on Breeding Birds

62. Two key breeding bird species had been identified in the ES and subsequent assessment for the Goole Fields II wind farm, nightjar and marsh harrier. Specific design and mitigation measures were implemented for nightjars to avoid the possibility of any likely significant effect on the Thorne and Hatfield Moors SPA nightjar population, with no turbines located within 400m of the SPA and no construction activity on the southern row of turbines (closest to the SPA) during the May-August nightjar breeding season. The surveys have shown that these measures have been effective to date, with the nightjar population during the construction in 2016 being the same (10 pairs) as the peak breeding population recorded during the pre-construction surveys in 2014, and higher than the other four pre-construction years (when 4-9 pairs were recorded). In 2017 the nightjar population increased further to 12 pairs. Marsh harrier numbers have continued to increase in the wider survey area during construction and the first year of operation of the Goole Fields II wind farm. There was no evidence, therefore, of any adverse effect of the construction or operation of the wind farm on the breeding populations of either of these species. The same finding has been reported for the adjacent Goole Fields wind farm (Percival et al. 2015).

63. The ES assessment of the effects of the wind farm on the breeding bird populations used precautionary zones of 300m and 500m around the Goole Fields II wind turbines, so those same zones have been used in the preliminary analysis of the effects of construction presented here (and excluding areas that were closer to the Goole Fields 1 turbines). Table 17 summarises the numbers of birds recorded breeding within 300m of the wind turbines, the zone 301-500m from the turbines and in the wider area more than 500m from any construction activities, in each of the three survey years. Table 18 presents the same results but for the bird densities (standardising for the different areas of each of the three zones).

Table 17. Breeding bird populations (estimated numbers of breeding pairs) in the Goole Fields II core breeding bird survey area within 300m of the wind turbines, 301-500m from the wind turbines and in the zone more than 500m from the wind turbines during the pre-construction (2008, 2009, 2012, and 2013), construction phase (2016) and post-construction (2017) surveys.

	Wind farm <300m						300-500m						>500m					
Species	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**
Greylag Goose	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Shelduck	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Mallard	6	8	7	2	5	2	2	5	4	6	2	1	5	5	2	5	1	1
Shoveler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Red-legged Partridge	3	2	0	0	0	2	0	2	0	0	0	0	0	1	1	0	0	0
Grey Partridge	1	3	2	1	1	2	1	3	1	1	1	0	1	1	2	0	0	0
Quail	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pheasant	3	4	3	1	5	3	2	4	2	3	8	5	2	5	1	2	5	1
Sparrowhawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Buzzard	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	1	1
Kestrel	1	1	1	3	1	1	0	0	2	1	0	1	0	0	0	0	0	0
Hobby	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Moorhen	0	2	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1	1
Lapwing	2	4	2	2	3	1	1	3	5	2	4	3	0	1	0	0	0	0

	Wind farm <300m						300-500m						>500m					
Species	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**	**2008**	**2009**	**2012**	**2013**	**2016**	**2017**
Redshank	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Black-headed Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Feral Pigeon	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Dove	2	13	2	11	1	6	4	3	0	3	1	2	2	5	1	3	2	4
Woodpigeon	9	6	0	20	14	1	11	9	10	12	2	16	24	19	46	13	38	33
Collared Dove	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Cuckoo	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0
Barn Owl	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Little Owl	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Nightjar	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0
Green Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Great Spotted Woodpecker	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Skylark	70	60	63	61	75	73	27	19	29	16	27	28	11	7	5	7	7	12
Swallow	0	1	2	0	2	0	0	0	0	0	2	1	0	1	2	2	2	4
Meadow Pipit	18	22	13	23	35	33	9	9	12	8	10	11	0	2	2	1	4	6
Yellow Wagtail	28	34	34	36	45	38	15	9	11	12	13	17	4	6	6	7	7	9
Pied Wagtail	0	3	3	4	12	5	2	6	2	5	3	3	1	2	0	0	1	4
Wren	0	0	0	0	1	3	8	7	3	4	9	11	2	5	4	9	9	8
Dunnock	0	0	0	0	0	0	1	0	1	2	1	2	0	2	1	0	3	2
Robin	0	0	0	0	0	0	3	5	3	3	8	6	3	8	3	3	7	7
Blackbird	0	0	0	0	0	1	1	4	1	1	2	4	2	8	6	4	7	9
Song Thrush	0	0	0	0	0	0	1	2	0	0	0	0	2	3	1	1	1	1
Mistle Thrush	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	5
Sedge Warbler	0	1	0	0	0	2	0	1	0	0	0	5	1	1	0	0	0	0
Reed Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Blackcap	0	0	0	0	0	0	2	4	2	2	4	5	1	4	5	1	5	4
Garden Warbler	0	0	0	0	0	0	0	0	4	1	2	0	1	0	0	2	0	1
Whitethroat	10	7	7	6	11	8	9	11	6	6	9	9	3	4	4	2	4	5
Chiffchaff	0	0	0	0	0	0	0	0	2	1	3	3	2	2	1	0	3	1
Willow Warbler	0	0	0	0	0	0	6	14	7	8	3	13	3	12	4	6	8	8
Goldcrest	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Spotted Flycatcher	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Long-tailed Tit	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	0	0	1
Blue Tit	0	0	0	0	0	0	1	1	4	1	2	1	2	3	1	0	2	2
Great Tit	0	0	0	0	0	1	1	1	1	2	1	2	0	3	0	2	5	3
Coal Tit	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Willow Tit	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Tit	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Treecreeper	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Jay	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Magpie	0	0	0	0	0	0	0	1	2	1	1	0	1	0	0	0	0	0
Jackdaw	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carrion Crow	3	4	2	2	3	4	1	2	1	3	5	2	1	2	0	1	1	3
Starling	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	2	2
Tree Sparrow	1	0	0	0	0	1	0	0	1	0	0	0	0	2	1	1	1	1

Species	Wind farm <300m						300-500m						>500m					
	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017
Chaffinch	0	1	1	0	0	2	3	9	7	6	12	10	5	8	6	5	10	11
Greenfinch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Goldfinch	1	3	0	2	1	2	0	1	2	0	4	0	1	1	1	4	4	2
Linnet	18	6	14	16	8	9	12	5	4	12	10	7	2	2	5	2	4	1
Lesser Redpoll	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Yellowhammer	0	4	1	0	0	0	4	8	3	4	1	3	0	4	3	1	4	0
Reed Bunting	4	9	7	8	11	18	5	1	6	2	9	6	2	2	0	1	4	1
Corn Bunting	12	18	10	7	9	12	2	9	4	2	3	5	1	3	2	4	2	0

Table 18. Breeding bird densities (estimated numbers of breeding pairs per km^2) in the Goole Fields II core breeding bird survey area within 300m of the wind turbines, 301-500m from the wind turbines and in the zone more than 500m from the wind turbines during the pre-construction (2008, 2009, 2012, and 2013), construction phase (2016) and post-construction (2017) surveys..

Species	Wind farm <300m						300-500m						>500m					
	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017
Greylag Goose	0	0	0	0.7	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
Shelduck	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0
Mallard	2.0	2.7	2.4	0.7	1.7	0.7	1.4	3.5	2.8	4.2	1.4	0.7	6.5	6.5	2.6	6.5	1.3	1.3
Shoveler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0
Red-legged Partridge	1.0	0.7	0	0	0	0.7	0	1.4	0	0	0	0	0	1.3	1.3	0	0	0
Grey Partridge	0.3	1.0	0.7	0.3	0.3	0.7	0.7	2.1	0.7	0.7	0.7	0	1.3	1.3	2.6	0	0	0
Quail	0	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pheasant	1.0	1.4	1.0	0.3	1.7	1.0	1.4	2.8	1.4	2.1	5.6	3.5	2.6	6.5	1.3	2.6	6.5	1.3
Sparrowhawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	1.3
Buzzard	0	0	0	0	0.3	0.3	0	0	0	0.7	0	0	0	0	1.3	0	1.3	1.3
Kestrel	0.3	0.3	0.3	1.0	0.3	0.3	0	0	1.4	0.7	0	0.7	0	0	0	0	0	0
Hobby	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
Moorhen	0	0.7	0	0	0	0	0.7	0	0	0	0	0	1.3	1.3	0	1.3	1.3	1.3
Lapwing	0.7	1.4	0.7	0.7	1.0	0.3	0.7	2.1	3.5	1.4	2.8	2.1	0	1.3	0	0	0	0
Redshank	0	0	0	0	0.3	0	0	0	0	0	0.7	0	0	0	0	0	0	0
Black-headed Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
Feral Pigeon	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Dove	0.7	4.4	0.7	3.7	0.3	2.0	2.8	2.1	0	2.1	0.7	1.4	2.6	6.5	1.3	3.9	2.6	5.2
Woodpigeon	3.0	2.0	0	6.8	4.7	0.3	7.7	6.3	7.0	8.4	1.4	11.2	31.2	24.7	59.7	16.9	49.4	42.9
Collared Dove	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0
Cuckoo	0	0	0	0	0	0	0	0	0.7	0	0.7	0	0	0	1.3	1.3	0	0
Barn Owl	0	0.3	0.3	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0
Little Owl	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	1.3	0	0
Nightjar	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	2.6	0	0
Green Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	1.3	1.3	0	0	0	0

Species	Wind farm <300m						300-500m						>500m					
	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017	2008	2009	2012	2013	2016	2017
Great Spotted Woodpecker	0	0	0	0	0	0	0	0	0	0	0.7	0	1.3	0	0	0	0	0
Skylark	23.6	20.3	21.3	20.6	25.3	24.7	18.9	13.3	20.3	11.2	18.9	19.6	14.3	9.1	6.5	9.1	9.1	15.6
Swallow	0	0.3	0.7	0	0.7	0	0	0	0	0	1.4	0.7	0	1.3	2.6	2.6	2.6	5.2
Meadow Pipit	6.1	7.4	4.4	7.8	11.8	11.1	6.3	6.3	8.4	5.6	7.0	7.7	0	2.6	2.6	1.3	5.2	7.8
Yellow Wagtail	9.5	11.5	11.5	12.2	15.2	12.8	10.5	6.3	7.7	8.4	9.1	11.9	5.2	7.8	7.8	9.1	9.1	11.7
Pied Wagtail	0	1.0	1.0	1.4	4.1	1.7	1.4	4.2	1.4	3.5	2.1	2.1	1.3	2.6	0	0	1.3	5.2
Wren	0	0	0	0	0.3	1.0	5.6	4.9	2.1	2.8	6.3	7.7	2.6	6.5	5.2	11.7	11.7	10.4
Dunnock	0	0	0	0	0	0	0.7	0	0.7	1.4	0.7	1.4	0	2.6	1.3	0	3.9	2.6
Robin	0	0	0	0	0	0	2.1	3.5	2.1	2.1	5.6	4.2	3.9	10.4	3.9	3.9	9.1	9.1
Blackbird	0	0	0	0	0	0.3	0.7	2.8	0.7	0.7	1.4	2.8	2.6	10.4	7.8	5.2	9.1	11.7
Song Thrush	0	0	0	0	0	0	0.7	1.4	0	0	0	0	2.6	3.9	1.3	1.3	1.3	1.3
Mistle Thrush	0	0	0	0.3	0	0	0	0	0	0	0	0.7	0	0	0	0	0	6.5
Sedge Warbler	0	0.3	0	0	0	0.7	0	0.7	0	0	0	3.5	1.3	1.3	0	0	0	0
Reed Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0
Blackcap	0	0	0	0	0	0	1.4	2.8	1.4	1.4	2.8	3.5	1.3	5.2	6.5	1.3	6.5	5.2
Garden Warbler	0	0	0	0	0	0	0	0	2.8	0.7	1.4	0	1.3	0	0	2.6	0	1.3
Whitethroat	3.4	2.4	2.4	2.0	3.7	2.7	6.3	7.7	4.2	4.2	6.3	6.3	3.9	5.2	5.2	2.6	5.2	6.5
Chiffchaff	0	0	0	0	0	0	0	0	1.4	0.7	2.1	2.1	2.6	2.6	1.3	0	3.9	1.3
Willow Warbler	0	0	0	0	0	0	4.2	9.8	4.9	5.6	2.1	9.1	3.9	15.6	5.2	7.8	10.4	10.4
Goldcrest	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0
Spotted Flycatcher	0	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0
Long-tailed Tit	0	0	0	0	0	0	0	0	1.4	0	0.7	0	0	0	1.3	0	0	1.3
Blue Tit	0	0	0	0	0	0	0.7	0.7	2.8	0.7	1.4	0.7	2.6	3.9	1.3	0	2.6	2.6
Great Tit	0	0	0	0	0	0.3	0.7	0.7	0.7	1.4	0.7	1.4	0	3.9	0	2.6	6.5	3.9
Coal Tit	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
Willow Tit	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Tit	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
Treecreeper	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0
Jay	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	1.3	0
Magpie	0	0	0	0	0	0	0	0.7	1.4	0.7	0.7	0	1.3	0	0	0	0	0
Jackdaw	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carrion Crow	1.0	1.4	0.7	0.7	1.0	1.4	0.7	1.4	0.7	2.1	3.5	1.4	1.3	2.6	0	1.3	1.3	3.9
Starling	0.7	0	0.3	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	2.6	2.6	2.6
Tree Sparrow	0.3	0	0	0	0	0.3	0	0	0.7	0	0	0	0	2.6	1.3	1.3	1.3	1.3
Chaffinch	0	0.3	0.3	0	0	0.7	2.1	6.3	4.9	4.2	8.4	7.0	6.5	10.4	7.8	6.5	13.0	14.3
Greenfinch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	1.3
Goldfinch	0.3	1.0	0	0.7	0.3	0.7	0	0.7	1.4	0	2.8	0	1.3	1.3	1.3	5.2	5.2	2.6
Linnet	6.1	2.0	4.7	5.4	2.7	3.0	8.4	3.5	2.8	8.4	7.0	4.9	2.6	2.6	6.5	2.6	5.2	1.3
Lesser Redpoll	0	0	0	0	0	0	0	0	0	0.7	0.7	0	0	0	0	0	0	0
Yellowhammer	0	1.4	0.3	0	0	0	2.8	5.6	2.1	2.8	0.7	2.1	0	5.2	3.9	1.3	5.2	0
Reed Bunting	1.4	3.0	2.4	2.7	3.7	6.1	3.5	0.7	4.2	1.4	6.3	4.2	2.6	2.6	0	1.3	5.2	1.3
Corn Bunting	4.1	6.1	3.4	2.4	3.0	4.1	1.4	6.3	2.8	1.4	2.1	3.5	1.3	3.9	2.6	5.2	2.6	0

64. Comparison of the breeding populations recorded during the construction with those from earlier surveys generally suggests that there has been little effect resulting from the construction works over this period. Most breeding populations have been maintained in 2017 in comparison with the pre-construction baseline, even in close proximity to the wind farm.

65. The more detailed gradient analysis also found no evidence of any displacement attributable to the operation of the wind farm in 2017. This was carried out for the six species of conservation importance for which there were sufficient data; corn bunting, linnet, meadow pipit, skylark, reed bunting and yellow wagtail. Four of these six species showed a positive association with ditch length. Three (skylark, yellow wagtail and corn bunting) were less abundant in grid squares where rape was the predominant crop. Four showed a statistically significant relationship between breeding bird numbers and distance from the wind farm in any of these species, but in all four species this relationship was negative, i.e. they were more abundant closer to the wind turbines. The results of these analyses are summarised in Table 19. They provided strong evidence of no disturbance effect of the wind turbines on breeding birds.

Table 19. Poisson Regression Modelling results of the factors affecting bird grid square breeding numbers.

Species	Statistically significant predictors of breeding bird numbers in grid squares
Skylark	Ditch length (+++), Crop (rape < other crops), Turbine distance (- - -)
Meadow Pipit	Ditch length (+++), Turbine distance (- - -)
Yellow Wagtail	Crop (rape < other crops), Turbine distance (- -)
Linnet	No significant factors
Reed Bunting	Ditch length (+++)
Corn Bunting	Ditch length (+++), Crop (rape < other crops), Turbine distance (- -)

+/- indicates statistically significant positive/negative relationship, +++/- - - = p<0.001, ++/- - = p<0.01, +/- = p<0.05.

66. Possible displacement of breeding birds during construction was tested further by comparing the distances that these six more-abundant species were recorded in relation to distance from the wind turbines in the pre-construction baseline before and during operation. If birds were avoiding the turbines, then one would expect a greater distance from the turbines in 2017 during operation than during the pre-construction baseline surveys. The results of these analyses are summarised in Table 20, which gives the median distance to the nearest turbines for each species for the five years. The Table also gives the results of the statistical (Kruskal-Wallis non-parametric one-way analysis of variance) analysis of these data, with a null hypothesis of no difference between the years. The H-statistic from the analysis, the sample sizes for each year and the probability associated with the test are given. A probability of less than 0.05 would be required to reject the null hypothesis (i.e. to conclude that there was a significant difference across the years). There was no statistically significant difference in the median distance to the nearest turbine across the six years, and no indication of any displacement effect of construction or operation.

Table 20. Median closest turbine distances to breeding birds recorded within the Goole Fields II core breeding bird survey area during construction in 2017, with those for the same area for 2008, 2009, 2012 and 2013 (prior to construction of the wind farm), and 2016 (during construction) given for comparison.

Species	Median distance to nearest turbine (m)						H-statistic	P
	2008	2009	2012	2013	2016	2017		
Skylark	244	215	225	211	210	245	3.23	0.66
Meadow Pipit	229	204	301	219	194	258	3.97	0.55
Yellow Wagtail	275	206	232	239	266	256	3.37	0.64
Linnet	298	369	368	225	341	303	2.45	0.78
Reed Bunting	309	168	261	210	307	257	6.82	0.23
Corn Bunting	274	238	267	294	230	187	3.03	0.70

Sample sizes are numbers of pairs for core survey area (given in Table 11 above)

Effects on Autumn/Wintering Birds

67. The assessment of the effects of the wind farm used a precautionary zone of 600m around the wind turbines for wintering birds, so that same zone has been used in the initial analysis. In order to focus specifically on the potential effects of the Goole Fields II wind farm, the fields within this zone that were closer to the Goole Fields 1 turbines were excluded from this analysis. Tables 21 and 22 present the mean and peak ground counts respectively of birds within this zone, for each survey year.

68. Population increases in several key species have been recorded recently in the local area and regionally (Percival et al. 2017), and several have increased in numbers within the 600m zone around the wind farm, including during the construction and operational phase. Numbers of marsh harrier were higher than in the earlier baseline surveys. Numbers of golden plover and pink-footed geese in this zone during the first year of operation were similar to those observed during the pre-construction surveys, but numbers of lapwings were rather lower than the pre-construction levels. This was the only species for which this initial analysis was consistent with any displacement from this zone, though lower numbers of this species have been recorded here before in some of the pre-construction years.

Table 21. Wintering bird populations recorded in the Goole Fields II core 600m buffer zone field counts during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and first winter of operation (2017-18): mean ground counts (n=14 surveys in each winter).

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Mute Swan	0	0.3	0	0.3	0	0	0	0
Whooper Swan	0.1	0	0	0.1	0	0	0	0
Pink-footed Goose	0	13.6	92.9	0	1.1	56.6	103.6	18.0
White-fronted Goose	0	0	0	0	0	0	0	0
Greylag Goose	0	0	8.6	0	2.1	0.1	3.1	0.4
Shelduck	0	0	0	0	0	0	0	0.4
Teal	0.3	0	0	0	0	0	0	0
Mallard	1.7	0.3	0.3	2.8	0.3	0.4	0.5	12.2

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Shoveler	0	0	0	0	0	0	0	0.3
Little Grebe	0	0.2	0	0	0	0	0	0
Cormorant	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	0.1	0.4
Grey Heron	0.1	0.4	0.1	0.2	0	0.1	0	0.1
Marsh Harrier	0	0.1	0.1	0.1	0.5	0.2	0.1	0.3
Hen Harrier	0	0	0.1	0	0.1	0	0	0
Sparrowhawk	0.2	0	0.1	0.1	0.1	0	0	0
Buzzard	0	0	0.1	0.6	1.3	0.7	0.4	0.8
Kestrel	0.7	1.1	1.2	2.8	1.1	0.9	1.7	1.7
Merlin	0	0	0	0	0.2	0	0.1	0.1
Hobby	0	0	0	0.2	0	0	0	0
Peregrine	0.1	0.1	0.2	0.2	0.2	0.1	0	0.3
Common Crane	0	0	0	0.3	0	0.1	0.6	0
Golden Plover	36.2	29.4	21.3	26.4	64.3	13.2	38.4	14.8
Lapwing	8.3	32.6	0	44.4	0.9	3.6	1.6	1.6
Snipe	0	0	0	0	0	0	0	0.1
Green Sandpiper	0	0	0	0	0	0	0	0.2
Redshank	0	0	0	0	0	0	0.4	0.3
Mediterranean Gull	0	0	0	0.1	0	0	0	0
Common Gull	21.5	20.1	16.5	57.7	10.9	25.5	28.9	26.3
Caspian Gull	0	0	0	0.1	0	0.1	0.1	0.4
Lesser Black-backed Gull	1.9	6.1	5.6	44.6	1.3	54.1	31.9	42.5
Yellow-legged Gull	0	0.4	0	1.3	0.4	3.6	2.5	2.1
Herring Gull	1.6	4.1	0.8	1.3	0.6	1.9	5.4	3.7
Great Black-backed Gull	0	0.6	0.1	0.1	0	0.3	0.5	0.4
Black-headed Gull	8.2	73.0	12.1	177.9	80.4	57.6	73.6	54.3
Barn Owl	0	0.1	0	0	0.1	0	0	0
Little Owl	0	0.1	0	0.1	0	0.3	0	0.1

Table 22. Wintering bird populations recorded in the Goole Fields II 600m buffer zone field counts during September– March, for the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15) and construction phases (2015-16 and 2016-17): peak ground counts (n=14 surveys in each winter).

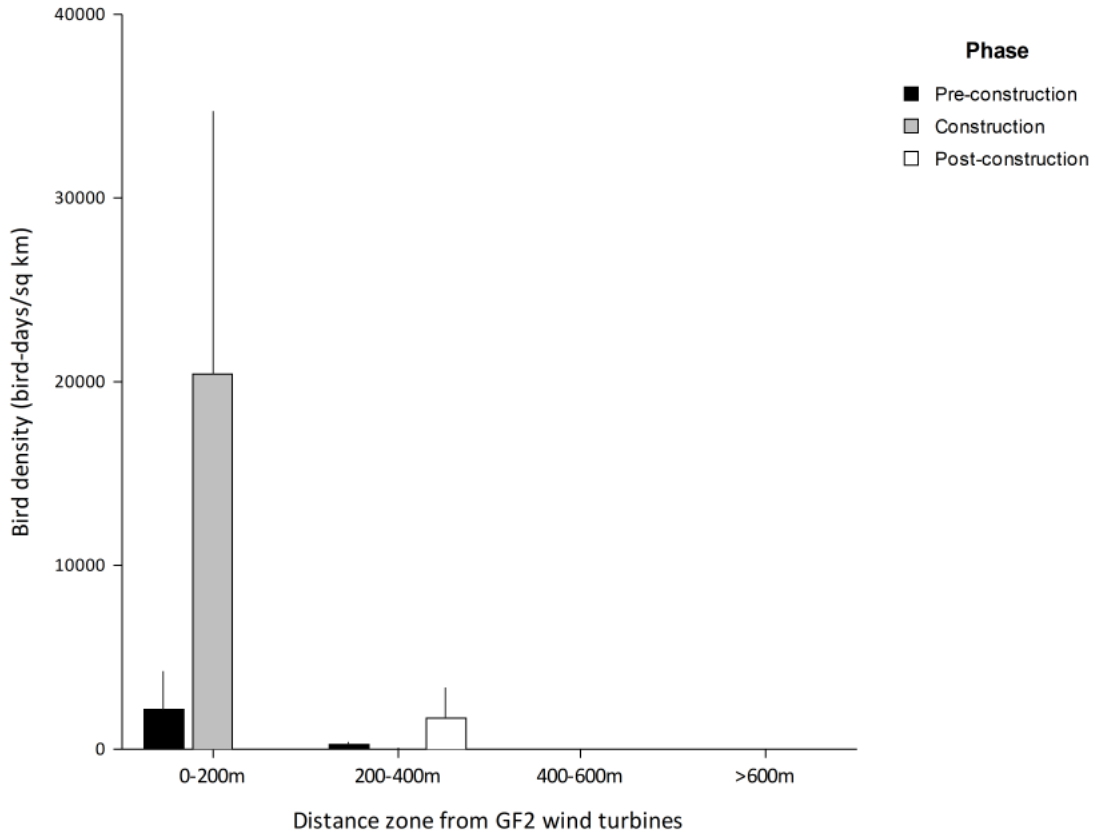
Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Mute Swan	0	2	0	4	0	0	0	0
Whooper Swan	1	0	0	2	0	0	0	0
Pink-footed Goose	0	190	1300	0	12	581	930	252
White-fronted Goose	0	0	0	0	0	0	0	0
Greylag Goose	0	0	120	0	15	2	44	6
Shelduck	0	0	0	0	0	0	0	3
Teal	4	0	0	0	0	0	0	0
Mallard	18	2	2	33	2	2	3	157

Species	Pre-construction					Construction		Post-construction
	2007-08	2008-09	2011-12	2013-14	2014-15	2015-16	2016-17	2017-18
Shoveler	0	0	0	0	0	0	0	4
Little Grebe	0	3	0	0	0	0	0	0
Cormorant	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	0	0	1	5
Grey Heron	1	3	1	2	0	1	0	1
Marsh Harrier	0	1	1	1	4	1	1	2
Hen Harrier	0	0	1	0	1	0	0	0
Sparrowhawk	1	0	1	1	1	0	0	0
Buzzard	0	0	1	2	3	2	1	3
Kestrel	2	3	4	5	4	3	5	6
Merlin	0	0	0	0	1	0	2	1
Hobby	0	0	0	3	0	0	0	0
Peregrine	1	1	2	2	2	1	0	3
Common Crane	0	0	0	4	0	2	6	0
Golden Plover	122	344	153	237	568	38	480	56
Lapwing	50	347	0	446	7	46	13	16
Snipe	0	0	0	0	0	0	0	1
Green Sandpiper	0	0	0	0	0	0	0	3
Redshank	0	0	0	0	0	0	6	4
Mediterranean Gull	0	0	0	1	0	0	0	0
Common Gull	106	140	134	255	49	80	126	164
Caspian Gull	0	0	0	1	0	1	1	3
Lesser Black-backed Gull	19	49	58	467	12	280	291	396
Yellow-legged Gull	0	4	0	10	4	17	23	18
Herring Gull	21	53	8	15	6	14	64	27
Great Black-backed Gull	0	8	2	2	0	2	6	3
Black-headed Gull	62	678	66	908	760	290	312	480
Barn Owl	0	1	0	0	1	0	0	0
Little Owl	0	2	0	1	0	2	0	1

69. The species selected for further analysis of field use in relation to distance from the wind farm comprised pink-footed goose, golden plover, lapwing, common gull and black-headed gull. All of the other species were seen on the ground in insufficient numbers or in an insufficient number of fields to enable meaningful analysis to be undertaken.

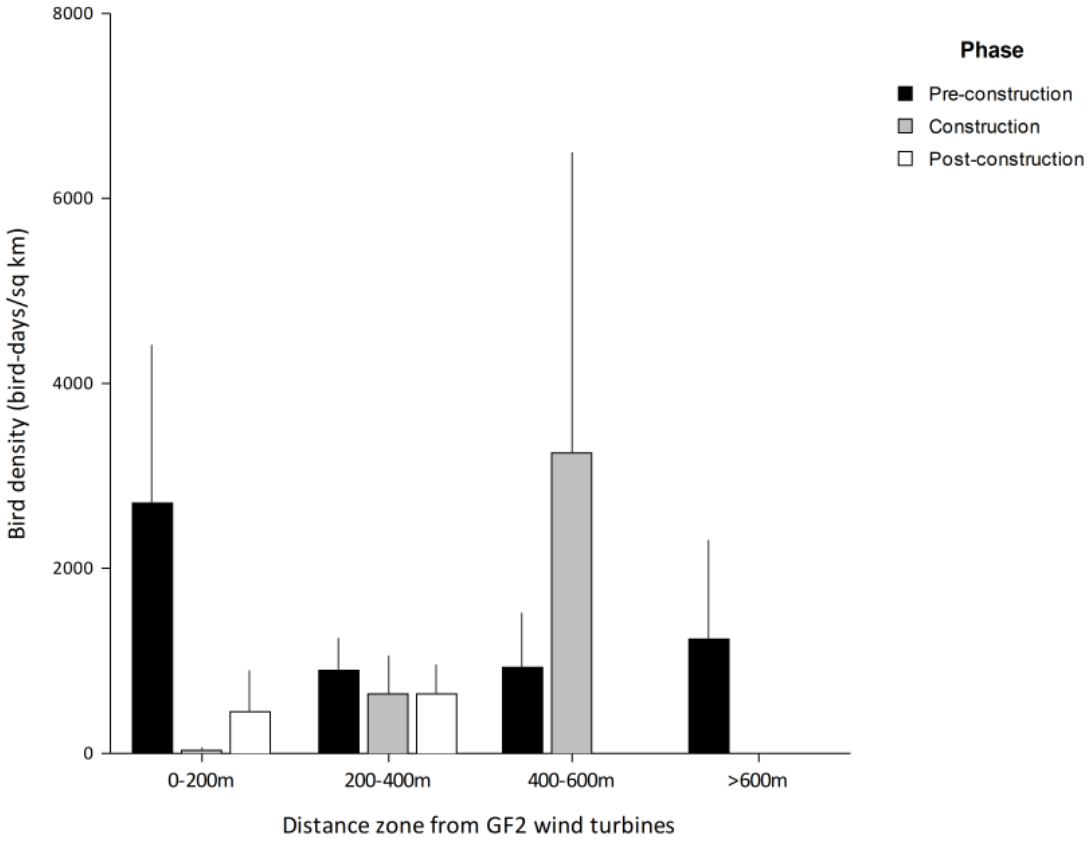
70. Pink-footed goose densities in each zone from the wind turbines are summarised in Figure 14. The large majority of records within the core survey area were from the closest zone to the wind turbines (i.e. within 200m throughout the surveys. Overall, there was no evidence of any displacement effect of construction of the wind farm on this species. Numbers were too low within the Goole Fields II core area in 2017-18 to determine any effect post-construction (other than to establish that they did use the area within 600m of the wind turbines).

Figure 14. Pink-footed goose density in relation to distance from the Goole Fields II wind turbines during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and post-construction (2017-18).



71. Golden plover densities in relation to the distance from the wind turbines are summarised in Figure 15. This gives the mean number of bird-days per km^2 for each 200m zone from the turbines.

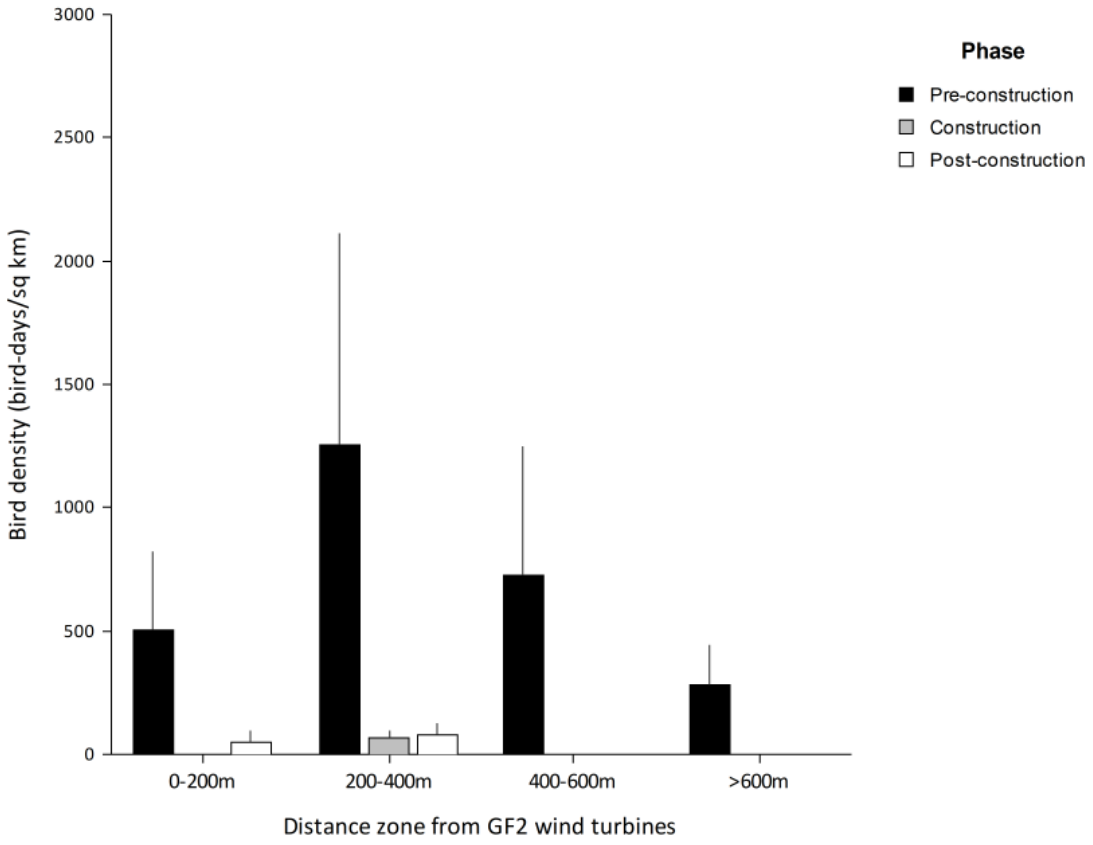
Figure 15. Golden plover density in relation to distance from the Goole FieldsII2 wind turbines during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and post-construction (2017-18)



72. Though the variability in the data was high (as shown by the large standard error bars on the Figure), there is an indication of a reduction in golden plover numbers in the zone closest to the wind turbines (0-200m) during construction (indicative of a possible displacement of birds from that zone). There was no evidence of any displacement beyond 200m. A similar result was apparent in the first year of operation, though numbers were lower overall in that winter, and there was higher use of the 0-200m zone that there had been during construction.

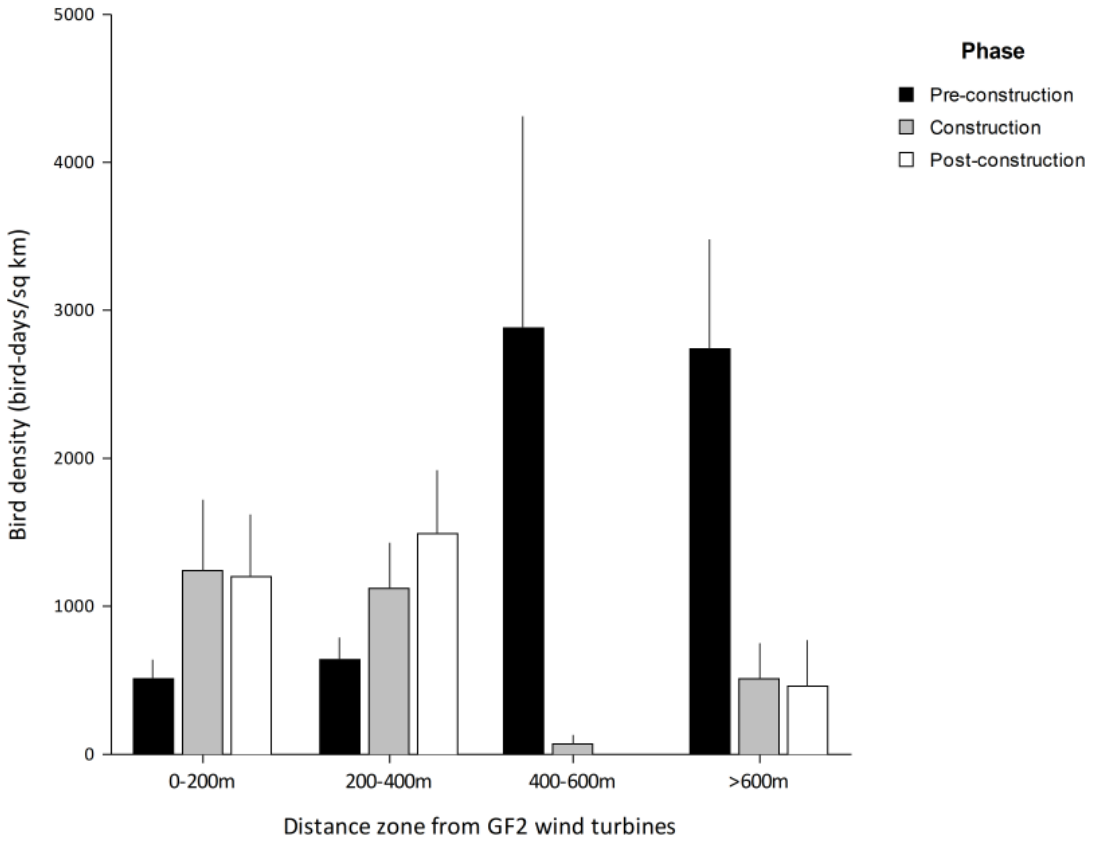
73. Lapwing densities were much lower across all parts of the survey area during construction and operation than in the pre-construction baseline surveys, making it difficult to reach any conclusions about how this species might have been affected by the construction or operation of the wind farm (Figure 16).

Figure 16. Lapwing density in relation to distance from the Goole Fields II wind turbines during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and post-construction (2017-18).



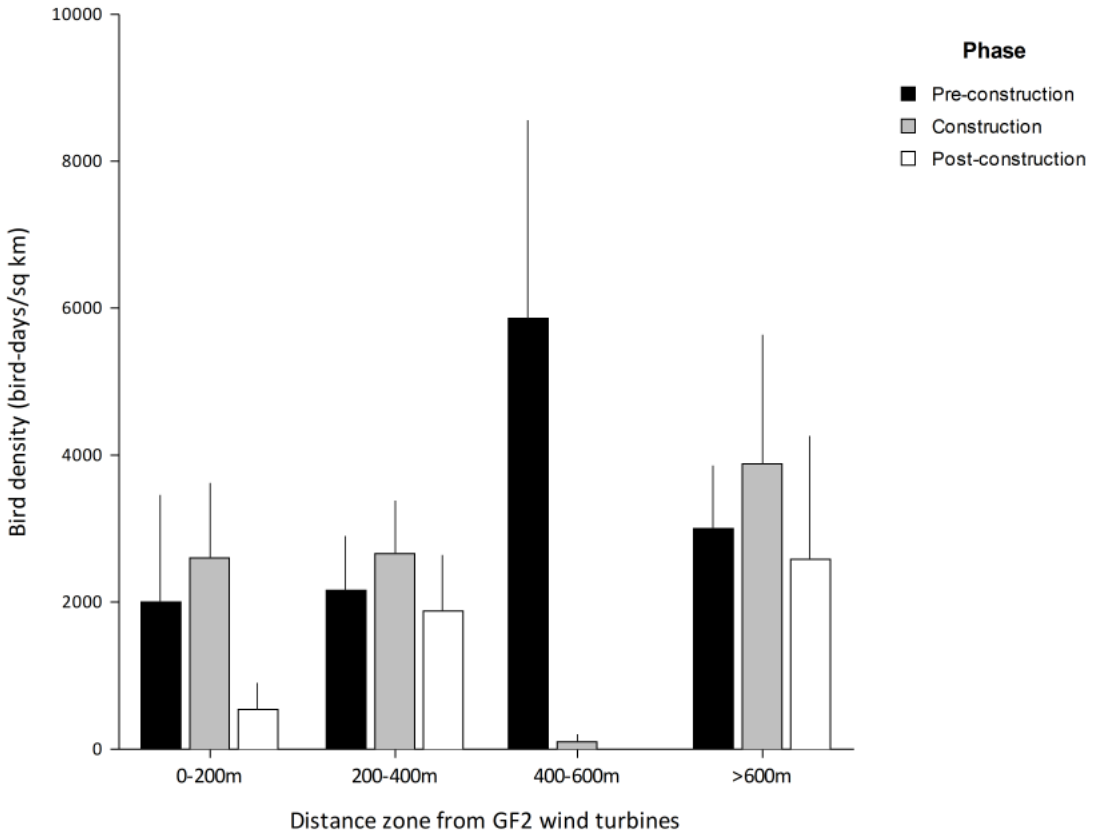
74. Common gull densities did not show any decline in proximity to the wind farm during construction or in the first winter of operation in comparison with the pre-construction baseline. Numbers were actually higher than the pre-construction baseline within 400m of the wind turbines during construction but lower beyond 400m (Figure 17). Overall, there was no evidence of any displacement effect of construction or operation of the wind farm on common gulls.

Figure 17. Common gull density in relation to distance from the Goole Fields II wind turbines during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and post-construction (2017-18).



75. Black-headed gull showed a no decline in numbers within 400m of the wind turbines during construction, but there were lower numbers recorded within 200m in the first winter of operation (Figure 18). There were much lower numbers of this species >400m from the turbines in both the construction and operation winters. The high variability in the numbers between years across all of the sectors makes it difficult to establish any effects of the wind farm.

Figure 18. Black-headed gull density in relation to distance from the Goole Fields II wind turbines during the pre-construction (2007-08, 2008-09, 2011-12, 2013-14 and 2014-15), construction phases (2015-16 and 2016-17) and post-construction (2017-18).



Bird Flight Activity in the vicinity of the wind farm

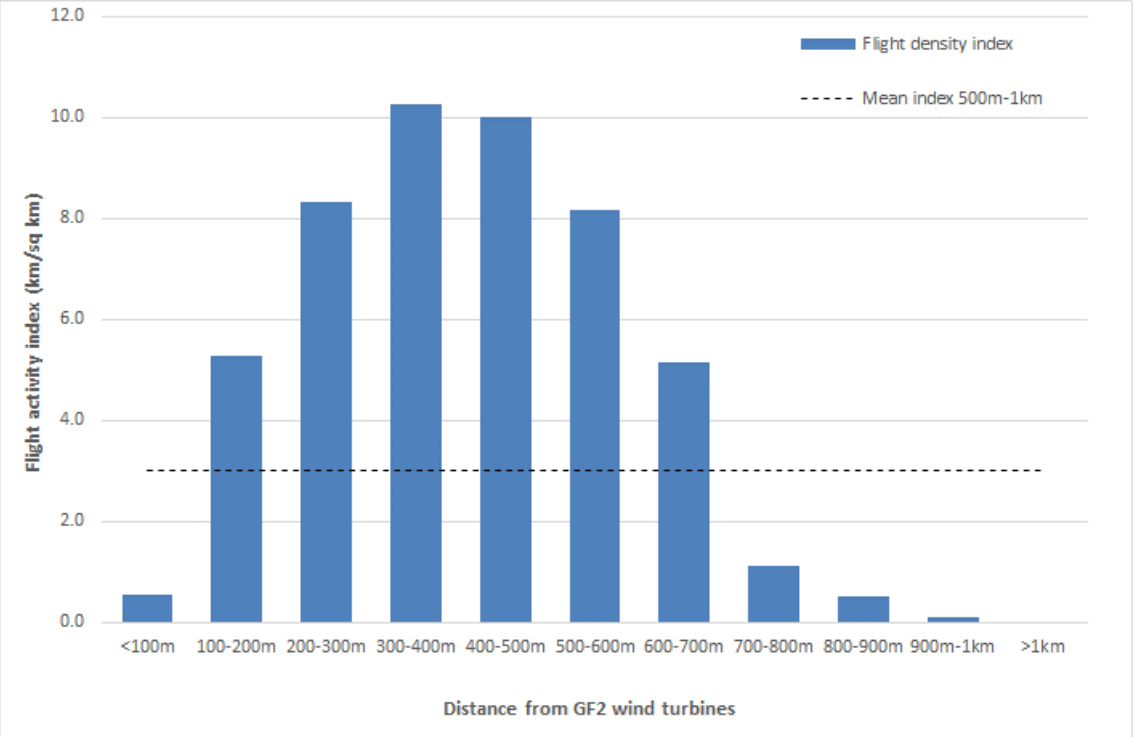
76. Eight species were selected for further analysis of flight activity in relation to distance from the wind farm; pink-footed goose, marsh harrier, buzzard, kestrel, common gull, lesser black-backed gull, herring gull and black-headed gull. These species were recorded during the VP surveys in sufficient numbers to enable a meaningful analysis to be undertaken. Further analysis of flight activity will be undertaken when more post-construction year's surveys have been completed, using a grid overlay and a combination of gradient analysis and before/after comparison.

77. The flight analyses and associated Figures excluded the flights from the eastern edge of the VP survey area for the area that lies closer to the Goole Fields 1 turbines than those of the Goole Fields II wind farm, to exclude the possible effect of the Goole Fields 1 turbines on the results.

Pink-footed Goose

78. Pink-footed goose flight activity in 100m bands from the Goole Fields II wind turbines in 2017-18 is summarised in Figure 19. Flights within 100m of the wind turbines were reduced by 82% in comparison with the 500m-1km mean. Beyond 100m, flight activity was above the 500m-1km mean level, indicative of a lack of evidence of displacement of flights further than 100m from the turbines.

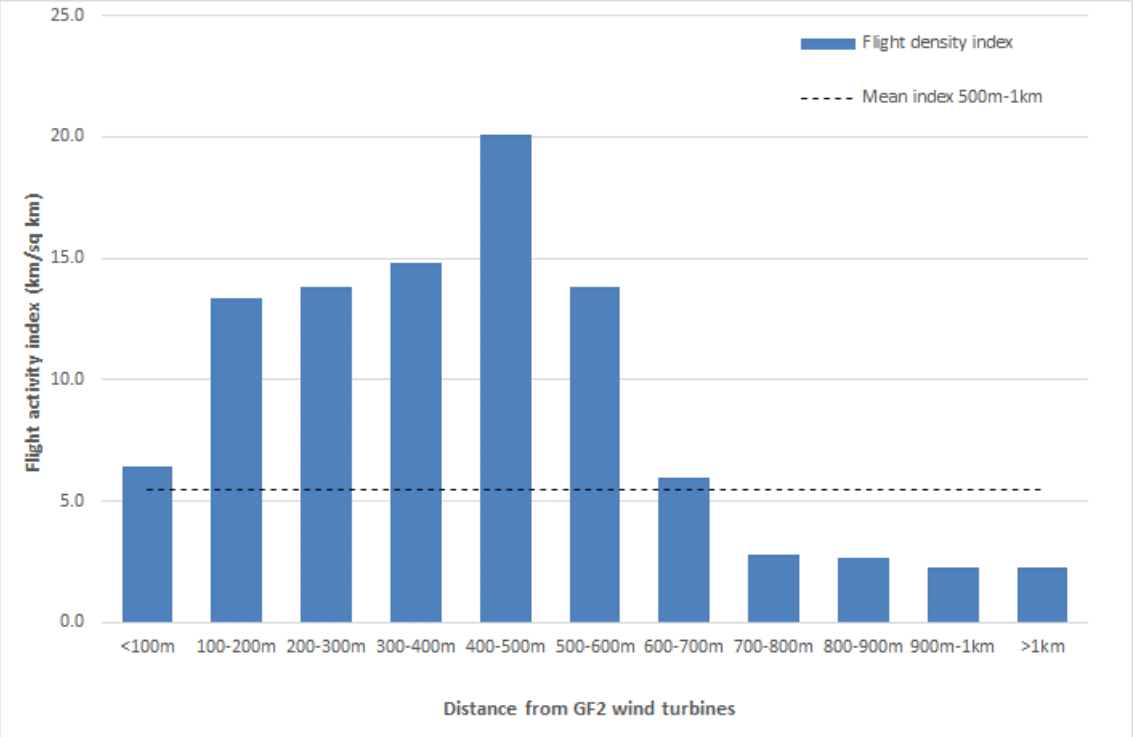
Figure 19. Pink-footed Goose flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.



Marsh Harrier

79. Marsh harrier flight activity in 100m bands from the wind turbines in 2016-17 is summarised in Figure 20. Flight density within 100m of the wind turbines was higher than the 500m-1km mean, suggesting little if any displacement of flight activity from around the wind turbines, though flight density within 100m of the turbines was about 50% lower than that in the 200-600m zones.

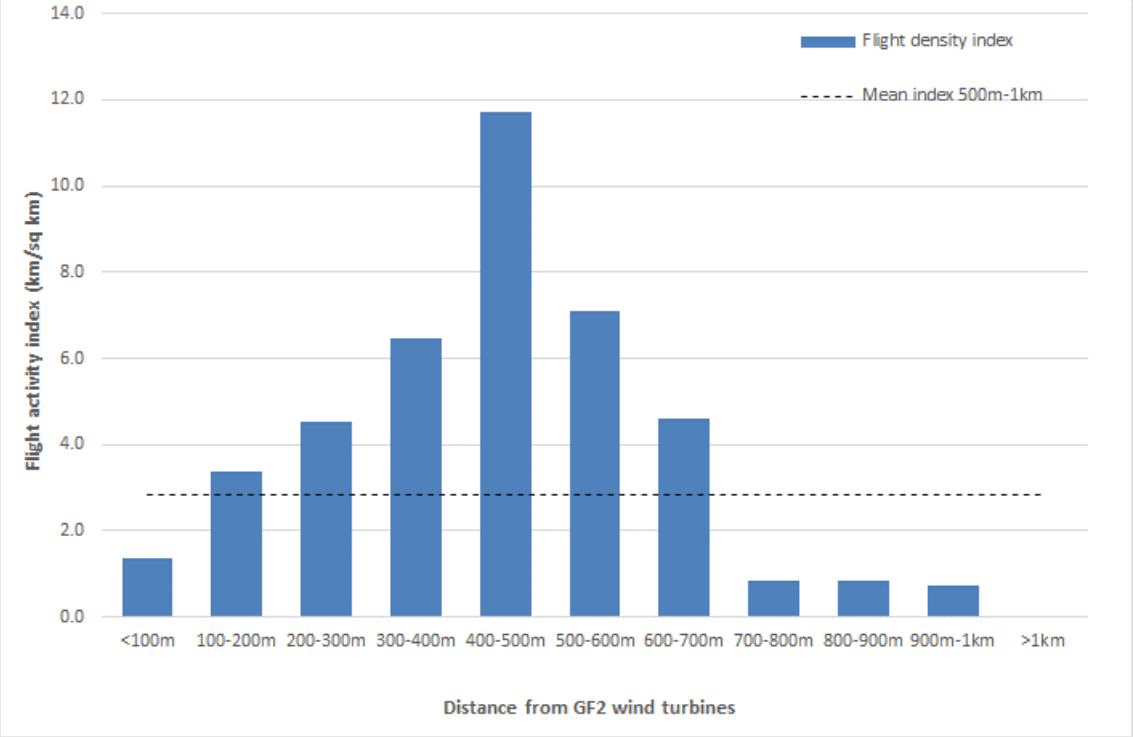
Figure 20. Marsh Harrier flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.



Buzzard

80. Buzzard flight activity in 100m bands from the Goole Fields II wind turbines in 2017-18 is summarised in Figure 21. Flights within 100m of the wind turbines were reduced by 52% in comparison with the 500m-1km mean. Beyond 100m, flight activity was above the 500m-1km mean level, indicative of a lack of evidence of displacement of flights further than 100m from the turbines.

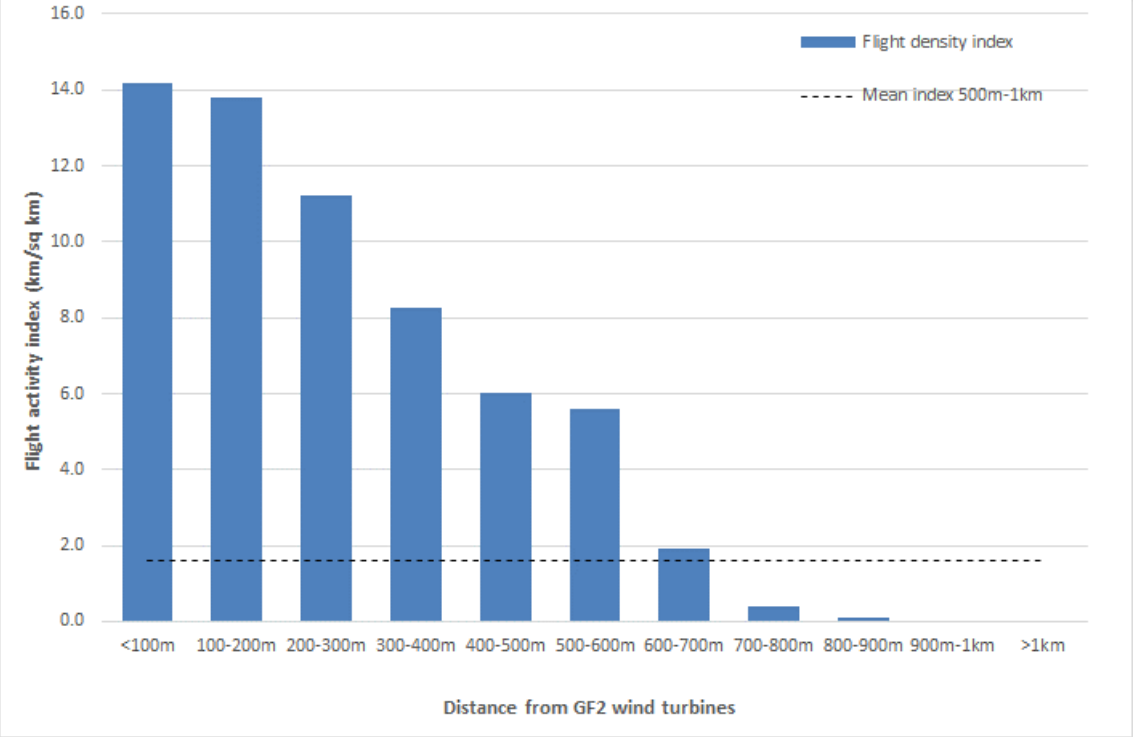
Figure 21. Buzzard flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.



Kestrel

81. Kestrel flight activity in 100m bands from the wind turbines in 2016-17 is summarised in Figure 20. Flight density within 100m of the wind turbines was higher than the 500m-1km mean, suggesting no displacement of flight activity from around the wind turbines. Flight activity was actually highest in closest proximity to the turbines, suggesting that this species may have been attracted into the wind farm (possibly using the grassy track margins for feeding habitat).

Figure 22. Kestrel flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.



Gulls

82. Common gull, lesser black-backed gull, herring gull and black-headed gull all showed similar patterns of flight activity in relation to distance from the wind turbines in 2016-17, with lower flight activity within 100m in all three species but no evidence of any flight displacement beyond that distance (Figures 23, 24, 25 and 26). Flights within 100m of the wind turbines in comparison with the 500m-1km mean were reduced by 54% for common gull, 49% for lesser black-backed gull, 83% for herring gull and 57% for black-headed gull.

Figure 23. Common Gull flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.

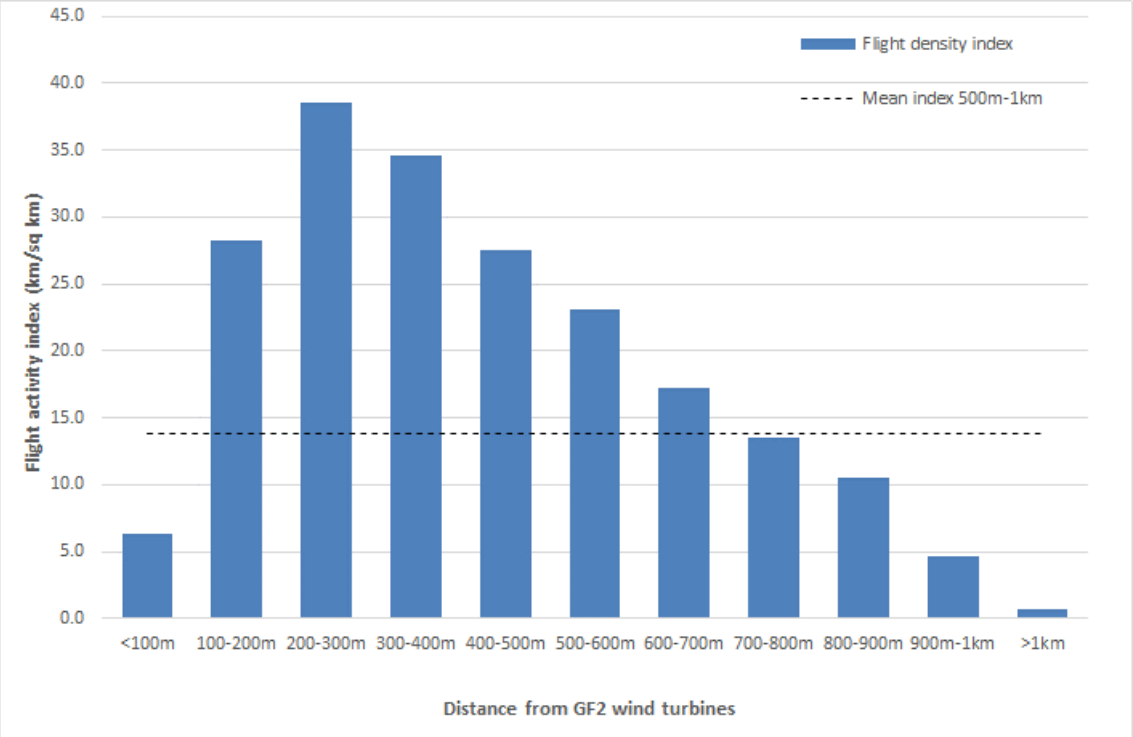


Figure 24. Lesser Black-backed Gull flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.

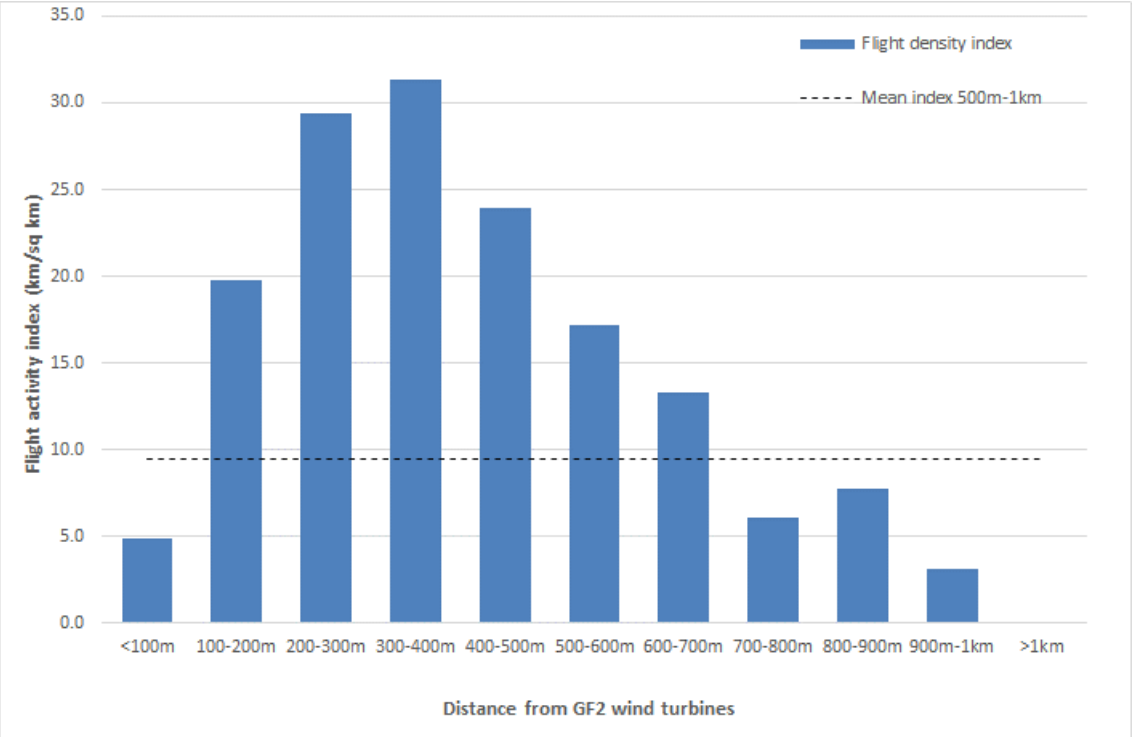


Figure 25. Herring Gull flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.

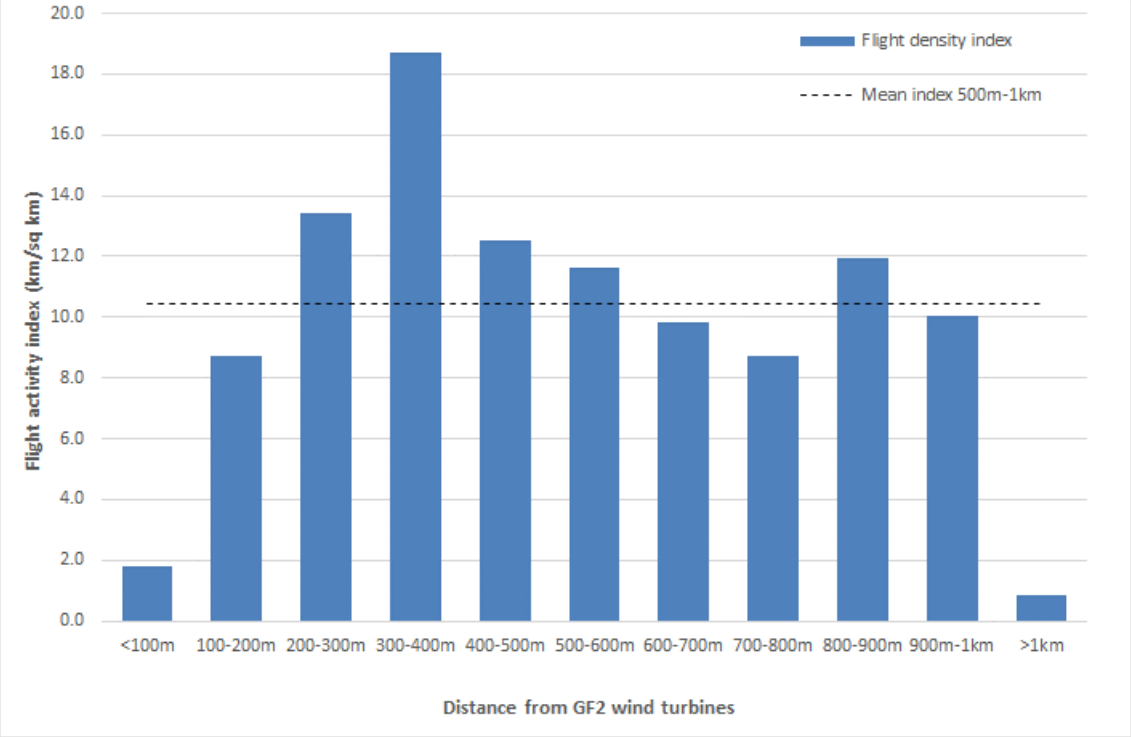
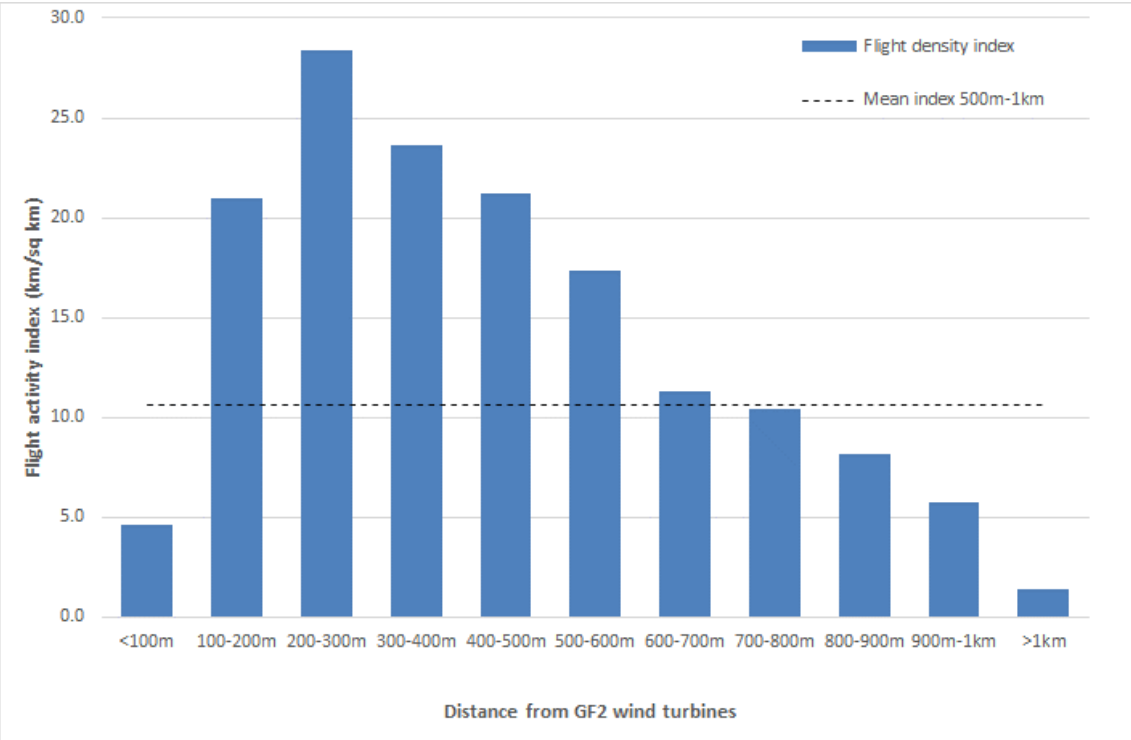


Figure 26. Black-headed Gull flight density at Goole Fields II in 2017-18 in relation to distance from the wind turbines.



Collision Risk

83. A field trial in the 2017 breeding season showed observer search efficiency to be high, with 91% of test birds found later the same day. Whilst this is only an initial value based on a single trial, a similar high rate was also recorded at the Goole Fields I wind farm.

84. Scavenger trials showed that some trial corpses were removed rapidly without any signs remaining. Three estimates of scavenger removal were derived during the 2017/18 surveys, one based on dead birds found during the searches, one on a scavenger removal trial and one on a camera-trapping trial. These gave mean time to disappearance of 72 days, 51 days and 20 days respectively. Combining all three of these together gave an overall mean value of 48 days, equivalent to a daily disappearance rate of 2.1% (very similar to value determined over a longer time period at the Goole Fields I wind farm). Given that, on average, a corpse would need to be present for 4 days to be detected, this would mean that 8.1% of collisions would be missed as they had occurred and disappeared between the weekly searches.

85. It was not possible to reliably cover all parts of the turbine search zone on all visits (as a result of vegetation cover when crops grew higher), so this too needs to be taken into account in estimating the actual number of collisions that have occurred. The extent of the survey coverage of each wind turbine was estimated in the field on monthly basis. This gave a mean coverage of 81% during September 2017 - March 2018.

86. The number of collisions of each species recorded over the first winter of post-construction monitoring are given in Table 9, together with the estimated numbers of actual collisions incorporating the observer efficiency, scavenger removal and survey effective coverage (though these are all preliminary values based on only a single season's data).

Table 9. Numbers of dead birds found during the collision victim monitoring surveys, September 2017 - March 2018, and estimated numbers of actual collisions (incorporating observer efficiency, scavenger removal and survey effective coverage).

Species	Number of collisions recorded in 2017/18	Estimated number of actual collisions
Buzzard	1	1.5
Kestrel	1	1.5
Pheasant	1	1.5
Golden Plover	1	1.5
Woodcock	1	1.5
Lesser Black-backed Gull	1	1.5
Black-headed Gull	2	2.9
Woodpigeon	6	8.8
Goldcrest	1	1.5

87. The collision rates predicted in the ES and those observed during 2017-18 are compared in Table 23. The estimated numbers of actual collisions were considerably lower than those predicted in the ES.

Table 23. ES predictions of collision risk and the estimated number of actual collisions during 2017-18.

Species	Predicted number of collisions per year (ES)	Number of collisions recorded	Estimated number of actual collisions
Pink-footed Goose	7.1	0	0
Marsh Harrier	0.2	0	0
Merlin	0.03	0	0
Peregrine	0.03	0	0
Golden Plover	13.2	1	1.5
Lapwing	3.3	0	0
Ruff	0.02	0	0

Conclusions

88. The analysis of the first year of post-construction phase surveys in 2017-18 indicates that the effects of the operation of the Goole Fields II wind farm on the local wintering bird populations have been minor so far, with no indication of any effects that could be potentially significant. Low numbers of key species across the whole survey area and highly variable numbers made any definitive analysis of displacement of wintering birds difficult, but no clear effects of the wind turbines were apparent. It is clear that the 600m zone used to define the potential disturbance zone in the ES assessment was overly precautionary, as most key species were observed feeding in this zone during operation.

89. The breeding bird survey results in 2017 found no statistically or biologically significant effects resulting from the operation of the wind farm over this period. Most breeding populations have been maintained in 2017 in comparison with the pre-construction baseline, even in close proximity to the wind farm.

90. Vantage point surveys suggested that most key species showed reduced flight activity in close proximity to the wind turbines. Flight densities were reduced, though this effect was largely only within 100m of the turbines, with a resultant reduction in collision risk. Further data from the post-construction monitoring will enable the effects on these species' flight behaviour to be more comprehensively determined.

91. The collision searches found a small number of birds that may have collided with the wind turbines, comprising 6 woodpigeons, 2 black-headed gulls and single individual buzzard, kestrel, pheasant, golden plover, woodcock, lesser black-backed gull and goldcrest (making the worst-case assumption that all dead birds found were collision victims). An unidentified small bat and a pipistrelle bat were also found. Bird remains lasted on average for 72 days and observer detection of dead birds was high (91%). Collison rates have been considerably lower than those predicted in the ES.

92. Given the results of the collision searches from 2017-18, and the scavenger removal and observer efficiency trials, it is recommended that the collision monitoring be continued

through the second and third years of post-construction monitoring, as it is generating scientifically useful data, particularly quantifying the actual collision rates.

93. Overall the ES predicted that there would not be any significant ornithological impacts resulting from the Goole Fields II wind farm, and the results to date have supported that position.

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