APPENDIX 4: ORNITHOLOGY

INTRODUCTION

4.1 This chapter assesses any significant changes in the population of breeding and wintering birds using the proposed Heckington Fen Wind Park site between 2007/8 and 2014/15. A detailed assessment of the potential effect of the proposed Heckington Fen Wind Park on birds was carried out in 2009. This concluded "no effects of the development on birds are considered to be significant under the terms of the EIA regulations."

4.2 The use of the site by wintering and breeding birds is largely determined by the habitats within in the site and the land use. An updated enhanced phase 1 survey was carried out in April 2018 (**Appendix 3 Annex 1).** This found no significant change in the habitat present on the site since 2009.

4.3 However, a precautionary approach has been taken and as part of the ongoing monitoring of the site further baseline surveys were conducted in 2014/15.

4.4 The baseline surveys were undertaken by Kevin Shepherd - Consultant Ornithologist Limited.

STATEMENT OF COMPETENCE

4.5 Kevin Shepherd (Consultant Ornithologist) is a highly experience ornithological consultant with over 20 years of experience and is one of the leading UK consultants conducting ornithological surveys for wind farm development. He has conducted surveys and prepared EIA chapter for wind farm development across the UK. Ecotricity has used Kevin Shepherd Consultant services , amongst other consultants for at least ten years more recent sites include ornithology chapter for EIA for , Stoke Heights near Milton Keynes , Dalby Leicestershire , Black ditch in Somerset , Upper Sonochan in Argyle and Bute, Dulater Hill in Perthshire , Kirkdale Hill in Dumfriesshire Kevin has been involved in development of suitable birds survey methods is a joint author on one the definitive papers of bird surveys methods (*Brown, A.F. & Shepherd, K.B. (1993) A method for censusing upland breeding waders. Bird Study, 40, 189-195.).*

METHODS

Baseline studies

4.6 A twelve-month baseline ornithological survey was initiated in April 2014. The objectives were to survey:

- All bird species breeding within an area extending to at least 500m beyond the locations of the proposed turbines and site infrastructure (undertaken during April-July 2014);
- All bird species utilising the above area during the non-breeding period (undertaken during September 2014 – March 2015);

4.7 Field surveys were undertaken by Neil Bostock and Kevin Shepherd. The surveyors are both first class, highly experienced field ornithologists each with over 20 years of experience. Nevertheless, extensive training was provided both prior to and during survey, irrespective of previous experience. Aspects covered included navigation, application of the various survey methods, techniques to minimise fieldworker effects on bird detection, and recognition of birds, bird signs and bird behaviour. Emphasis was placed on the importance of carrying out the surveys in a systematic, standardised way to enable collection of rigorous survey data and direct comparison of data from different areas and survey periods. Full details of survey methods and results are given in **Annex 1: Ornithological Survey Methods and Results**.

Evaluating Nature Conservation Importance

4.8 The nature conservation importance of the bird species potentially affected by development is defined in accordance with **Table 4.1**. The classification is hierarchical; so species that qualify under more than one category are defined according to the highest class.

Table 4.1 Determining factors for nature conservation importance.

Importance	Definition
Very high	Species that form the qualifying interest of nearby SPAs and SSSIs.
High	Species listed on Annex I of EC Directive 79/409/EEC on the Conservation of Wild Birds 1979 (Annex I species). Breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (Schedule 1 species). Species present in nationally important numbers (>1% UK population).
Moderate	Breeding species listed as UK Biodiversity Action Plan priority species (UK BAP priority species). Breeding species listed on the Birds of Conservation Concern 'Red' list (BOCC Red List species)[1]. Species present in regionally[2] important numbers (>1% regional population). Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the proposed development.
Low	All other species.

[1] *Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R., Aebischer, N.J., Gibbons, D.W., Evans, A. and Gregory, R.D. (2009). Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102: 296-341.*

[2] *Region is defined as the relevant Natural England Regional Area (*http://www.naturalengland.org.uk*), in this case NE East Midlands Region.*

Evaluating the magnitude of effects

4.9 Effect is defined as change in the population of a given bird species present as a result of the development. Change can occur during or beyond the life of the development. Where the response of a population has varying degrees of likelihood, the probability of these differing outcomes is considered. Note that effects can be adverse, neutral or favourable.

4.10 The overall magnitude of effects is determined by taking three factors into account:

- The behavioural sensitivity of the species;
- The spatial magnitude of the effect; and
- The temporal magnitude of the effect.

4.11 Behavioural sensitivity is determined subjectively based on species' ecological function and behaviour, using the broad criteria set out in **Table 4.2**. The judgement takes account of information available on the responses of birds to various stimuli (e.g. predators, noise and disturbance by humans). Note that behavioural sensitivity can differ even between similar species[3] and that, within a particular species, some populations and individuals may be more sensitive than others. Thus the behavioural responses of birds are likely to vary with both the nature and context of the stimulus and the experience and personality of the bird. Sensitivity also depends on the activity of the bird. For example, a species may be less tolerant of disturbance whilst breeding than at other times, though tolerance is likely to increase as breeding progresses[4].

Table 4.2 Determining factors for behavioural sensitivity.

Sensitivity	Definition
High	Species or populations occupying habitats remote from human activities, or that exhibit strong and long-lasting reactions to disturbance events.
Moderate	Species or populations that appear to be warily tolerant of human activities, or exhibit short-term reactions to disturbance events.
Low	Species or populations occupying areas subject to frequent human activity and exhibiting mild and brief reaction (including flushing behaviour) to disturbance events.

4.12 The magnitude of effects is also judged in terms of space (**Table 4.3**) and time (**Table 4.4**)[5].

Table 4.3 Spatial magnitude criteria.

Magnitude	Definition
Very high	Total loss or very major alteration to key elements/features of the baseline (pre-development) conditions such that the post development attributes would be fundamentally changed and may be lost altogether. Guide: >80% of regional population affected, >20% of national population affected.
High	Major loss or major alteration to key elements/features of the baseline conditions such that the post development attributes would be fundamentally changed. Guide: 21-80% of regional population affected, 6-20% of national population affected.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development attributes would be partially changed. Guide: 6-20% of regional population affected, 1-5% of national population affected.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration would be discernible but the underlying attributes would be similar to pre-development circumstances/patterns. Guide: 1-5% of regional population affected, <1% of national population affected.
Negligible	Very slight change from baseline conditions. Change barely distinguishable, approximating to the "no change" situation. Guide: <1% of regional population affected, no discernible effect on national population.

Table 4.4 Temporal magnitude criteria.

Magnitude	Definition
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25 years), except where there is likely to be substantial improvement after this period (e.g. the replacement of mature trees by young trees which need >25 years to reach maturity, or restoration of ground after removal of a development. Such exceptions can be termed very long term effects).
Long-term	Approximately 15-25 years or longer (see above).
Medium-term	Approximately 5-15 years.

[3] *Schueck, L.S., Marzluff, J.M., & Steenhof, K. (2001). Influence of military activities on raptor abundance and behavior. Condor 103: 606-615.*

[4] *Holthuijzen, AMA (1985). Behavior and productivity of nesting prairie falcons in relation to construction at Swan Falls Dam and experimental blasting. Snake River Birds of Prey Research Project Annual Report 1985.*

[5] *Regini, K. (2000). Guidelines for ecological evaluation and impact assessment. Ecology and Environmental Management. In Practice 29 (September): 1-7. Institute of Ecology and Environmental Management, Winchester.*

Temporary	Up to approximately 5 years.

4.13 In the case of internationally or nationally designated sites (e.g. SPAs, SSSIs), magnitude is assessed in respect of the area within the designated site boundary. For non-designated sites, magnitude is assessed in respect of an appropriate ecological unit, e.g. Natural England Regional Area.

4.14 Knowledge of how rapidly the population or performance of a species is likely to recover following loss or disturbance (e.g. by birds being recruited from other populations elsewhere) is used to assess temporal effects, where such information is available.

4.15 The above factors are taken into account in order to come to an overall assessment of impact magnitude using simple categories (**Table 4.5**). These place an emphasis on the integrity of species/populations, in line with the approach set out in European law for the protection of populations of birds, particularly within SPAs. The integrity of a population is essentially the coherence of its ecological structure and function, across its range that enables it to sustain itself. A population that achieves such coherence is considered to be in favourable condition.

Table 4.5 Overall impact magnitude.

Magnitude	Criteria
Major negative	The change is likely to cause an adverse effect on the integrity of a species/population of nature conservation importance.
Negative	The change adversely affects the species/population, but there will probably be no effect on its integrity.
Neutral	No or negligible effect.

Evaluating the effects

4.16 A matrix (**Table 4.6**) is then used to assign a level of effect (**Table 4.7**) of the potential impact.

Table 4.6 Impact effect matrix.

Overall Impact Magnitude	Nature conservation importance			
	Very high	High	Moderate	Low
Major negative	Extreme	Extreme	Extreme-moderate	Major-minor
Negative	Major- minor	Major-minor	Major-minor	Moderate-minor
Neutral	No/negligible impact			

Table 4.7 Definitions of effects.

Significance	Definition
Extreme	These effects represent key factors in the decision making process. They are generally, but not exclusively, associated with sites and features of international or national importance (e.g. SPA/SSSIs) and resources/features which are unique and which, if lost, cannot be replaced or relocated.
Major	These effects are likely to be important considerations at a regional or district scale, but, if adverse, are potential concerns to the project, depending upon the relative importance attached to the issue during the decision making process.
Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or a particular resource.
Minor	These effects may be raised as local issues but are unlikely to be of importance in the decision making process. Nevertheless, they may be of relevance in the detailed design of the project.
Negligible	No effects (or those beneath levels of perception); within normal bounds of variation or within margins of forecasting error.

4.17 Where the boxes in **Table 4.6** contain a range of values, professional judgement is used to assign a value within the range given. Impacts judged to be of moderate or greater significance should be considered 'significant' in terms of the EIA regulations, while impacts assessed as being of minor significance or no impact do not need to be treated as significant effects in terms of the EIA regulations.

BASELINE DESCRIPTION

Designated sites

4.18 No SSSIs lie within 10km of the proposed wind park.

Baseline survey results

4.19 A total 77 Species were record using the survey areas during November 2014-March 2015. This compares to 81 species recorded during wintering bird survey conducted in 2007/8.

4.20 Those species recorded in 2007/8 but not recorded in 2014/15 were mainly wetland birds (wigeon, shoveler, tufted duck, water rail, curlew, redshank, greater black backed gull and grey wagtail) which were only recorded in small number in 2007/8. In addition, house sparrow and corn bunting were recorded in 2007/8 but not in 2014/15 as well as the vagrant Lapland bunting recorded in 2007/8

4.21 The areas surveyed in 2014/15 was smaller than the area surveyed in 2007/8. This is due to a reduction in the developable area in the permitted scheme compared to the maximum developable area which was being considered for the original application at the time the original surveys were carried out.

Generally the number of birds of each species recorded was broadly similar in 20014/15 to 2007/8. However, in 2014/15 there were more pink footed geese in the area close to the site than in 2007/8 and a large flock was recorded within the survey area in November 2014. The counts of lapwing within the survey area were generally higher in 2014/15 than in 2007/08 although the number golden plover recorded in 2014/15 were generally lower than in 2007/8. The distribution of number of wintering birds in an arable landscape is very much determined by the particular crop or sate of cultivation in each field during the winter.

4.22 Eight Annex I species (little egret, marsh harrier, hen harrier, merlin, peregrine, golden plover, short-eared owl and kingfisher) were recorded during the winter baseline surveys.

4.23 Little egrets were seen foraging adjacent to the site in Holland Dike.

4.24 Marsh harriers were recorded occasionally foraging on and around the site during April-September and on two occasions during winter surveys. Extensive surveys for breeding birds found no evidence marsh harrier breeding within 2km of the site.

4.25 Hen harriers were occasionally recorded foraging on and around the site .

4.26 There were single records of Peregrine in December 2014, January 2015 and February 2015.

4.27 Flocks of golden plover were recorded on agricultural fields on and around the site during wintering birds surveys in November 2015 (count 78), December 2015 (count 140), January 2015 (count 35) February 2015 (count 90) and March 2015 (count 1). This compares counts of 143, 176, 125, 256 and 25 in the same months during winter 2007/2008. Golden plovers do not breed in Lincolnshire[6]. Large numbers arrive in autumn from breeding grounds in northern Britain, Iceland, Scandinavia and Russia, the majority then moving on to winter further south or south-west. Wintering birds then return north from February onwards, with spring passage generally being lighter than autumn[7] [8]. The numbers recorded in the Heckington Fen area during the year therefore reflect a typical overall pattern of occurrence.

4.28 Single short-eared owls were recorded foraging on and around the site in February and March sightings are considered to have related to very small numbers of passage migrants or wandering wintering birds in the area at these times. .

4.29 Small numbers of kingfishers were recorded foraging along dikes on and around the site (mainly along the main Head/Holland Dike) during winter months but were not recorded during the breeding season probably reflecting the lack of suitable banks for nesting..

4.30 Single hobbies were recorded occasionally foraging on and around the site during May – July but extensive searches found no evidence of birds breeding within 2km of the site.

4.31 Barn owls resident through the year were recorded with one pair breeding successfully in 2014.

4.32 A total of 54 species were recorded during the breeding bird survey. A total of 473 breeding territories of 40 species breed were recorded making a breeding attempt. This compares to 54 species recorded during the breeding season in 2007 when a total 958 territories of 44 species were recorded making breeding attempt. The area surveyed in 2014 was only 60% of the area surveyed in 2007. The reduced survey area and annual year to variation can account for most of the differences between the in number and species record between the two surveys.

4.33 The absence of quail, starling, greenfinch and corn bunting in 2014 compared to 2007 may be due to year to year variations or it may reflect national declines in breeding population of these species.

4.34 No Annex 1 species were recorded breeding on the site in 2014, however marsh harrier were occasionally recorded during the breeding season as they were in 2007/8. There was no evidence marsh harrier or hobby breeding with 2km of the site in 2014

4.35 Ten UK BAP priority species were found breeding in the survey area (for mapped locations, see **Figure 2a & 2b**); grey partridge, lapwing, skylark, yellow wagtail, dunnock, song thrush, tree sparrow, linnet, yellowhammer and reed bunting. Eight of these (grey partridge, lapwing, skylark, yellow wagtail, song thrush, tree sparrow, linnet and yellowhammer) are also BOCC 'Red List' species. The number of pairs recorded in 2007 is given in brackets

4.36 Seven pairs of grey partridge were found breeding in agricultural fields and field margins (5 in 2007).

4.37 Three pairs of lapwing were found breeding in agricultural fields (16 in 2007).

4.38 A total of 101 pairs of skylark were found breeding in agricultural fields and field margins (151 in 2007)

4.39 A total of 33 pairs of yellow wagtail were found breeding in agricultural fields and field margins (30 in 2007).

4.40 Eight pairs of dunnock were found breeding in hedgerows and low scrub (20 in 2007).

4.41 One pair of song thrush were found breeding in copse in the hedgerow in eth centre of the site (2 in 2007).

4.42 Eight pairs of tree sparrow were found breeding in buildings (9 in 2007).

4.43 Eight pairs of linnet were found breeding in hedgerows and low scrub (16 in 2007).

4.44 A total of 13 pairs of yellowhammer were found breeding in hedgerows and low scrub (22 in 2007).

4.45 A total of 77 pairs of reed bunting were found breeding in agricultural fields and field margins, hedgerows and low scrub and in dense vegetation alongside dikes and drainage ditches (131 in 2007).

4.46 The site does not support any bird populations of national importance.

4.47 Other than Annex I / Schedule 1 / UK BAP priority / BOCC Red List species, the site does not support any bird populations of regional importance.

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[6] *Gibbons, D.W., Reid, J.B. and Chapman, R.A. (1993). The New Atlas of Breeding Birds in Britain and Ireland:1988-91. Poyser, Berkhamsted.*

[7] *Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R. (2002). The Migration Atlas: movements of the birds of Britain and Ireland. Poyser, London.*

[8] *Cramp, S. (1983). Handbook of the Birds of Europe, the Middle East and North Africa: The birds of the Western Palearctic. Volume III (waders to gulls). Oxford University Press, Oxford.*

4.48 The site does not lie on any recognised bird migration routes and is therefore unlikely to be used by significant numbers of migratory birds. Numbers of migratory birds noted during the baseline surveys were small and clearly insignificant.

4.49 There is no possibility that the site would be designated as internationally or nationally important for birds.

ASSESSMENT OF EFFECTS AND STATEMENT OF SIGNIFICANCE

4.50 Ten species of **high** nature conservation importance using the criteria set out in **Table 4.1** were recorded during the breeding and wintering bird surveys including little egret, marsh harrier, hen harrier, merlin, peregrine, golden plover, short-eared owl, kingfisher, hobby, and barn owl. This compares to sixteen during the 2007/2008 surveys.

4.51 Ten species of **moderate** nature conservation importance were identified using the criteria set out in **Table 8.1**: grey partridge, lapwing, skylark, yellow wagtail, dunnock, song thrush, tree sparrow, linnet, yellowhammer and reed bunting are all UK BAP priority species. Grey partridge, lapwing, skylark, yellow wagtail, song thrush, tree sparrow, linnet and yellowhammer are also BOCC 'Red List' species.

4.52 The numbers and range of species of birds using the site in 2014/2015 is very similar to that in 2007/2008. The difference are not considered significant. The minor variation in number and species is likely to be due the smaller survey area, national declines in certain species and possibly differences in particular crops in different years.

4.53 The detailed assessment submitted as part of the permitted scheme concluded that "no effects of the development on birds are considered to be significant under the terms of the EIA regulations". Given the similarity the number and species using the site it is considered that this conclusion is still valid for this site.

HABITAT/BIODIVERSITY ENHANCEMENT AND MONITORING

4.54 The site and its surrounding area supports farmland bird populations and the development may have effects on small numbers of barn owl, grey partridge, lapwing, skylark, yellow wagtail, dunnock, tree sparrow, linnet, yellowhammer and reed bunting breeding nearby. The suitable farmland bird habitat enhancement plan for the local area as stated in condition 18 is still valid and the plan could include, for example:

- the provision of nest-boxes for barn owls and tree sparrows;
- appropriate bank/dike/ditch maintenance protocols to improve breeding bird habitat and maximise prey abundance for barn owls and other raptors;
- the provision of short or sparsely vegetated areas in appropriate locations in spring for breeding lapwings;
- the provision of skylark 'plots';
- the provision of conservation headlands and uncultivated margins;
- the maintenance/enhancement of suitable hedgerows for foraging/nesting/roosting birds;
- the sowing of wild bird mixture on set-aside or fallow land.

4.55 An appropriate pre-construction bird monitoring programme as set out in condition 17 is still valid.

TECHNICAL ANNEX

HECKINGTON FEN 2014-15: ORNITHOLOGICAL SURVEY METHODS AND RESULTS

SCOPE

Baseline ornithological surveys of the proposed Heckington Fen Wind Park were undertaken in 2007-08[1]. This document reports further surveys undertaken during November 2014 – June 2015; with the following objectives:

- To determine the distribution and abundance of birds breeding within at least 500m of the proposed wind park;
- To determine the distribution and abundance of raptors (excluding sparrowhawk, buzzard and kestrel) and short-eared owl breeding within at least 2km of the proposed wind park;
- To determine the distribution and abundance of birds wintering within at least 500m of the proposed wind park;
- To quantify levels of flight activity, particularly by birds of high nature conservation importance[2], within at least 200m of the proposed wind park.

The location of the proposed wind park and the survey areas referred to above are shown in **Figure 1**.

The work was undertaken by Kevin Shepherd - Consultant Ornithologist Limited.

FIELD SURVEY METHODS

Field surveys were undertaken by Neil Bostock and Kevin Shepherd. The surveyors were both first class, highly experienced field ornithologists. Nevertheless, extensive training was provided both prior to and during survey, irrespective of previous experience. Aspects covered included navigation, application of the various survey methods, techniques to minimise fieldworker effects on bird detection, and recognition of birds, bird signs and bird behaviour. Emphasis was placed on the importance of carrying out the surveys in a systematic, standardised way to enable collection of rigorous survey data and direct comparison of data from different areas and survey periods.

Breeding birds

The breeding bird survey method was based upon the British Trust for Ornithology's Common Birds Census method[3].

Five visits were made to the survey area between 6 April – 7 June 2015 (on 6-8 and 26-27 April, 8-11 and 21-22 May and 4-7 June 2015). Work was undertaken between dawn and noon BST in optimum weather conditions for survey i.e. light winds, good visibility and lack of precipitation. During each visit, emphasis was placed on thoroughly surveying all parts of the survey area; achieved by slowly walking around, frequently pausing at appropriate vantage and listening points. All woodland, copse and scrub boundaries, hedgerows, ditches, rivers and streams were walked. Water bodies, isolated trees and buildings were carefully approached and examined. All parts of the survey area[4] were approached to within 50m.

The objective of the fieldwork was to carry out a full *breeding* bird survey of the site; to map the locations of breeding territories and hence to derive population estimates for all species. Emphasis was therefore placed on accurately mapping the locations of all birds exhibiting breeding behaviour. Birds were considered to be present within breeding territories if any of the following were observed:

- song/courtship/display
- bird engaged in territorial behaviour/territorial dispute
- nest-building (including excavating nest-hole)
- adult visiting probable nest-site
- location of nest or newly fledged young
- agitated behaviour of adult bird (e.g. repetitive alarm-calling, distraction display) indicating nearby presence of nest or young
- bird carrying food to nearby nest or young
- bird removing faecal sac from nearby nest.

During each visit, special care was taken:

- to record each individual bird exhibiting breeding behaviour once only
- to link observations likely to relate to single breeding pairs (e.g. singing male / nearby nest-site, two birds repetitively alarm-calling)
- to emphasise observations clearly relating to separate breeding pairs (e.g. males singing simultaneously, males involved in territorial disputes).

At the end of each visit, a 'visit-map' was compiled showing all registrations made.

At the end of the survey, for each species, registrations on the visit-maps were transferred on to 'species maps' from which the locations of breeding territories (registrations in suitable breeding habitat, usually in 'clusters', relating to the activity of breeding pairs), hence minimum population estimates were derived.

Breeding barn owl

Field methods were based upon those currently recommended[5], based upon those used during the 1994-97 British Trust for Ornithology / Hawk and Owl Trust national barn owl survey[6].

The survey area was thoroughly searched for all *potential* barn owl nest sites during November 2014:

- A building with a suitable entrance hole and possibility of a suitable nest-site beyond was recorded as a potential site (a group of such buildings, e.g. a farm, was classified as a single site);
- A hay-bale stack was recorded as a potential site;
- A heavily ridged or creviced cliff or quarry face was recorded as a potential site;

[1] *Ecotricity (2011). Environmental Statement to accompany an application under section 36 of the Electricity Act 1989 for up to 22 wind turbines on land at Six Hundreds Farm, near East Heckington in the County of Lincolnshire: Chapter 8 Ornithology. (DECC ref: 12.04.09.04/31C).*

[2] *i.e. species listed on Annex I of EC Directive 79/409/EEC on the Conservation of Wild Birds 1979, breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981), geese (other than greylag goose and Canada goose), lapwing, herring gull and cuckoo.*

[3] *Marchant, J.H. (1983). BTO Common Birds Census Instructions. British Trust for Ornithology, Thetford.*

[4] *Access permission could not be obtained to walk some parts of the survey area. These were surveyed from adjacent points of access, overlooking higher ground and public rights of way (Fig. 1).*

[5] *Gilbert, G., Gibbons, D.W. and Evans, J. (1998). Bird Monitoring Methods; a manual of techniques for key UK species. RSPB, Sandy.*

[6] *Toms, M. (1995).* Project Barn Owl 1995: fieldwork instructions; information sheets and recording sheets*. A BTO / Hawk and Owl Trust Collaboration. BTO, Thetford.*

- All trees[7] were checked for suitable cavities, each tree recorded as a single site;
- All bridges and underpasses were checked for suitable cavities, each bridge/underpass recorded as a single site;
- Locations of visible barn owl nest-boxes were recorded.

Each potential nest/roost site was mapped, numbered and described.

All potential nest sites located were then carefully observed for any barn owl activity during the fieldwork, particularly during the extensive flight activity watches undertaken. The sites were also checked for obvious signs of breeding in June 2015 e.g. barn owl(s), pellets, feathers, white splashings. To avoid any disturbance to breeding birds, potential nest locations (e.g. nest-boxes) were not closely approached.

At any sites with signs of presence, attempts were then made to confirm breeding e.g. young, recent prey remains, adult carrying food to nest.

All potential nest/roost sites located during the winter survey were categorised as either:

- No signs of barn owls;
- Signs of barn owl presence but no evidence of breeding (with details);
- Breeding barn owls (with details);
- Site lost or destroyed.

Breeding raptors and short-eared owl

Surveyors were constantly aware of the importance of locating breeding Annex I / Schedule 1 raptors and short-eared owl and were therefore constantly seeking and recording these species during all visits to the site and its surrounding area during November 2014 – June 2015.

In addition, systematic surveys up to at least 2km of the proposed development were undertaken in optimum weather conditions for survey (i.e. light winds, good visibility and lack of precipitation) during four visits made between 4 April – 24 June 2014 (on 4-8 April, 1-5 May, 15-17 and 24 June 2015). These surveys employed all current recommended survey methods for these species (Gilbert et al 1998, Hardey et al 2009), with particular focus on seeking breeding marsh harrier and hobby.

Wintering birds

The survey area was surveyed once per calendar month during November 2014 - March 2015. Work was undertaken mainly between sunrise and noon GMT in optimum weather conditions for survey i.e. light winds, good visibility and lack of precipitation. During each survey visit, emphasis was placed on thoroughly surveying all parts of the survey area; achieved by slowly walking around, frequently pausing at appropriate vantage and listening points. All woodland, copse and scrub boundaries, hedgerows, ditches, rivers and streams were walked. Water bodies were carefully approached and examined. All parts of the survey area[8] were approached to within 100m.

All birds utilising the survey area were counted. Localised movements of birds were carefully noted to avoid double recording. Locations of all individuals of the following species and species groups were mapped: grebes, egrets, swans, geese (except greylag and Canada), duck (except mallard), raptors (except sparrowhawk, buzzard and kestrel), grey partridge, waders, owls (except tawny), kingfisher, tree sparrow, linnet, bullfinch, yellowhammer, reed bunting, corn bunting and unexpected species.

Flight activity

Information on bird flight activity was collected during November 2014 – June 2015 during timed watches from strategic vantage points (VPs)[9]. VPs were selected to maximise visibility of the proposed wind park using the minimum number of points. Five VPs (1-5) were selected (**Table 1**).

Table 1. Location of vantage points used for flight activity watches

VP	Grid reference
1	TF 19539 46184
2	TF 20826 46038
3	TF 19582 45216
4	TF 20751 45283
5	TF 20660 44464

Observers positioned themselves at VPs to minimise their effects on bird behaviour. Watches were undertaken by a single observer in weather conditions rendering clear visibility of all ground being observed. A total of twelve hours observations were made from each VP per calendar-month; comprised of watches of precisely one, two or three hours duration, spread throughout daylight hours between dawn and dusk. Numerous dawn and dusk watches were undertaken; to investigate flightlines of birds moving to/from roost and crepuscular species A total of 480 hours observations were therefore undertaken during November 2014 – June 2015; 96 hours from each of the five VPs.

During each watch, two hierarchical recording methods were used, as follows:

(a) Focal bird sampling. The observer scanned the VP recording zone constantly until a *target species*[1] was detected in flight. Once detected, the bird was followed until it ceased flying, had clearly vacated the VP recording zone or was lost to view. The time the bird was initially detected and the times (to the nearest second) spent flying within the VP recording zone at three categories of flying height (<18m, 18-140m and >140m above ground) were recorded. The route followed by the bird was plotted on to a 1:15,000 scale map with direction of flight indicated and flying heights depicted in black (<18m above ground), red (18-140m above ground) and blue (>140m above ground). These observations had priority over activity summaries (below).

(b) Activity summaries. At the end of each one-hour period, flight activity within the VP recording zone by *secondary species*[10] was summarised. For each species, the number of bird-flights observed between 18-140m above ground was recorded.

Data entered in the field on to recording sheets were later transferred to Excel spreadsheets. Maps of flight activity by target species were compiled for each watch. Each flying bout was numbered consecutively and cross-referenced to the relevant flight-path on the map. Summary maps were compiled for each species at the end of the season.

[7] *Trees of trunk diameter <45cm were ignored. Up to 3 trees only from woodland edges were checked.*

[8] *Access permission could not be obtained to walk some parts of the survey area. These were surveyed from adjacent points of access, overlooking higher ground and public rights of way (Fig. 1).*

[9] *Band, W., Madders, M. & Whitfield, D.P. (2006). Developing field and analytical methods to assess avian collision risk at wind farms. In: de Lucas, M., Janss, G. & Ferrer, M. (eds). Birds and Wind Power. Lynx Edicions, Barcelona.*

[10] *i.e. cormorant, grey heron, mute swan, greylag goose, Canada goose, ducks, sparrowhawk, buzzard, kestrel, waders, gulls and raven.*

FIELD SURVEY RESULTS

Breeding birds

A total of 54 species were recorded during the breeding bird survey of which 40 species bred (**Table 2**).

Table 2. Numbers of territories recorded during the breeding bird survey. F = Species foraging, but no evidence of breeding.

Species	No. territories
Grey heron	F
Mute swan	4
Gadwall	F
Mallard	7
Tufted duck	F
Marsh harrier	F
Sparrowhawk	F
Buzzard	F
Kestrel	2
Hobby	F
Red-legged partridge	13
Grey partridge	7
Pheasant	10
Moorhen	2
Coot	1
Lapwing	3
Stock dove	4
Woodpigeon	10
Cuckoo	F
Barn owl	2
Little owl	1
Swift	F
Great spotted woodpecker	F
Skylark	101
Sand martin	F
Swallow	5
House martin	F
Meadow pipit	14
Yellow wagtail	33
Pied wagtail	3
Wren	24
Dunnock	8
Robin	3
Blackbird	6
Song thrush	1
Grasshopper Warbler	1
Sedge Warbler	37
Lesser Whitethroat	1
Common Whitethroat	38
Blackcap	2
Long-tailed tit	1
Blue tit	2
Great tit	1
Jay	F
Magpie	3
Jackdaw	4
Rook	F
Carrion crow	8
Tree sparrow	8
Chaffinch	9
Goldfinch	1
Linnet	8
Yellowhammer	13
Reed bunting	77

Two breeding pairs of barn owl (a Schedule 1 species) and a total of 175 breeding territories of nine Birds of Conservation Concern 'Red List' species[11] were found (**Figure 2a/b**); seven grey partridge, three lapwing, 101 skylark, 33 yellow wagtail, one song thrush, one grasshopper warbler, eight tree sparrow, eight linnet and thirteen yellowhammer.

Breeding raptors and short-eared owl

No Annex I / Schedule 1 raptors or short-eared owl were found breeding within 2km of the proposed development in 2015.

Wintering birds

A total of 73 species were recorded using the survey area during November 2014 - March 2015 (**Table 3**).

Table 3. Numbers of birds recorded during the wintering bird survey.

Species	Nov	Dec	Jan	Feb	Mar
Little grebe	0	1	1	0	0
Cormorant	0	1	4	4	1
Little egret	0	1	0	0	0
Grey heron	5	3	3	5	6
Mute swan	4	16	15	6	4
Pink-footed goose	2130	0	0	0	0
Greylag goose	0	0	1	0	0
Barnacle Goose	1	0	0	0	0
Gadwall	0	0	4	0	4
Teal	3	70	119	85	46
Mallard	77	32	94	152	38
Red kite	0	0	0	0	1
Marsh harrier	1	0	0	1	0
Hen harrier	1	0	2	0	0
Sparrowhawk	2	1	2	2	1
Buzzard	5	4	5	6	5
Kestrel	6	6	6	7	7
Merlin	1	1	2	2	0
Peregrine	0	1	1	1	0
Red-legged partridge	20	26	22	22	12

[11] *Eaton, M.A., Aebischer, N.J., Brown, A.F., Hearn, R.D., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A. & Gregory, R.D. (2015). Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108: 708–746*.

Grey partridge	3	17	15	15	6
Pheasant	79	30	58	42	77
Moorhen	8	0	5	1	0
Coot	0	0	2	0	0
Golden plover	78	140	35	90	1
Lapwing	677	875	420	366	6
Ruff	28	0	0	0	0
Snipe	0	0	5	1	3
Woodcock	0	0	0	1	0
Green sandpiper	0	0	1	0	0
Black-headed gull	690	37	554	121	0
Common gull	26	40	253	49	2
Lesser black-backed gull	1	0	0	0	0
Herring gull	8	0	0	0	0
Stock dove	119	46	103	144	26
Woodpigeon	336	154	680	929	649
Collared dove	1	0	0	0	0
Barn owl	3	4	3	4	3
Little owl	1	1	1	1	1
Short-eared owl	0	0	0	6	1
Kingfisher	0	1	1	0	0
Great spotted woodpecker	3	1	1	1	1
Skylark	369	160	141	170	139
Meadow pipit	10	6	3	8	3
Pied wagtail	8	3	5	3	2
Wren	43	29	24	26	30
Dunnock	19	9	12	12	8
Robin	4	3	3	3	4
Stonechat	0	0	0	2	0
Blackbird	32	32	29	27	28
Fieldfare	119	586	189	45	4
Song thrush	6	2	5	14	6
Redwing	38	72	73	30	5
Mistle thrush	0	0	4	0	0
Goldcrest	0	2	2	5	1
Long-tailed tit	0	14	23	2	2
Coal tit	0	0	1	0	0
Blue tit	10	8	13	9	6
Great tit	2	5	4	2	4
Jay	0	2	0	0	0
Magpie	13	16	23	22	11
Jackdaw	154	77	95	140	25
Rook	460	499	270	245	65
Carrion crow	19	12	14	14	9
Starling	2505	442	195	63	49
Tree sparrow	30	27	25	6	0
Chaffinch	62	44	32	45	15
Greenfinch	10	0	2	0	0
Goldfinch	48	54	22	20	10
Linnet	65	33	153	111	87
Bullfinch	2	0	2	0	0
Yellowhammer	45	13	26	20	29
Reed bunting	66	29	54	75	97

The mapped monthly distributions of selected species are available upon request.

Flight activity

Flight activity by 35 species of bird was recorded, including eighteen target species; little egret, Bewick's swan, whooper swan, pink-footed goose, barnacle goose, red kite, marsh harrier, hen harrier, merlin, hobby, peregrine, golden plover, lapwing, ruff, herring gull, cuckoo, barn owl and short-eared owl (**Table 4**).

Table 4. Summary of flight activity by target species. *Table shows the total number of flights, flock size, mean flock size, total flying time and time spent flying within the three categories of flying height*.

Species	VP	No. flights	Flock size	Mean flock size	Flying time (bird-secs)			
					Total	<18m	18-140m	>140m
Little egret	1	0	-	-	-	-	-	-
	2	2	1-2	1.5	223	223	0	0
	3	0	-	-	-	-	-	-
	4	0	-	-	-	-	-	-
	5	0	-	-	-	-	-	-
Bewick's swan	1	1	3	3	84	0	84	0
	2	0	-	-	-	-	-	-
	3	0	-	-	-	-	-	-
	4	0	-	-	-	-	-	-
	5	0	-	-	-	-	-	-
Whooper swan	1	0	-	-	-	-	-	-
	2	0	-	-	-	-	-	-
	3	2	4-26	15	2468	0	0	2468
	4	1	9	9	333	0	333	0
	5	3	2-22	12	3524	0	3524	0
Pink-footed goose	1	38	1-450	101	88553	54616	33937	0
	2	63	1-1900	253	971686	746755	224931	0
	3	51	2-720	118	207331	184431	4460	18440
	4	84	1-600	64	235465	171291	64174	0
	5	42	1-280	74	372042	79347	281395	11300
Barnacle goose	1	0	-	-	-	-	-	-
	2	0	-	-	-	-	-	-
	3	0	-	-	-	-	-	-
	4	1	1	1	45	45	0	0
	5	0	-	-	-	-	-	-
Red kite	1	0	-	-	-	-	-	-
	2	2	1	1	452	178	106	168
	3	0	-	-	-	-	-	-
	4	1	1	1	187	164	23	
	5	0	-	-	-	-	-	-
Marsh harrier	1	7	1	1	433	429	4	0
	2	5	1	1	218	218	0	0
	3	5	1	1	335	295	40	0
	4	10	1	1	1929	1753	95	81
	5	2	1	1	340	340	0	0
Hen harrier	1	1	1	1	86	86	0	0
	2	2	1	1	104	104	0	0
	3	1	1	1	53	53	0	0
	4	0	-	-	-	-	-	-
	5	0	-	-	-	-	-	-

Merlin	1	1	1	1	228	25	203	0
	2	5	1	1	130	99	31	0
	3	10	1	1	274	274	0	0
	4	3	1	1	44	44	0	0
	5	3	1	1	27	27	0	0
Hobby	1	1	1	1	24	24	0	0
	2	0	-	-	-	-	-	-
	3	0	-	-	-	-	-	-
	4	1	1	1	21	12	9	0
	5	0	-	-	-	-	-	-
Peregrine	1	0	-	-	-	-	-	-
	2	2	1	1	63	59	4	0
	3	2	1	1	21	19	2	0
	4	9	1	1	143	123	20	0
	5	1	1	1	428	414	14	0
Golden plover	1	8	1-75	26	4608	2613	1995	0
	2	1	47	47	470	0	0	470
	3	15	1-65	10	3197	2173	1024	0
	4	1	36	36	1548	1152	396	0
	5	11	1-36	18	6866	2507	4359	0
Lapwing	1	26	1-145	35	35522	12714	19217	3591
	2	15	1-260	64	34249	4894	27475	1880
	3	11	12-500	151	35832	28941	6891	0
	4	17	1-220	50	68685	17322	51363	0
	5	56	1-360	67	229633	73427	156086	120
Ruff	1	0	-	-	-	-	-	-
	2	0	-	-	-	-	-	-
	3	0	-	-	-	-	-	-
	4	2	68	68	11152	5100	6052	0
	5	0	-	-	-	-	-	-
Herring gull	1	1	1	1	12	12	0	0
	2	1	1	1	85	0	85	0
	3	1	4	4	180	0	140	40
	4	2	1-2	1.5	228	140	88	0
	5	13	1-5	2	1461	639	822	0
Cuckoo	1	0	-	-	-	-	-	-
	2	2	1	1	82	82	0	0
	3	0	-	-	-	-	-	-
	4	0	-	-	-	-	-	-
	5	0	-	-	-	-	-	-
Barn owl	1	4	1	1	231	231	0	0
	2	41	1	1	1734	1734	0	0
	3	0	-	-	-	-	-	-
	4	32	1	1	4222	4222	0	0
	5	12	1	1	916	916	0	0
Short-eared owl	1	0	-	-	-	-	-	-
	2	1	1	1	25	25	0	0
	3	2	1	1	123	123	0	0
	4	0	-	-	-	-	-	-
	5	0	-	-	-	-	-	-

Two little egret flights were recorded (Table 4); one in December and one in May.

One Bewick's swan flight was recorded (Table 4); in November.

Six whooper swan flights were recorded (Table 4); three in November, one in December, one in February and one in March.

A total of 278 pink-footed goose flights were recorded (Table 4); 270 in November, three in December, three in January, one in February and one in March.

One barnacle goose flight was recorded (Table 4); in November.

Three red kite flights were recorded (Table 4); singles in March, April and June.

A total of 29 marsh harrier flights were recorded (Table 4); one in November, one in February, three in April, twelve in May and twelve in June.

Four hen harrier flights were recorded (Table 4); one in December and three in January.

A total of 22 merlin flights were recorded (Table 4); two in November, six in December, seven in January, six in February and one in April.

Two hobby flights were recorded (Table 4); one in May and one in June.

Fourteen peregrine flights were recorded (Table 4); eleven in December and three in February.

A total of 36 golden plover flights were recorded (Table 4); nine in November, thirteen in December, five in January, six in February, two in March and one in April.

A total of 125 lapwing flights were recorded (Table 4); 28 in November, 46 in December, fifteen in January, 24 in February, seven in March, one in April, two in May and two in June.

Two ruff flights were recorded (Table 4); both in November.

Eighteen herring gull flights were recorded (Table 4); three in November, one in December, eight in January, three in February, one in March and two in April.

Two cuckoo flights were recorded (Table 4); both in June.

A total of 89 barn owl flights were recorded (Table 4); three in November, four in December, four in January, sixteen in February, thirteen in March, 24 in April, eight in May and seventeen in June.

Three short-eared owl flights were recorded (Table 4); one in February and two in March.

The mapped flight lines of target species are available upon request.

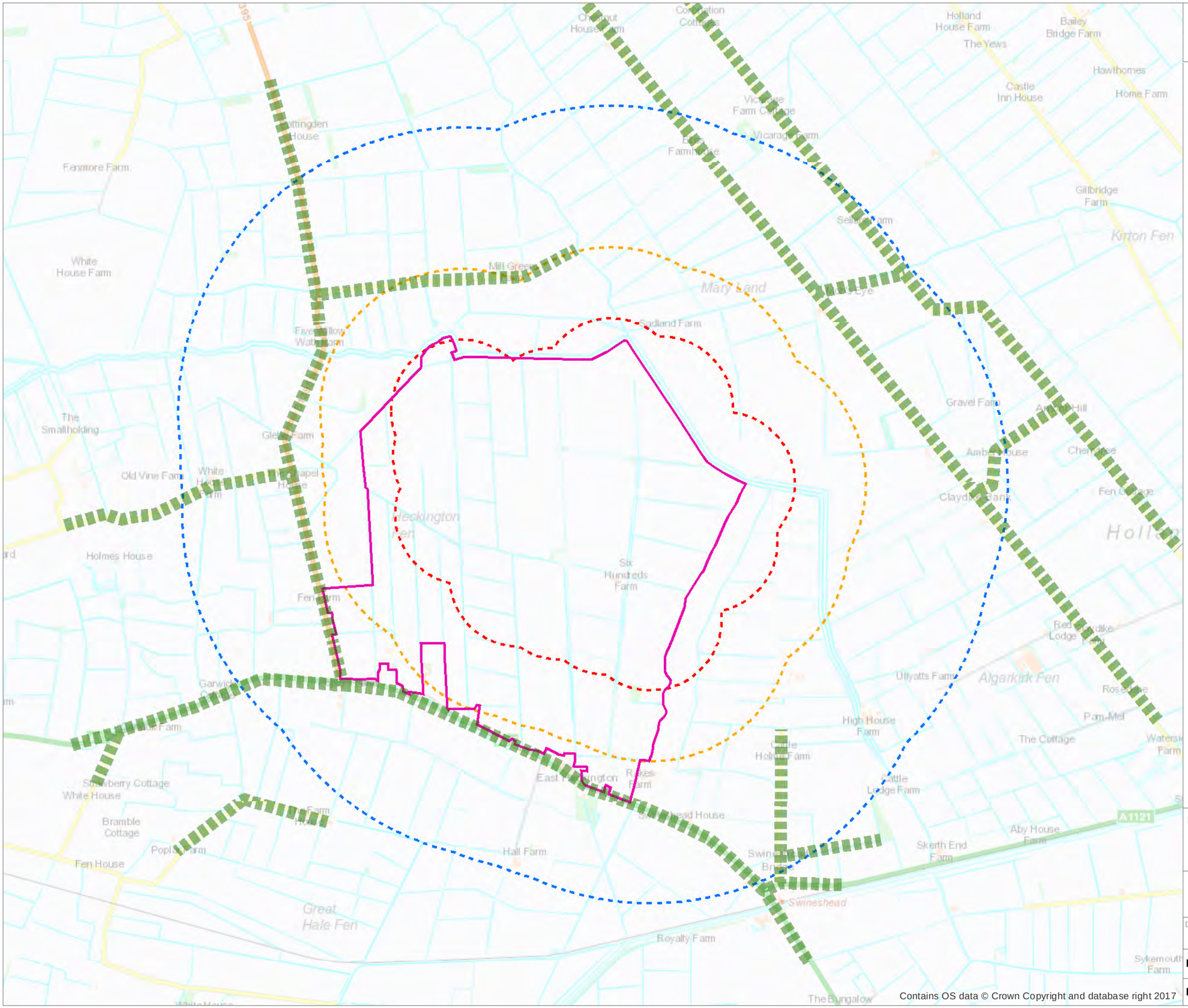
Seventeen non-target species were observed: cormorant, grey heron, mute swan, greylag goose, gadwall, teal, mallard, sparrowhawk, buzzard, kestrel, curlew, kittiwake, black-headed gull, common gull, lesser black-backed gull, great black-backed gull and raven (Table 5).

Table 5. Summary of flight activity by non-target species. ***Table shows the percentage number of hours each species was recorded and the mean number of bird-flights per hour*****.**

Species		VP1	VP2	VP3	VP4	VP5	Overall
Cormorant	% hours	9	11	0	2	4	5
	Mean flights	0.2	0.1	0	<0.1	<0.1	<0.1
Grey heron	% hours	17	14	7	4	3	9
	Mean flights	0.2	0.2	<0.1	<0.1	<0.1	<0.1
Mute swan	% hours	0	1	1	0	0	<1
	Mean flights	0	<0.1	<0.1	0	0	<0.1
Greylag goose	% hours	1	2	0	0	0	<1
	Mean flights	<0.1	<0.1	0	0	0	<0.1
Gadwall	% hours	1	1	0	0	0	<1
	Mean flights	<0.1	<0.1	0	0	0	<0.1

Teal	% hours	3	5	0	0	0	2
	Mean flights	<0.1	0.3	0	0	0	<0.1
Mallard	% hours	39	23	23	4	7	19
	Mean flights	1.2	1.4	0.5	0.1	0.2	0.7
Sparrowhawk	% hours	4	3	4	5	5	4
	Mean flights	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Buzzard	% hours	6	18	22	11	23	16
	Mean flights	<0.1	0.3	0.3	0.2	0.3	0.2
Kestrel	% hours	45	47	20	31	33	35
	Mean flights	0.5	0.6	0.2	0.4	0.4	0.4
Curlew	% hours	0	0	0	0	1	<1
	Mean flights	0	0	0	0	<0.1	<0.1
Kittiwake	% hours	0	0	0	0	1	<1
	Mean flights	0	0	0	0	<0.1	<0.1
Black-headed gull	% hours	21	19	14	15	31	20
	Mean flights	9.3	7.9	21.2	11.0	28.4	15.6
Common gull	% hours	21	20	10	14	29	19
	Mean flights	1.2	1.7	0.8	3.9	5.9	2.7
Lesser black-backed gull	% hours	11	11	8	9	6	9
	Mean flights	0.3	0.9	0.2	0.6	0.2	0.4
Great black-backed gull	% hours	3	2	4	3	5	4
	Mean flights	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Raven	% hours	0	0	0	0	1	<1
	Mean flights	0	0	0	0	<0.1	<0.1

Low levels of flight activity were recorded for mallard, buzzard, kestrel, black-headed gull, common gull and lesser black-backed gull. All other species were recorded occasionally.



ecotricity

Legend

- Public Areas Accessed
- Site Land Boundary (Access Obtained)

Distance Bands

- 500m
- 1km
- 2km

Figure 1

Title: Location of proposed wind park and bird survey areas

N

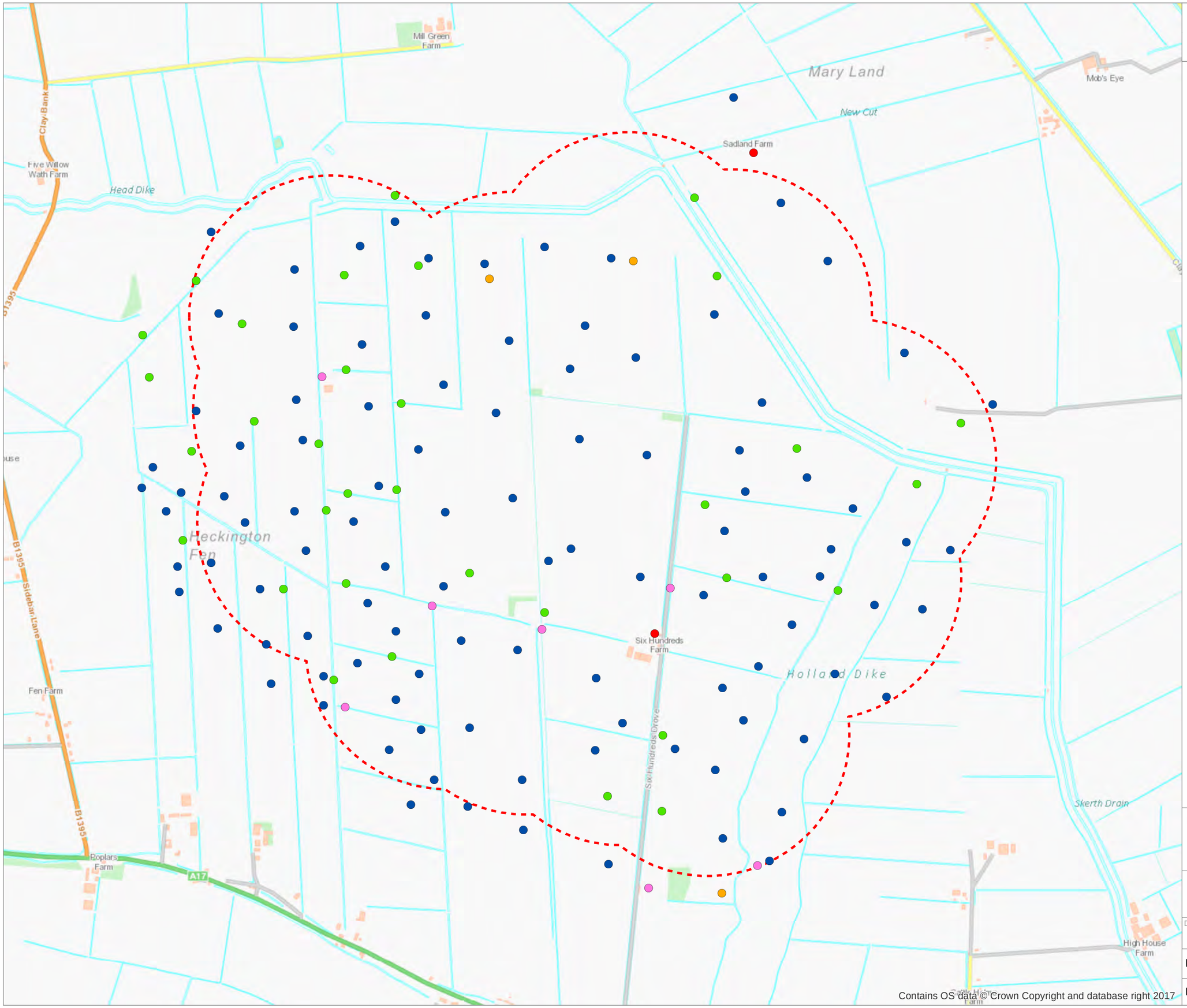
0 0.5 km

Scale: 1:25,000 @ A3

Drawn by:	Checked by:	Approved by:

Ref: 4038_T0504_01 **Date:** April 2018

Heckington Fen Wind Park



ecotricity

Legend

- 500m Distance Band
- Barn Owl (2)
- Grey Partridge (7)
- Lapwing (3)
- Skylark (101)
- Yellow Wagtail (33)

Figure 2a

Title: Breeding bird survey result

N

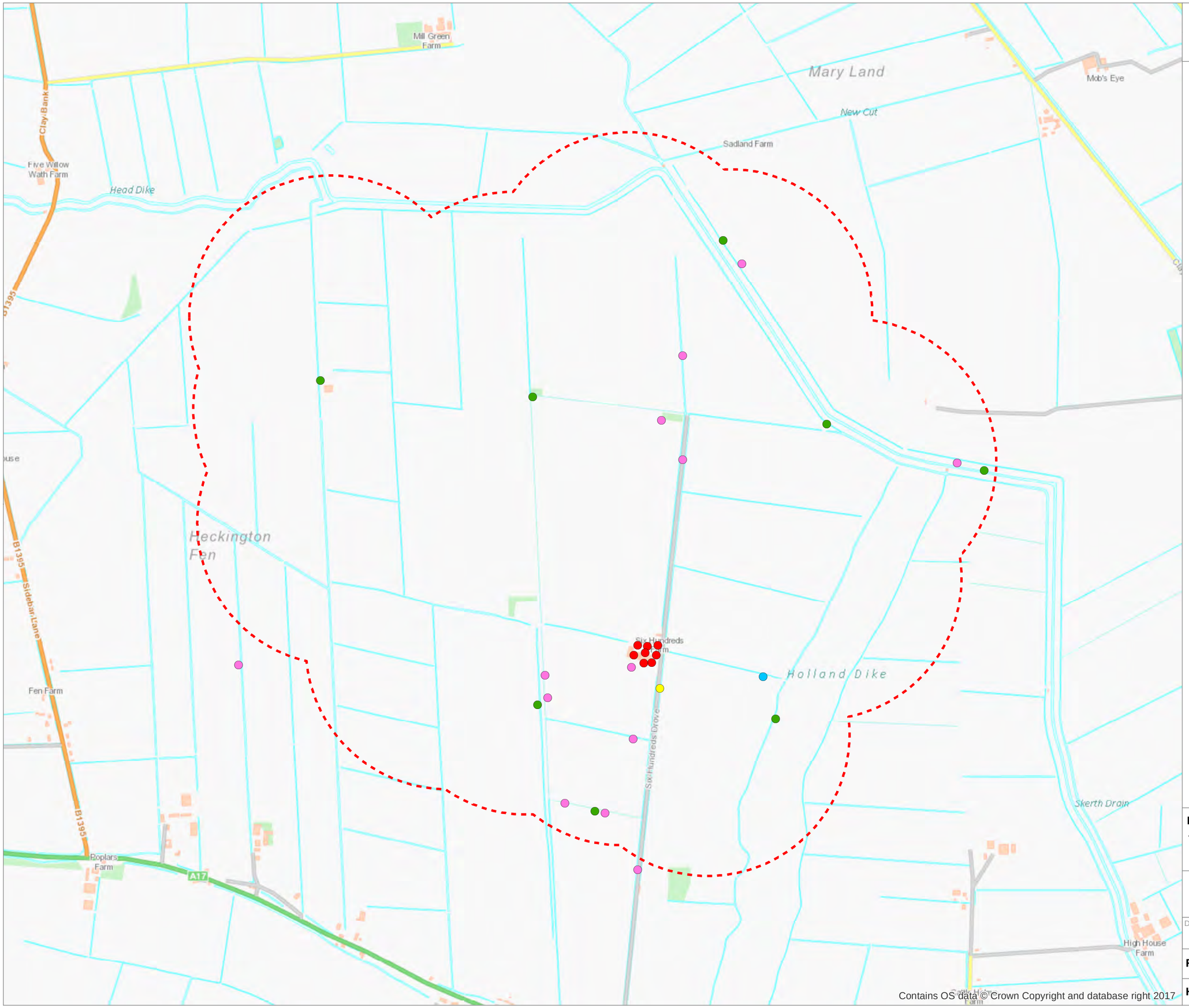
0 0.325 km

Scale: 1:12,500 @ A3

Drawn by:	Checked by:	Approved by:

Ref: 4038_T0506_01 **Date:** May 2018

Heckington Fen Wind Park



ecotricity

Legend

- 500m Distance Band
- Song Thrush (1)
- Grasshopper Warbler (1)
- Tree Sparrow (8)
- Linnet (8)
- Yellowhammer (13)

Figure 2b

Title: Breeding bird survey result

N

0 0.325 km

Scale: 1:12,500 @ A3

Drawn by:	Checked by:	Approved by:

Ref: 4038_T0507_01 **Date:** May 2018

Heckington Fen Wind Park