Rigged Hill Windfarm Repowering

Environmental Statement

Volume 3 – A9.1 Ornithology Surveys 2014-2019
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A9.1 Ornithology Surveys 2014 – 2019

1. Introduction

1. This **Technical Appendix A9.1** details the methods and findings for Chapter 9 – Ornithology of the Environmental Statement (ES) for the Rigged Hill Windfarm Repowering proposal (the Development), which is fully set out in the ES.

2. Baseline ornithology monitoring was undertaken by Bird Surveyors Ltd to establish the distribution and abundance of existing ornithological features for the Development. The baseline information provides information used to inform the design of the Development and inform potential impacts of the Development due to collision, disturbance and/or displacement of birds.

3. The methods utilised have four main aims:

- To provide baseline data on all extant ornithological features to establish the risk posed to birds due to the Development;
- To quantify the risk of collision with turbines to extant bird species flying through the Development area throughout the year;
- To identify locations of priority target species territories to establish risk posed due to Development; and
- To identify mitigatory habitats, options and future monitoring needs, where required, upon assessment of displacement and/or collision risk due to the Development

4. The objectives of baseline monitoring were to:

- Establish the sensitivities and designated site features within the landscape, in particular to establish and identify any species-specific risk and identify key ornithological receptors;
- Establish the distribution and abundance of nearest known priority species using desk-based studies;
- Establish the spatial distribution and relative abundance of all bird species from primary field surveys during the breeding and wintering season from walkover and vantage point surveys within 500 m of the Development;
- Establish the breeding distribution and abundance of curlew *Numenius arquata* within 800 m of the Development (see Pearce – Higgins et al., 2009)[1];
- Establish the breeding distribution and abundance of snipe *Gallinago gallinago* within 500 m of the Development;
- Establish the breeding distribution and abundance of red grouse *Lagopus lagopus* within 500 m of the Development;
- Establish the distribution and abundance of priority species (specifically waders, raptors, swans and geese) from primary field surveys during both the breeding and wintering season within 2 km and 5 km (swans / hen harrier); and
- Establish the distribution and abundance of suitable displacement habitats or mitigation options and provide recommendations for management, if necessary.

5. This Technical Appendix is further analysed and reviewed in **Chapter 9** of the ES and should be read in conjunction with that Chapter and also **Volume 2: Figures.**

6. This Technical Appendix A9.1 includes the following elements:

- Assessment Methodology; and
- Baseline Description.

2. Assessment Methodology

7. A range of guidance, best practice and peer-review methodologies have been utilised in the scoping, preparation and completion of the surveys works undertaken for the Development.

2.1. Study Area / Survey Area

8. The ornithological survey area was digitally mapped in ArcGIS 10.5 and defined as the Site Boundary at the time of scoping (hereafter Survey Area) buffered by 500 m (hereafter 500 m Survey Area) respectively for breeding and wintering bird surveys and vantage point surveys (**Figure 9.1**). This buffer was selected as recent research has shown the majority of wind turbine effects are prevalent up to 500 m (Pearce-Higgins *et al.,* 2009, Ruddock & Reid, 2010[2]; **Figure 9.1; Figure 9.2**).

9. An 800 m buffer (hereafter 800 m Survey Area) defined the search area for curlew during breeding season surveys; as displacement effects on this species are considered up to 800 m (Pearce-Higgins *et al.,* 2009; **Figure 9.1**). The wider priority species survey area was defined as the 2 km buffer (hereafter 2 km Survey Area) to search for hen harrier and merlin nest locations and/or breeding territories or wintering locations of species considered vulnerable and/or priority species within Northern Ireland (**Table 9.1**). A wider search area up to 5 km (hereafter 5 km Survey Area) was utilised during priority species searches for swans and geese and hen harrier (**Figure 9.3**). Additional analyses and mapping were conducted where necessary on the Operational Rigged Hill Windfarm turbines and the Development turbines and associated 500 m buffers.

Table 9.1: Details of species surveyed during vantage point observations and priority species searches.

Species	Vantage Point (Target 1) *	Vantage Point (Target 2) **	Migration Vantage Point	Priority Species Surveys (2 km)
Hen harrier	•		•	•
Peregrine falcon	•		•	•
Merlin	•		•	•
White-tailed eagle	•		•	•
Golden eagle	•		•	•
Goshawk	•		•	•
Osprey	•		•	•
Red kite	•		•	•
Marsh harrier	•		•	•
Golden plover	•		•	•
Whooper swan	•		•	•
Mute swan	•		•	•
Chough	•		•	•
Barn owl	•		•	•
Short-eared owl	•		•	•
Long-eared owl	•		•	•
Red grouse	•		•	(500 m)
Curlew	•		•	•
Geese (all species)	•		•	•
Buzzard		•	•	•
Kestrel		•	•	•
Sparrowhawk		•	•	•
Snipe		•	•	(500 m)
Lapwing		•	•	•
Raven		•	•	•
Grey heron		•	•	•
Cormorant		•	•	•
Corncrake		•	•	•
Waders (all species)		•	•	•
Ducks (all species)		•	•	•

[1] Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology* 46: 1323-1331.

[2] Ruddock, M. & Reid, N. (2010). Review of windfarms and their impact on biodiversity: guidance for developments in Northern Ireland. *Report by the Natural Heritage Research Partnership, Quercus for the Northern Ireland Environment Agency, Northern Ireland, UK.*

Species	Vantage Point (Target 1) *	Vantage Point (Target 2) **	Migration Vantage Point	Priority Species Surveys (2 km)
Grebes (all species)		•	•	•
Gulls (all species)		•	•	•
Terns (all species)		•	•	•
SPA citation species (all)	•	•	•	•

* Target 1 species are recorded to the nearest minute, and assigned a five minute interval and the flight route is mapped. Flying height (at 15 second intervals) and flight duration to the nearest second are recorded.

** Target 2 species are recorded to the nearest minute and assigned a five minute interval and the flight route is mapped. Flying height is recorded at point of detection and an altitudinal range also recorded for the duration of the bout.

2.2. Review of Site Sensitivities & Designations

10. Desktop studies were undertaken including a review of designated site databases to establish local, regional or national importance of the area and especially for designated ornithological receptors up to 10 km from the survey area.

11. Data searches were conducted for Northern Ireland, which were obtained from Northern Ireland Environment within Department of Agriculture & Rural Affairs (DAERA) www.daera-ni.gov.uk/topics/biodiversity-land-and-landscapes/protected-areas. The GIS data (shapefiles) were downloaded and imported into the project GIS and projected accordingly to ensure standard spatial reference of all databases and designated boundaries.

12. Data for Northern Ireland were reviewed on Special Areas of Conservation (SAC), Special Protection Areas (SPA), Areas of Special Scientific Interest (ASSI), RAMSAR sites, National Nature Reserves (NNR), Areas of Outstanding Natural Beauty (AONB), World Heritage Sites and Landscape Character Areas (LCA).

13. The details of these designated sites, including any protected and/or cited ornithological features were also extracted from the site synopsis documents, where available, along with the distance to the Site Boundary which was calculated in ArcGIS.

2.3. Review of published data and data requests

14. This study identified and reviewed external data sources on both general and priority target bird species in order to inform the indicative species risk matrix within the site and wider area as well as to inform the indicative work programme for bird surveys.

15. Online and/or hard copy data requests were submitted to establish the types and/or abundance of key bird species in the area in order to understand whether any wider impacts or ornithology issues could arise. These included data obtained at the 10km resolution and/or at the tetrad (2 km by 2 km) resolution where available.

16. Data requests were submitted to the National Biodiversity Network (NBN), British Trust for Ornithology (BTO), Northern Ireland Raptor Study Group (NIRSG). These were mostly available at the 10 km resolution but where possible the information requests were extended to include the nearest known historical geese, swan, raptor, wader and/or other priority species locations.

17. Published literature were reviewed to identify priority species breeding or wintering areas derived from both data consultation and published reports for wintering whooper swan (Robinson et al., 2004[3]), red grouse (Allen et al., 2004[4]; Cummins et al., 2010[5]) and breeding hen harrier (Sim et al., 2007[6]; Hayhow et al., 2013[7]; Wotton et al.,2018[8]).

18. Extant ornithological information of ornithology, particularly raptors, from the author's personal knowledge (Dr Marc Ruddock) having surveyed in this area for more than a decade, and other project ornithologists with knowledge of the area were also reviewed to identify other key constraints and/or vulnerable target species.

2.4. Breeding Bird Surveys (BBS)

19. Breeding bird territories were surveyed using a modified Brown & Shepherd (1993)[9] transect methodology to incorporate passerines and provide breeding estimates and distribution for all bird species within the 500 m turbine buffer boundary and for breeding curlew within 800 m of the turbines. This survey included an assessment of the abundance of meadow pipits and skylarks, considered to be important prey species for hen harriers and merlin.

20. To allow for variation in detection of early and late breeding species four surveys were conducted in April, May, June and July respectively. Fieldwork commenced earlier in the day to maximise detection for passerines. Periods of high wind (>Force 4) and low visibility were avoided to maximise visual and auditory detection rates of birds. Equipment used during the surveys included Leica 8-12 x 40 binoculars; Leica APO Televid 70 and a Sony Alpha 77 digital camera with a 500 mm lens.

21. Surveys covered the ground systematically with constant search effort and all points within the survey area were closely approached to within 100m depending on accessibility. Improved pasture was scanned with binoculars and observed for short periods to identify foraging areas of detected species. Where accessibility was constrained the surveyor stopped and scanned with binoculars and listened for bird song/calls. Patches of scrub, isolated trees, rocky outcrops, streams, water-bodies, buildings and linear features such as hedge rows and trees were investigated closely. The surveyor paused at regular intervals to scan and listen for calling and singing birds.

22. Behaviours indicative of breeding were recorded in the field. When individuals or pairs of birds were encountered, efforts were made to establish whether, in the fieldworker's opinion, the birds were different from those previously encountered, and involved attention to the movements of birds, together with birds' sex and plumage characteristics. Where necessary, surveyors retraced their steps in order to check the continued presence of previously recorded birds.

23. The location and activity of birds were recorded using standard (BTO) codes and the position of each bird was mapped at the point it was first detected. At the end of each visit a summary map was compiled showing the location of each identified territory or breeding pair. Population estimates were derived by comparing the summary maps for the four surveys and identifying distinct territories (Marchant, 1983), plotted centrally by convention and assessing breeding behaviours and spatial locations to establish breeding status.

24. Based on diagnostic evidence each detected species is categorised as:

- **Confirmed breeding** – single and/or pair of birds exhibiting breeding behaviour or evidence of breeding including i) courtship or territorial display (on multiple visits); ii) alarm calling or agitated behaviour by adult(s) indicating the presence of a nearby nest or young (e.g. repetitive alarm calling, distraction display); iii) territorial dispute; iv) fledged young; v) nest building; vi) active nest or recently used nest; vii) adults removing faecal sac; viii) adult(s) carrying food;
- **Probable breeding** – single or pair of birds occupying suitable breeding habitat and exhibiting breeding behaviour (e.g. singing) **or** pair of birds occupying suitable breeding habitat but not exhibiting breeding behaviour or evidence of breeding;
- **Possible breeding** – single birds occupying suitable breeding habitat and not exhibiting breeding behaviour or evidence of breeding; and
- **Non-breeding** – sightings of birds commuting, foraging or flying above the site and exhibiting no attachment to the survey area.

[3] Robinson, JA, K Colhoun, JG McElwaine & EC Rees. 2004. Whooper Swan *Cygnus cygnus* (Iceland population) in Britain and Ireland 1960/61 – 1999/2000. Waterbird Review Series. The Wildfowl & Wetlands Trust/Joint Nature. Conservation Committee, Slimbridge.
[4] Allen, D., Mellon, C. Mahwhinney, K. (2004). The status of red grouse in Northern Ireland. Unpublished report to Environment and Heritage Service.
[5] Cummins, S., Bleasdale, A., Douglas, C., Newton, S., O' Halloran, J. & Wilson, H.J. (2010). The status of Red Grouse in Ireland and the effects of land use, habitat and habitat quality on their distribution. Irish Wildlife Manuals, No. 50. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.
[6] Sim, I.M.W, Dillon, I.A., Eaton, M.A., Etheridge, B., Lindley, P., Riley, H., Saunders, R., Sharpe, C., Tickner, M. (2007). Status of the Hen harrier Circus cyaneus in the UK and Isle of Man in 2004, and a comparison with the 1988/89 and 1998 surveys. Bird Study 54: 256–267
[7] Hayhow, D.B., Eaton, M.A., Bladwell, S., Etheridge, B., Ewing, S., Ruddock, M., Saunders, R., Sharpe, C., Sim, I.M.W. & Stevenson, A. (2013). The status of the Hen Harrier, Circus cyaneus, in the UK and the Isle of Man in 2010. Bird Study 60: 446-458.
[8] Wotton, S., Bladwell, S., Morris, N., Raw, D., Ruddock, M., Stevenson, A., Stirling-Aird, P. & Eaton, M. (2018) Status of the Hen Harrier *Circus cyaneus* in the UK and Isle of Man in 2016. Bird Study 65: 145-160.
[9] Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study* 40: 189-195.

25. Each detected species, from breeding surveys were classified according to regional and national conservation status as red, amber or green listed (Colhoun & Cummins, 2013[10]; Eaton et al., 2015[11]).

2.5. Wintering Bird Surveys (WBS)

26. Winter bird surveys were carried out using transects covering the whole survey area and 500 m buffer during the winter period from September to February. Surveys covered the ground systematically with constant search effort and all points within the survey area were closely approached to within 50-100 m depending on accessibility.

27. The surveyor paused at regular intervals to scan and listen for calling and singing birds. Where accessibility was constrained the surveyor stopped and scanned with binoculars and listened for bird song/calls. Patches of scrub, isolated trees, rocky outcrops, streams, water-bodies, buildings and linear features such as hedge rows and trees were investigated closely. Improved pasture was scanned with binoculars and observed for short periods to identify foraging areas of extant species.

28. Species locations, numbers and brief description of behaviours were plotted, at the point they were first detected, using standard BTO codes on hard copy maps and/or by GPS on a recording form.

29. Each detected species from breeding surveys were classified according to regional and national conservation status as red, amber or green listed (Colhoun & Cummins, 2013; Eaton et al., 2015).

2.6. Breeding Vantage Point (BVP) and Wintering Vantage Point (WVP) Surveys

30. Vantage point surveys were carried out over the breeding period from March to August and over the wintering period from September to February / March) in order to collect information on flying heights, distribution and occurrence of target species (**Table 9.1**; SNH, 2005).

31. Focal observations from four vantage points over-looking the site were utilised to assess target species activity, flight height and flight routes in a hierarchical fashion (see **Table 9.1**). Where target species were recorded inside the survey boundary the detection time, flight trajectory, flight duration (to the nearest second) and flight height were assigned within stratified height bands (<15 m, 15 m – 25 m, 25 m – 50 m, 50 m – 75 m, 75 m – 100 m, 100 m – 125 m; 125 m – 140 m; >140 m) to reflect the parameters of the proposed turbines and flying height above ground level was recorded visually at detection and at 15 second intervals using an audible countdown timer.

32. The vantage points were located outside the 500 m boundary, where possible, to minimise effects of observer disturbance to bird activity and/or behaviour. Based on topographical constraints and in order to ensure clear visibility of key ornithological habitats one of the vantage point locations was inside the survey area boundary but given existing infrastructure, windfarm operational activities and agricultural activity inside the survey area no key constraints or disturbances are considered to have occurred or been derived due to the location of these vantage points.

33. Observers scanned a 180° arc both visually and with binoculars (Leica 8-12 x 40). Weather conditions were recorded at hourly intervals from the start of the focal observation until the end of the observation period. The weather conditions recorded included cloud cover, cloud height (estimated in metres from height above ground level), wind direction and speed (Beaufort Scale), precipitation and visibility (km). A range of diurnal and crepuscular times and weather conditions were sampled.

2.7. Migration Vantage Point (MVP) Surveys

34. Focal observations of target species were carried out from a single vantage point located to assess the spatial distribution and occurrence of migrating birds over-flying the proposed development. Bird migration occurs in two distinct seasonal periods' i.e. autumn migration arbitrarily defined from September to November and spring migration arbitrarily defined from late January to late March/early April.

35. The minimum recommended survey effort is 36 hours for each seasonal period (SNH, 2005) although it is recognised survey scope may be lower for re-powering developments (SNH, 2014). A range of times and weather conditions were sampled although migration surveys were not conducted during periods of high winds or persistent heavy rain. However, when encountered, intermittent periods of poor visibility (i.e. fog) were surveyed using auditory techniques.

36. The autumn migration vantage point (AMVP) and spring migration vantage point (SMVP) were selected on elevated ground to maximise visibility and covered a viewing arc of 180° facing north (in autumn) and south (in spring) of the survey area (**Figure 9.1**) to maximise the detection of arriving and/or localised movements of over-flying migrants.

37. Target species were defined primarily as the migratory species generally detected in Northern Ireland; **Table 9.1**) although all vantage point target species were also included (**Table 9.1**). Whilst, preferably, vantage points should not be located outside the development boundary, where possible, to minimise effects of disturbance on bird activity and/or behaviour, due to topographical constraints it was necessary to locate the MVP within the 500 m survey boundary (**Figure 9.1**) to facilitate detection of migrant birds over the survey area and track flight(s) when detected.

38. Weather conditions were recorded at hourly intervals from the start of the focal observation until the end of the observation period. The weather conditions recorded included cloud cover, cloud height (estimated in metres from height above known landscape features), wind direction and speed (Beaufort Scale), precipitation and visibility (km). A range of diurnal and crepuscular times and weather conditions were sampled.

39. Focal observations from a single migration vantage points over-looking the site were utilised to assess target species activity, flight height and flight routes in a hierarchical fashion (see **Table 9.1**). Where target species were recorded inside the survey boundary the detection time, flight trajectory, flight duration (to the nearest second) and flight height were assigned within stratified height bands (<15 m, 15 m – 25 m, 25 m – 50 m, 50 m – 75 m, 75 m – 100 m, 100 m – 125 m; 125 m – 140 m; >140 m) to reflect the parameters of the proposed turbines and flying height above ground level was recorded visually at detection and at 15 second intervals using an audible countdown timer.

40. The vantage points were located outside the 500 m boundary, where possible, to minimise effects of observer disturbance to bird activity and/or behaviour. Based on topographical constraints and in order to ensure clear visibility of key ornithological habitats the migration vantage point locations were inside the survey area boundary but given existing infrastructure, windfarm operational activities and agricultural activity inside the survey area no key constraints or disturbances are considered to have occurred or been derived due to the location of these vantage points.

41. Observers scanned a 180° arc both visually and with binoculars (Leica 8-12 x 42). Weather conditions were recorded at hourly intervals from the start of the focal observation until the end of the observation period. The weather conditions recorded included cloud cover, cloud height (estimated in metres from height above ground level), wind direction and speed (Beaufort Scale), precipitation and visibility (km). A range of diurnal and crepuscular times and weather conditions were sampled.

2.8. Breeding Priority Species Surveys (PSS)

42. Breeding priority species searches were carried out between March and August to establish if suitable habitat(s) contained breeding target species (**Table 9.1**) to identify risk species for turbine collision or displacement. These searches include specific assessments of the suitable habitat(s) to identify nesting distribution and breeding status for species of high conservation concern notably Annex I (EU Birds Directive), Schedule 1 (Wildlife (Northern Ireland) Order 1985) and Birds of Conservation Concern (Colhoun & Cummins, 2013; Eaton *et al.,* 2015; **Table 9.1**) within the 2 km Survey Area.

2.8.1. Raptor surveys

43. Surveys for breeding raptors specifically followed prescribed methods (Hardey et al., 2006; 2009; 2013) between March and August. For breeding locations, each detected species is categorised the same as for breeding bird surveys as confirmed, probable or possible. Priority species search effort was primarily undertaken outside the 500 m and 800 m boundary since vantage point and transect breeding bird surveys were concentrated in these areas, and nesting target species would be identified during these surveys.

44. Specifically for hen harriers, the survey area was thoroughly searched and suitable habitats were identified up to 5 km from the survey area (**Figure 9.1**) during the breeding season. This included areas of deep, contiguous heather *Calluna vulgaris*

[10] Colhoun, K. & Cummins, S. (2013). Birds of conservation concern in Ireland 2014 – 2019. Irish Birds 9: 523-544.

1. [11] Eaton MA, Aebischer NJ., Brown AF., Hearn R., Lock L., Musgrove AJ., Noble DG., Stroud D. and Gregory R.D (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 108, pp 708–746[11]

and pre-thicket stage coniferous forest plantations which were surveyed (Sim et al., 2007; Hardey et al., 2013[12]). Vantage points were chosen to offer unrestricted views over suitable habitat within these categories to watch for target species. The nearest known territory and/or optimal hen harrier habitat was also surveyed.

45. Raptor surveys were undertaken for merlin with additional walkover effort along the edges of mature conifer plantations (Ewing et al., 2011[13]) to look for signs e.g. prey remains and/or suitable old crow nests occupied by merlin. Surveys were conducted over the course of the breeding season March to August inclusive. All target species seen during vantage points were recorded. Details of search effort, weather conditions and locations of breeding attempts and/or territories were reported and/or mapped where relevant.

46. To support the primary field surveys recent extant ornithological information for Schedule 1 (Wildlife NI Order 1985) raptors was requested from the Northern Ireland Raptor Study Group (NIRSG) within the 2 km buffer survey area (see **Figure 9.1**). In addition, the data request was extended to establish the nearest known hen harrier, merlin and peregrine nest and/or historical territory locations.

2.8.2. Red grouse surveys

47. Additional breeding season surveys were carried out for red grouse in April and August. This method comprised dusk and / or dawn counts for calling grouse to establish the abundance and distribution within the 500 m survey boundary (Natural Research, 2007). Surveys were carried out, from a vantage point, at dusk to familiarise the observer with area and location of birds and counts were conducted again at dawn the following morning.

48. The observers were positioned at strategically located vantage points that afforded comprehensive coverage of the survey area. All parts of the survey area were within approximately 1 km of a vantage point. The dusk count commenced one hour before dark and continued until no further cocks were heard. Dawn counts began 30 minutes before first light and continued until one hour after dawn.

49. Observers listened intently for calling grouse. When a bird was heard, its sex was determined, the time noted, and a compass bearing of its location taken together with an estimate of distance from the observer. This procedure was repeated for each new grouse heard or seen. Observers compared registrations at the end of the survey to establish if any calls were duplicated. In August, an extensive walkover survey was conducted to identify the locations of red grouse coveys, if any, within the application site and 500 m survey buffer.

2.8.3. Wader surveys

50. Curlew, lapwing and snipe were also specifically targeted during searches between March and August and additional walkover surveys were conducted where required. These included “dusk” surveys during May to look and listen for displaying (‘drumming’ and ‘chipping’) snipe within survey buffers and also locations which were recorded from vantage points.

51. Curlew were surveyed using vantage point and walkover surveys at suitable habitat and all sightings of curlew were followed up to establish breeding activity. To establish the location of curlew, lapwing and snipe territories; cumulative analyses were undertaken which integrated observations from the vantage points, breeding bird surveys and priority species searches to identify distinct territories.

2.9. Wintering Priority Species Surveys

52. During the winter, between September and March, surveys were carried out to identify hen harrier winter roosts and whooper swan roosting and foraging areas and/or commuting routes. Surveys for hen harriers were carried out at suitable habitat (Hardey et al., 2009) at dawn and/or dusk.

53. Whooper swan surveys were carried out within all parts within the 2 km survey boundary during each survey visit. These latter surveys including driving and/or walking all parts of the 2 km survey area, with short vantage point or walkover surveys completed at areas not visible from the road. Simultaneously, wider (5-10 km) searches were carried out to identify the nearest whooper swan wintering areas and desktop reviews of published whooper swan wintering areas (Robinson et al., 2004).

54. During whooper swan surveys, swans (and any other waterbirds or wildfowl) were counted during short vantage point observations with telescope (Leica APO Televid x 20-60) and/or binoculars and the location recorded according to the nearest townland name. Records of swan movements and/or direction of movements were recorded during surveys.

2.10. Survey efforts

55. The extensive suite of surveys undertaken for the Development spanned a five year period (2014 – 2019) and were undertaken by Bird Surveyors Ltd on behalf of ScottishPower Renewables by experienced and expert ornithologists including Dr Marc Ruddock, Mr Andrew Murray, Mr Karl Hamilton, Mr Douglas Ruddock, Mr Craig Swenarton and Mr Kevin Mawhinney. Several hundred hours were undertaken in survey effort to inform the baseline assessment and ornithological analysis (**Table 9.2**).

Table 9.2: Survey Effort

Survey Type	Survey Season	Timeframe	Hours completed
Breeding Walkover Surveys	Mar - Jul	Mar 2014 – Jul 2014; Mar 2018 – Jul 2018	132 hours 92 hours
Wintering Walkover Surveys	Sep - Feb	Sep 2014 – Feb 2015; Sep 2018 – Mar 2019	42 hours 46 hours
Breeding Vantage Point Surveys	Mar - Aug	4 VPs Mar 2014 – Aug 2014 4 VPs Mar 2018 – Aug 2018	36+ hours per VP per season
Wintering Vantage Point Surveys	Sep – Feb / Mar	4 VPs Sep 2014 – Feb 2015 4 VPs Sep 2018 – Mar 2019	36+ hours per VP per season
Spring Migration Vantage Point Surveys	Jan – Apr (spring)	1 VP Jan 2015 – Apr 2015 1 VP Jan 2018 – Apr 2018	36 hours per VP per season
Autumn Migration Vantage Point Surveys	Sep – Nov (autumn)	1 VP Sep 2014 – Nov 2014 1 VP Sep 2018 – Nov 2018	36 hours per VP per season
Breeding Priority Species	Mar - Aug	Mar 2014 – Aug 2014; Mar 2015 – Aug 2015; Mar 2016 – Aug 2016; Mar 2018 – Aug 2018	82 – 126 hours
Wintering Priority Species	Sep – Feb	Sep 2014 – Feb 2015; Sep 2016 – Feb 2017; Sep 2018 – Feb 2019	44 – 76 hours

3. Baseline conditions

56. This section details the technical findings from the suite of desktop and literature reviews and field surveys undertaken for the Development. The key parameters at this site are that the baseline comprises an operational windfarm with associated infrastructure and 10 Nordtank 500-37 turbines which have been in operation since 1994.

3.1. Review of Site Sensitivities & Designations

57. The Site is not located within any nationally or internationally designated sites for ornithological features (see **Figure 9.4**). The Operational Rigged Hill windfarm is located approximately 10 km to the north-west of the Lough Foyle SPA, designated in 1999 for whooper swan, light-bellied brent geese and bar-tailed godwit and the wintering waterbird assemblage. This SPA was designated five years after the approval of the Operational Rigged Hill Windfarm in 1994. Lough Foyle is also designated as an ASSI and a RAMSAR site (see **Table 9.3**).

58. Within 5 km the Coolnasillagh ASSI mentions curlew and snipe and the Ballyrisk More ASSI designated for species rich grassland mentions willow warbler and meadow pipit in the citation document. Gortcobies ASSI Castle River Valley ASSI, Smulgedon ASSI and Brockagh Quarry ASSI only generally mentions the suitability of the site for birds, but does not list any specific species. The River Roe & Tributaries SAC and ASSI is located approximately 4 km to the west and north-west but are not designated for ornithological interests. There are several other designated sites between 5 km and 10 km some of which

[12] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). Raptors: a field guide to survey and monitoring (3rd Edition). The Stationery Office, Edinburgh.

[13] Ewing, S.R., Rebecca, G.W., Heavisides, A., Court, I.R., Lindley, P., Ruddock, M., Cohen, S. & Eaton, M.A. (2011). Breeding status of Merlins Falco columbarius in the UK in 2008. Bird Study 58: 379-389.

cite ornithology features (see **Table 9.3**). Additionally, baseline surveys and assessment will consider any flight path connectivity between designated sites. Two adjacent turbines, north of Terrydoo Walker, which are located spatially closer to the SPA have been approved in recent years (see further details in cumulative analysis in **Chapter 9**).

Table 9.3: Details of designated sites within 10km of the Site

Reference	Name	County	Status	Distance (km)	Primary Site Features	Secondary Site Features	Year
ASSI267	Coolnasillagh	Londonderry	ASSI	2.7	Species rich grassland	Curlew, snipe	2009
ASSI266	Ballyrisk More	Londonderry	ASSI	3.1	Species rich grassland	Willow warbler, meadow pipit	2007
ASSI371	Gortcorbies	Londonderry	ASSI	3.6	Species rich grassland, wet heath	Mentions 'birds' but no species	2011
ASSI258	Smulgedon	Londonderry	ASSI	3.6	Species rich grassland	Feeding and roosting sites for 'birds' but no species	2006
ASSI395	Brockagh Quarry	Londonderry	ASSI	4.5	Damselfly, botany	Mentions 'birds' but no species	2013
ASSI257	Ballymacallion	Londonderry	ASSI	6.0	Species rich grassland	Woodland, scrub	2007
ASSI228	Aghanloo Wood	Londonderry	ASSI	6.7	Woodland	Mentions 'birds' but no species	2004
ASSI256	Errigal Glen	Londonderry	ASSI	7.1	Woodland	Mentions 'breeding birds' but no species	2007
ASSI171	Altikeeragh	Londonderry	ASSI	8.9	Peatland	Snipe, red grouse, raven, kestrel,	1999
NNR9	Altikeeragh	Londonderry	NNR	8.9	Peatland	Snipe, red grouse, raven	2002
ASSI212	Binevenagh	Londonderry	ASSI	9.0	Geology, flora, fauna	Peregrine falcon, fulmar	2000
ASSI167	Carn/Glenshane Pass	Londonderry	ASSI	9.3	Peatland	Red grouse	2000
NNR4	Binevenagh	Londonderry	NNR	9.7	Geology, botany	Kittiwake, fulmar, buzzard, raven, peregrine falcon	-
UK9020031	Lough Foyle	Londonderry	SPA	10.2	Whooper swan, light-bellied brent geese, bar-tailed godwit	Waterbird assemblage (red throated diver, great crested grebe, mute swan, bewick's swan, greylag geese, shelduck, teal, mallard, wigeon, eider, red-breasted merganser, oystercatcher, golden plover, grey plover, lapwing, knot, dunlin, curlew, redshank, greenshank, slavonian grebe)	1999
ASSI051	Lough Foyle	Londonderry	ASSI	10.2	Estuary	Whooper swan, light-bellied brent geese, bar-tailed godwit, red throated diver, great crested grebe, mute swan, bewick's swan, greylag geese, shelduck, teal, mallard, wigeon, eider, red-breasted merganser, oystercatcher, golden plover, grey plover, lapwing, knot, dunlin, curlew, redshank, greenshank, slavonian grebe	1998
UK12014	Lough Foyle RAMSAR site	Londonderry	RAMSAR	10.2	Wetland	Whooper swan, light-bellied brent geese, bar-tailed godwit,	1999
						red throated diver, great crested grebe, mute swan, bewick's swan, greylag geese, shelduck, teal, mallard, wigeon, eider, red-breasted merganser, oystercatcher, golden plover, grey plover, lapwing, knot, dunlin, curlew, redshank, greenshank,	
NR24	Roe Estuary	Londonderry	NNR	10.3	Estuary	Wintering waders, ducks, swans and geese; curlew; lapwing	-

3.2. Review of published data and data requests

59. A range of data requests were undertaken to establish and identify the range of target species for surveys and / or assessment of key ornithological receptors and / or pathways for significant effects on ornithology. The survey area and associated 500 m buffer, 2 km buffer and 5 km buffer (**Figures 9.1 & 9.3**) are located within 10 km squares IC71 and IC72. Data requests and reviews have been undertaken with NBN, BTO, NIRSG and published literature. A data request to RSPB was undertaken but no results have been received to date (May 2019).

3.2.1. National Biodiversity Network (NBN)

60. National Biodiversity Network (NBN) provide an extensive database of species occurrence within UK & Ireland. Database queries for a 10km buffer from the centre of the Site and included 10 km national grid squares IC61; IC62, IC71, IC72; IC81 and IC82 revealed that there were 107 bird species recorded (**Table 9.4**). There were 19 red-listed and 37 amber-listed species recorded of conservation priority in Ireland (Colhoun & Cummins, 2013) and there were 25 red-listed and 29 amber-listed species recorded of conservation priority in the UK (Eaton et al., 2015). Within a 2 km radius there were fewer species recorded (n = 20) with two red-listed species; cuckoo and red grouse.

Table 9.4: Details of bird species detected within 10 km radius of the Development from NBN

Latin Name	Common Name	BTO Code	BOCCI3	BOCC4
Tyto alba	Barn owl	BO	RED	GREEN
Turdus merula	Blackbird	B.	GREEN	GREEN
Sylvia atricapilla	Blackcap	BC	GREEN	GREEN
Chroicocephalus ridibundus	Black-headed gull	BH	RED	AMBER
Cyanocitta cristata	Blue jay	-	-	-
Cyanistes caeruleus	Blue tit	BT	GREEN	GREEN
Fringilla montifringilla	Brambling	BL	GREEN	GREEN
Pyrrhula pyrrhula	Bullfinch	BF	GREEN	AMBER
Fringilla coelebs	Chaffinch	CH	GREEN	GREEN
Phylloscopus collybita	Chiffchaff	CC	GREEN	GREEN
Periparus ater	Coal tit	CT	GREEN	GREEN
Streptopelia decaocto	Collared dove	CD	GREEN	GREEN
Buteo buteo	Common buzzard	BZ	GREEN	GREEN
Loxia curvirostra	Common crossbill	CR	GREEN	GREEN
Larus canus	Common gull	CM	AMBER	AMBER
Actitis hypoleucos	Common sandpiper	CS	AMBER	AMBER
Phalacrocorax carbo	Cormorant	CA	AMBER	GREEN
Crex crex	Corncrake	CE	RED	RED

Latin Name	Common Name	BTO Code	BOCCI3	BOCC4
Cuculus canorus	Cuckoo	CK	GREEN	RED
Numenius arquata	Curlew	CU	RED	RED
Cinclus cinclus	Dipper	DI	GREEN	AMBER
Prunella modularis	Dunnock	D.	GREEN	AMBER
Columba livia	Feral pigeon	FP	GREEN	GREEN
Turdus pilaris	Fieldfare	FF	GREEN	RED
Sylvia borin	Garden warbler	GW	GREEN	GREEN
Regulus regulus	Goldcrest	GC	AMBER	GREEN
Pluvialis apricaria	Golden plover	GP	RED	GREEN
Bucephala clangula	Goldeneye	GN	RED	AMBER
Carduelis carduelis	Goldfinch	GO	GREEN	GREEN
Mergus merganser	Goosander	GD	AMBER	GREEN
Locustella naevia	Grasshopper warbler	GH	GREEN	RED
Larus marinus	Great black-backed gull	GB	AMBER	AMBER
Parus major	Great tit	GT	GREEN	GREEN
Podiceps cristatus	Great-crested grebe	GG	AMBER	GREEN
Chloris chloris	Greenfinch	GR	AMBER	GREEN
Ardea cinerea	Grey heron	H.	GREEN	GREEN
Motacilla cinerea	Grey wagtail	GL	RED	RED
Circus cyaneus	Hen harrier	HH	AMBER	RED
Larus argentatus	Herring gull	HG	RED	RED
Corvus cornix	Hooded crow	HC	GREEN	GREEN
Corvus corone	Hooded crow	HC	GREEN	GREEN
Delichon urbicum	House martin	HM	AMBER	AMBER
Passer domesticus	House sparrow	HS	AMBER	RED
Lymnocryptes minimus	Jack snipe	JS	AMBER	GREEN
Corvus monedula	Jackdaw	JD	GREEN	GREEN
Garrulus glandarius	Jay	J.	GREEN	GREEN
Falco tinnunculus	Kestrel	K.	AMBER	AMBER
Alcedo atthis	Kingfisher	KF	AMBER	AMBER
Vanellus vanellus	Lapwing	L.	RED	RED
Larus fuscus	Lesser black-backed gull	LB	AMBER	AMBER
Acanthis cabaret	Lesser redpoll	LR	GREEN	RED
Linaria cannabina	Linnet	LI	AMBER	RED
Tachybaptus ruficollis	Little grebe	LG	AMBER	GREEN
Asio otus	Long-eared owl	LE	GREEN	GREEN
Aegithalos caudatus	Long-tailed tit	LT	GREEN	GREEN
Pica pica	Magpie	MG	GREEN	GREEN
Anas platyrhynchos	Mallard	MA	GREEN	AMBER
Anthus pratensis	Meadow pipit	MP	RED	AMBER
Falco columbarius	Merlin	ML	AMBER	RED
Turdus viscivorus	Mistle thrush	M.	AMBER	RED

Latin Name	Common Name	BTO Code	BOCCI3	BOCC4
Gallinula chloropus	Moorhen	MH	GREEN	GREEN
Cygnus olor	Mute swan	MS	AMBER	AMBER
Haematopus ostralegus	Oystercatcher	OC	AMBER	AMBER
Falco peregrinus	Peregrine	PE	GREEN	GREEN
Phasianus colchicus	Pheasant	PH	GREEN	GREEN
Motacilla alba	Pied wagtail	PW	GREEN	GREEN
Anas acuta	Pintail	PT	RED	AMBER
Aythya ferina	Pochard	PO	RED	RED
Corvus corax	Raven	RN	GREEN	GREEN
Lagopus lagopus	Red grouse	RG	RED	AMBER
Mergus serrator	Red-breasted merganser	RM	GREEN	GREEN
Tringa totanus	Redshank	RK	RED	AMBER
Turdus iliacus	Redwing	RE	GREEN	RED
Emberiza schoeniclus	Reed bunting	RB	GREEN	AMBER
Erithacus rubecula	Robin	R.	AMBER	GREEN
Saxicola rubicola	Robin	R.	AMBER	GREEN
Corvus frugilegus	Rook	RO	GREEN	GREEN
Riparia riparia	Sand martin	SM	AMBER	GREEN
Calidris alba	Sanderling	SS	GREEN	AMBER
Acrocephalus schoenobaenus	Sedge warbler	SW	GREEN	GREEN
Asio flammeus	Short-eared owl	SE	AMBER	AMBER
Spinus spinus	Siskin	SK	GREEN	GREEN
Alauda arvensis	Skylark	S.	AMBER	RED
Gallinago gallinago	Snipe	SN	AMBER	AMBER
Plectrophenax nivalis	Snow bunting	SB	GREEN	AMBER
Turdus philomelos	Song thrush	ST	GREEN	RED
Accipiter nisus	Sparrowhawk	SH	AMBER	GREEN
Muscicapa striata	Spotted flycatcher	SF	AMBER	RED
Sturnus vulgaris	Starling	SG	AMBER	RED
Columba oenas	Stock dove	SD	AMBER	AMBER
Hirundo rustica	Swallow	SL	AMBER	GREEN
Apus apus	Swift	SI	AMBER	AMBER
Anas crecca	Teal	T.	AMBER	AMBER
Passer montanus	Tree sparrow	TS	AMBER	RED
Certhia familiaris	Treecreeper	TC	GREEN	GREEN
Aythya fuligula	Tufted duck	TU	RED	GREEN
Linaria flavirostris	Twite	TW	RED	RED
Bombycilla garrulus	Waxwing	WX	GREEN	GREEN
Oenanthe oenanthe	Wheatear	W.	AMBER	GREEN
Saxicola rubetra	Whinchat	WC	RED	RED
Sylvia communis	Whitethroat	WH	GREEN	GREEN
Cygnus cygnus	Whooper swan	WS	AMBER	AMBER

Latin Name	Common Name	BTO Code	BOCCI3	BOCC4
Phylloscopus trochilus	Willow warbler	WW	GREEN	AMBER
Scolopax rusticola	Woodcock	WK	RED	RED
Columba palumbus	Woodpigeon	WP	GREEN	GREEN
Troglodytes troglodytes	Wren	WR	GREEN	GREEN
Emberiza citrinella	Yellowhammer	Y.	RED	RED

3.2.2. Bird Atlas (BTO)

61. The Bird Atlas 2007 – 2011 (Balmer *et al.,* 2013[14]) is the key resource for the UK & Ireland for understanding bird distribution, breeding / wintering status and abundance. All these data are published based on 10 km grid resolution, but some records are resolved to tetrad (2 km x 2 km) and these are described where available (**Technical Appendix 9.2**). Data were obtained for 10km square IC71 and IC72 which showed 82 species were recorded (**Technical Appendix 9.2**) of which 72 species were recorded breeding and the remainder 58 species) were recorded in the wintering season. Not all of these species will be breeding or wintering on the specific sites given the wider 10km search area but it is shown that a wide range of bird species occur in the area.

62. Based on Irish conservation status (Colhoun & Cummins, 2013) there were 10 red-listed and 27 amber-listed species (**Technical Appendix 9.2**) and there were 20 red-listed and 17 amber-listed species recorded of conservation priority in the UK (Eaton et al., 2015). There were seven raptor species recorded (buzzard, golden eagle, hen harrier, kestrel, merlin, peregrine and sparrowhawk; **Technical Appendix 9.2**) and one owl (long-eared owl) in the area in the BTO Atlas maps (Balmer et al., 2013). There were a range of wader species recorded including common sandpiper, jack snipe, golden plover (possible breeding), snipe and curlew (**Technical Appendix 9.2**).

3.2.3. Raptor records

63. The NIRSG and historical knowledge from this area of Dr Marc Ruddock record the presence of eight different raptor species at the 10 km square resolution within IC71 and IC72 namely; buzzard, hen harrier, kestrel, merlin, long-eared owl, peregrine, goshawk and sparrowhawk (**Table 9.6**). There were similar range of species were associated with the two 10 km squares. A smaller number of less common species have been recorded in the area (some of which are corroborated by the NBN data (**Table 9.4**) but not known to be breeding including golden eagle, white-tailed eagle, osprey, hobby, honey buzzard and marsh harrier and black kite. Eagle sightings in particular have typically been immature, non-territory holding individuals (M. Ruddock, personal observations).

64. Hen harriers in this area are primarily located in young forest plantations and/or heather lacunas within the forest plantations (M. Ruddock, personal observation) rather than on open moorland and are not known to occur within the survey area or within 500 m, but certainly occur within 2 km including in recent years (M. Ruddock, personal observation).

65. A review of published data for hen harrier is available from recent national hen harrier surveys (Hayhow et al., 2013[15]; Wotton et al., 2018[16]) where in 2010, there were 32 pairs of hen harrier recorded in Northern Ireland. However, in 2016, the national population and the SPA populations were known to have declined. Wotton et al., (2018) note that the SPA populations in Northern Ireland have declined by approximately 50% since designation.

66. Collectively, through various data sources, historically one to two pairs of hen harrier typically occur within 2 – 3 km of the survey area and this species has historically nested both in deep heather and in pre-thicket forest nests and also in areas in adjacent lands. Similarly, merlin are known to have occurred along the forest edge adjacent to the Operation Rigged Hill Windfarm and within 1 – 2 km of the survey area. Further surveys and on the extant locations of this species are recorded in this report.

Table 9.6. Details of raptor species known to occur within adjacent 10km squares

Latin name	Common name	Species	IC71	IC72
Tyto alba	Barn owl	BO	No records	No records
Buteo buteo	Buzzard	BZ	Confirmed	Confirmed
Aquila chrysaetos	Golden Eagle	EA	No records	No records
Accipiter gentilis	Goshawk	GI	Possible	Possible
Circus cyaneus	Hen harrier	HH	Confirmed	Confirmed
Falco subbuteo	Hobby	HY	No records	Sightings
Pernis apivorous	Honey Buzzard	HZ	No records	No records
Falco tinnunculus	Kestrel	K.	Confirmed	Confirmed
Asio otus	Long-eared owl	LE	Confirmed	Confirmed
Circus aeruginosus	Marsh harrier	MR	No records	No records
Falco columbarius	Merlin	ML	Confirmed	Confirmed
Pandion halietus	Osprey	OP	No records	No records
Falco peregrinus	Peregrine	PE	Confirmed	Confirmed
Milvus milvus	Red Kite	KT	No records	No records
Milvus migrans	Black kite	-	No records	Sightings
Asio flammeus	Short-eared owl	SE	No records	Sightings
Accipiter nisus	Sparrowhawk	SH	Confirmed	Confirmed
Haliaeetus albicilla	White-tailed eagle	WE	No records	Sightings

3.2.4. Whooper swan

67. Robinson *et al.,* (2004) published All-Ireland whooper swan wintering sites and more recently whooper swan have been recorded breeding in Ireland (see Balmer *et al.,* 2013). Based on these published data, wintering whooper swan are known to occur closest at 10.4 km from the nearest existing turbines but nearest sites towards the Lough Foyle SPA ranged between 8.5 km and 10 km (**Figure 9.5**) away from the Site Boundary.

68. Other data sources collated here have recorded whooper swans in other areas and some were recorded in these primary surveys including during dawn or dusk roost watches. Recent Bird Atlas data (Balmer *et al.,* 2013) recorded whooper and mute swans in the 10 km square IC72 only to the north and lists whooper swans as probable breeding.

3.2.5. Waders & red grouse

69. The biodiversity databases record common sandpiper, curlew, golden plover, jack snipe, lapwing, oystercatcher, redshank, sanderling, snipe and woodcock (**Table 9.3**) although no time frame (or season) of sightings is provided in those databases. In recent surveys (Balmer *et al.,* 2013) there were only a smaller range of species recorded some of which may occur in habitats not present within the site boundary and/or wider survey buffer areas. There were no waders recorded in the 2 km search area. This wider area is also known to historically have held curlew in the previous Bird Atlas (1988 – 1991; Gibbons *et al.,* 1994[17]).

70. Curlew and snipe appear to be the most likely priority breeding wader species based on these data and habitat is eminently suitable in and around the windfarm and landownership areas. These species do occur in the area as confirmed by field

[14] Balmer, D., Gillings, S., Caffrey, B., Swan, B., Downie, I. & Fuller, R. (2013). Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland. British Trust for Ornithology.
[15] Hayhow, D.B., Eaton, M.A., Bladwell, S., Etheridge, B., Ewing, S., Ruddock, M., Saunders, R., Sharpe, C., Sim, I.M.W. & Stevenson, A. (2013). The status of the Hen Harrier, Circus cyaneus, in the UK and the Isle of Man in 2010. Bird Study 60: 446-458.
[16] Wotton, S., Bladwell, S., Morris, N., Raw, D., Ruddock, M., Stevenson, A., Stirling-Aird, P. & Eaton, M. (2018) Status of the Hen Harrier *Circus cyaneus* in the UK and Isle of Man in 2016. Bird Study 65: 145-160.
[17] Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993). *The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991.* London: Poyser.

surveys and confirmed via data requests and on the basis of extant / suitable habitats in the area and it would be expected that this species would occur during breeding bird surveys.

71. Red grouse surveys conducted by Allen *et al.,* (2004) do report red grouse occurrence in all these 10 km squares and across the survey buffers where suitable habitat occurs (**Figure 9.6**). All aggregated data sources including NBN and BTO data requests confirm the presence of this species in the locality and field surveys shall confirm red grouse distribution and abundance, including within the survey area and in the wider 500 m buffer area (**Figure 9.1**).

3.3. Field Surveys 2014 - 2015

72. The results of the range of surveys undertaken between 2014 and 2015 are described in further details here and then further analysis and interpretation is undertaken in **Chapter 9 – Ornithology** of the ES.

73. The suite of surveys carried out during 2014 included breeding bird surveys, winter walkover surveys, breeding and wintering vantage point surveys, migration vantage point surveys and breeding and wintering priority species surveys. This suite of surveys was conducted over a 13-month period between January 2014 and February 2015.

3.3.1. Breeding Bird Surveys

74. Breeding season transect surveys were carried out between during April and July 2014 (**Table 9.7**). There were 132 hours of transect surveys undertaken, covering the survey area and both the 500 m buffer, for all species, and the 800 m buffer, for priority species (curlew) (see also Section 9.3.3.6.3 for curlew analysis). Survey times ranged from 04.50 hrs to 21.35 hrs (**Table 9.7**) and covered a wide range of weather conditions (**Table 9.7**).

75. All parts of the Site Boundary were accessible including land in / around both operational and proposed turbine buffers (**Figure 9.7**) for walkover surveys.

Table 9.7 Summary of survey effort and weather during breeding bird surveys

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
4	9	2014	KH	07:15	12:15	05:00	10	500	SW5	NIL	5
4	9	2014	AM	07:20	12:20	05:00	10	550	SW5	NIL	5
4	14	2014	KH	07:00	13:00	06:00	10	600	W3	NIL	5
4	14	2014	AM	07:00	13:00	06:00	10	600	W3	NIL	5
4	29	2014	KH	06:00	11:00	05:00	9	500	SE1	NIL	5
4	29	2014	MR	05:50	11:05	05:15	5	500	SE1	NIL	5
4	29	2014	AM	06:00	11:00	05:00	10	600	SE3	NIL	5
5	8	2014	KH	06:45	10:45	04:00	10	350	W4	ILR	2
5	15	2014	AM	09:45	14:45	05:00	6	1000	SW4	NIL	5
5	25	2014	KH	07:45	15:45	08:00	10	350	NE3	CLR	2
5	28	2014	MR	10:55	18:20	07:25	5	1000	NE3	NIL	5
5	28	2014	AM	11:20	18:00	06:40	6	1000	NE3	NIL	5
6	18	2014	AM	06:00	08:00	02:00	10	350	NW3	CLM	1
6	18	2014	DR	06:05	08:00	01:55	10	350	NW3	CLM	1
6	25	2014	KH	06:40	15:40	09:00	10	600	NE5	CLR	3
6	25	2014	MR	06:40	14:40	08:00	10	600	SW2	ILR	5
6	25	2014	MR	15:45	17:00	01:15	10	600	W1	NIL	5
6	25	2014	AM	06:45	15:15	08:30	10	600	SW2	ILR	5
6	29	2014	DR	04:50	06:00	01:10	10	350	SW1	CHM	1
7	7	2014	KH	08:05	14:20	06:15	9	500	SW4	NIL	5
7	7	2014	AM	08:05	14:20	06:15	8	500	SW4	NIL	5
7	7	2014	MR	08:05	14:20	06:15	8	500	SW4	NIL	5
7	18	2014	MR	07:40	14:05	06:25	9	1000	SE3	NIL	5
7	30	2014	MR	14:55	21:35	06:40	10	600	W3	NIL	2

76. There were 55 species recorded (**Table 9.8**) within the 500 m survey boundary (**Figure 9.1**) of which only three were red-listed species in Ireland (grey wagtail; meadow pipit and red grouse; Colhoun & Cummins, 2013) and 13 UK red-listed species (Eaton et al., 2014; cuckoo; grasshopper warbler, grey wagtail, hen harrier; house sparrow; linnet; lesser redpoll; mistle thrush; merlin, skylark; starling; song thrush and tree sparrow).

77. There were fewer species (32) recorded within the existing 500 m turbine buffer (**Table 9.9**) including two red-listed species (Colhoun & Cummins, 2013; meadow pipit and red grouse) and seven UK red-listed species (Eaton et al., 2014; cuckoo; grasshopper warbler; linnet; mistle thrush; merlin, skylark and song thrush). There were 36 species recorded within the proposed 500 m turbine buffer including two red-listed species (Colhoun & Cummins, 2013; meadow pipit and red grouse) and three UK red-listed species (Eaton et al., 2014; cuckoo; grasshopper warbler; linnet; lesser redpoll; mistle thrush; merlin, skylark and song thrush).

78. Behavioural analysis for all the species within the 500 m survey boundary indicates that there were 44 extant species recorded and/or exhibiting breeding behaviours. There were 37 confirmed breeding species and another six probable and four possible breeding species respectively (**Table 9.10**; **Figures 9.8; 9.9; 9.10**). There were fewer confirmed breeding species in the existing (n = 13) and proposed (n = 19) 500 m turbine buffers; and an additional 10 and 8 respectively probable and four and three possible breeding species.

79. Meadow pipits and skylarks were widespread across parts of the survey area (**Figure 9.11**) and the habitat associations of these species were evident from the distribution (**Figure 9.12**) with a scarcity in areas of improved pasture and / or afforested habitats and wider presence on the semi-improved / semi-natural habitats. A small number of territories were recorded at western parts of the area and at lower altitudes in areas of longer vegetation and in rank grassland at field margins (**Figure 9.12**).

80. Analyses of breeding bird transect surveys for waders indicates that there was evidence of 12 snipe territories within the survey area and 500 m buffer of which nine were located within either the 500 m existing or 500 m proposed turbine buffers. Additional territories were detected during other surveys (Sections 9.3.3.6) where cumulative analyses are undertaken of all snipe (and red grouse).

81. There were no curlew territories inside the survey area and 500 m buffer or within the 800 m buffer and beyond 500 m and 800 m from any existing or proposed turbines.

82. There was one red grouse territory recorded during breeding bird surveys within the survey area and the 500 m buffer and two additional territories within the 800 m buffer but further priority species surveys were undertaken to identify the full distribution and abundance of these species in the survey areas (see Section 9.3.3.6). The one territory identified during walkover surveys was within 500 m of existing turbines and also within 500 m of the proposed turbines.

83. Two pairs of buzzards nested within the survey area and 500 m buffer (see Section 9.3.3.6) and successfully fledged young (**Figure 9.8**), but breeding evidence was not recorded during walkover surveys and detailed priority species surveys located these nests.

Table 9.8 – Summary of numbers of territories of each species detected during breeding bird surveys inside the 500 m survey area including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
B.	10	24	8		42	GREEN	GREEN
BC		7			7	GREEN	GREEN
BF		1	1		2	GREEN	AMBER
BT	6	11	6		23	GREEN	GREEN
BZ				15	15	GREEN	GREEN
CC			1		1	GREEN	GREEN
CD	2	2	2		6	GREEN	GREEN
CH	9	150	25		184	GREEN	GREEN
CK	1	2			3	GREEN	RED
CR			1		1	GREEN	GREEN
CT	3	13	20		36	GREEN	GREEN
D.	2	19	9		30	GREEN	AMBER
FP		1			1	GREEN	GREEN
GC	2	16	27		45	AMBER	GREEN
GH	2	1	1		4	GREEN	RED
GL	1	3	2		6	RED	RED
GO	2	7	3		12	GREEN	GREEN
GR		2	2		4	AMBER	GREEN
GT	2	10	5		17	GREEN	GREEN
HC	6	5			11	GREEN	GREEN
HH				1	1	AMBER	RED
HM	10	9	5		24	AMBER	AMBER
HS	9	12	6		27	AMBER	RED
J.	2				2	GREEN	GREEN
JD	10	10	5	2	27	GREEN	GREEN
K.				2	2	AMBER	AMBER
LB				4	4	AMBER	AMBER
LI	1	17	6		24	AMBER	RED
LR		3			3	GREEN	RED
LT	1		1		2	GREEN	GREEN
M.	6	6	2		14	AMBER	RED
MG	13	3	10		26	GREEN	GREEN
ML				1	1	AMBER	RED
MP	139	201	57		397	RED	AMBER
PE				7	7	GREEN	GREEN
PW	6	2	15		23	GREEN	GREEN
R.	17	83	8		108	AMBER	GREEN
RB	1	5	6		12	GREEN	AMBER
RG			1		1	RED	AMBER
RN				33	33	GREEN	GREEN
RO	2	4	3	5	14	GREEN	GREEN
S.	11	183			194	AMBER	RED
SC	2		3		5	AMBER	GREEN
SG	11	11	9	1	32	AMBER	RED
SI				1	1	AMBER	AMBER
SK	1	2			3	GREEN	GREEN
SL	5	17	5	2	29	AMBER	GREEN
SN	11		1		12	AMBER	AMBER
ST	1	22			23	GREEN	RED
SW	1				1	GREEN	GREEN
TS			1		1	AMBER	RED
W.		2	1		3	AMBER	GREEN
WP	2	20	12		34	GREEN	GREEN
WR	34	93	12		139	GREEN	GREEN
WW	3	72	1		76	GREEN	AMBER
TOTAL	347	1051	283	74	1755		

Table 9.9 – Summary of numbers of territories of each species detected during breeding bird surveys inside the existing 500 m turbine area including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
B.		3			3	GREEN	GREEN
BC		2			2	GREEN	GREEN
BF			1		1	GREEN	AMBER
BT	1	1	1		3	GREEN	GREEN
BZ				2	2	GREEN	GREEN
CH	5	23	5		33	GREEN	GREEN
CK	1				1	GREEN	RED
CT		4	8		12	GREEN	GREEN
D.		1			1	GREEN	AMBER
GC	2	8	8		18	AMBER	GREEN
GH	1				1	GREEN	RED
GR		1	1		2	AMBER	GREEN

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
GT			1		1	GREEN	GREEN
HC		1			1	GREEN	GREEN
LB				1	1	AMBER	AMBER
LI			1		1	AMBER	RED
LT	1				1	GREEN	GREEN
M.	1	1			2	AMBER	RED
ML				1	1	AMBER	RED
MP	60	77	25		162	RED	AMBER
PE				2	2	GREEN	GREEN
R.		12	2		14	AMBER	GREEN
RB	1		1		2	GREEN	AMBER
RG			1		1	RED	AMBER
RN				6	6	GREEN	GREEN
S.	5	49			54	AMBER	RED
SC	2				2	AMBER	GREEN
SN	8		1		9	AMBER	AMBER
ST		3			3	GREEN	RED
WP		6	1		7	GREEN	GREEN
WR	7	14	2		23	GREEN	GREEN
WW		7			7	GREEN	AMBER
TOTAL	95	213	59	12	379		

Table 9.9 – Summary of numbers of territories of each species detected during breeding bird surveys inside the proposed 500 m turbine area including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
B.		4			4	GREEN	GREEN
BC		2			2	GREEN	GREEN
BF			1		1	GREEN	AMBER
BT	3	2	1		6	GREEN	GREEN
BZ				2	2	GREEN	GREEN
CH	6	31	7		44	GREEN	GREEN
CK	1	1			2	GREEN	RED
CT	1	5	12		18	GREEN	GREEN
D.		1			1	GREEN	AMBER
GC	2	9	15		26	AMBER	GREEN
GH	1				1	GREEN	RED
GR		1	1		2	AMBER	GREEN

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
GT	1		1		2	GREEN	GREEN
HC	1	1			2	GREEN	GREEN
J.	1				1	GREEN	GREEN
K.				1	1	AMBER	AMBER
LB				1	1	AMBER	AMBER
LI			1		1	AMBER	RED
LR		1			1	GREEN	RED
LT	1				1	GREEN	GREEN
M.	1	3			4	AMBER	RED
ML				1	1	AMBER	RED
MP	80	107	30		217	RED	AMBER
PE				5	5	GREEN	GREEN
R.	2	15	2		19	AMBER	GREEN
RB	1		3		4	GREEN	AMBER
RG			1		1	RED	AMBER
RN				15	15	GREEN	GREEN
S.	8	84			92	AMBER	RED
SC	2		1		3	AMBER	GREEN
SN	8		1		9	AMBER	AMBER
ST		4			4	GREEN	RED
SW	1				1	GREEN	GREEN
WP		6	1		7	GREEN	GREEN
WR	10	19	3		32	GREEN	GREEN
WW		10	1		11	GREEN	AMBER
TOTAL	131	306	82	25	544		

3.3.2. Wintering Bird Surveys

84. Wintering season transect surveys were carried out between September 2014 and February 2015 inclusive (**Table 9.10**). There were 42 hours and 20 minutes completed in wintering walkover surveys. Survey times ranged from 07.25 hrs to 16.30 hrs (**Table 9.10**) and covered a wide range of weather conditions (**Table 9.10**).

Table 9.10 Summary of survey effort and weather during wintering bird surveys

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
9	4	2014	AM	11:00	14:00	03:00	10	600	SE2	NIL	5
9	19	2014	AM	08:00	11:00	03:00	10	250	SE3	NIL	1
9	26	2014	MR	12:30	14:25	01:55	8	600	SE2	NIL	5
10	6	2014	AM	11:15	12:45	01:30	5	600	SW4	NIL	5
10	14	2014	AM	11:20	14:20	03:00	1	600	E2	NIL	5

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
11	19	2014	KH	11:30	14:40	03:10	10	500	E4	NIL	5
11	24	2014	MR	07:25	08:25	01:00	6	1000	SW3	NIL	5
11	24	2014	AM	12:10	15:10	03:00	6	1000	SW3	NIL	5
11	24	2014	KH	08:30	09:30	01:00	8	800	SW3	NIL	5
12	9	2014	KH	09:00	12:00	03:00	10	500	SW4	CLR	5
12	31	2014	KH	11:45	14:45	03:00	10	500	SE4	NIL	3
1	15	2015	AM	12:50	16:30	03:40	10	400	SW4	NIL	3
1	26	2015	AM	08:20	11:20	03:00	10	500	W4	NIL	5
2	18	2015	KH	08:35	11:35	03:00	10	400	NW4	NIL	5
2	25	2015	KH	08:05	11:05	03:00	7	300	SW3	NIL	5
2	25	2015	MR	08:05	11:10	03:05	3	1000	SW1	NIL	5

85. There were 759 observation of 2,268 individuals from 49 species recorded (**Tables 9.11; Figure 9.13)** within the 500 m survey area (**Figure 9.1**) of which only six were red-listed species in Ireland (black-headed gull, grey wagtail, golden plover, meadow pipit, red grouse and woodcock; Colhoun & Cummins, 2013) and 14 UK red-listed species (fieldfare, grey wagtail, hen harrier, house sparrow, linnet, lesser redpoll, mistle thrush, merlin, redwing, skylark, starling, song thrush, tree sparrow and woodcock; Eaton et al., 2014).

86. There were fewer species (95 observations of 136 individuals from 21 species) recorded within the 500 m existing turbine buffer (**Tables 9.12**) including three red-listed species (Colhoun & Cummins, 2013; golden plover, meadow pipit and red grouse) and two UK red-listed species (Eaton et al., 2014; skylark and song thrush).

87. Whilst within the proposed turbine 500 m buffer there were 151 detections of 250 individuals from 25 species (**Table 9.13**) including three red-listed species (Colhoun & Cummins, 2013; golden plover, meadow pipit and red grouse) and three UK red-listed species (Eaton et al., 2014; lesser redpoll, skylark and song thrush).

Table 9.11. Summary of numbers of each species detected during wintering bird surveys inside the 500 m survey area including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	16	17	GREEN	GREEN
BH	1	15	RED	AMBER
BT	23	30	GREEN	GREEN
BZ	3	3	GREEN	GREEN
CD	5	10	GREEN	GREEN
CH	35	64	GREEN	GREEN
CR	5	18	GREEN	GREEN
CT	13	17	GREEN	GREEN
D.	10	21	GREEN	AMBER
FF	5	43	GREEN	RED
GC	3	4	AMBER	GREEN
GL	4	4	RED	RED
GO	4	34	GREEN	GREEN
GP	6	28	RED	GREEN
GR	2	3	AMBER	GREEN
GT	9	10	GREEN	GREEN
H.	1	1	GREEN	GREEN
HC	33	67	GREEN	GREEN
HH	2	2	AMBER	RED
HS	17	63	AMBER	RED
JD	41	268	GREEN	GREEN
K.	2	3	AMBER	AMBER
LI	7	29	AMBER	RED
LR	1	2	GREEN	RED
LT	5	18	GREEN	GREEN
M.	6	7	AMBER	RED
MG	34	55	GREEN	GREEN
ML	1	1	AMBER	RED
MP	118	229	RED	AMBER
PE	3	3	GREEN	GREEN
PH	1	1	GREEN	GREEN
PW	21	25	GREEN	GREEN
R.	64	69	AMBER	GREEN
RE	8	82	GREEN	RED
RG	6	8	RED	AMBER
RN	19	43	GREEN	GREEN
RO	27	204	GREEN	GREEN
S.	17	23	AMBER	RED
SC	1	1	AMBER	GREEN
SG	23	374	AMBER	RED
SH	2	2	AMBER	GREEN
SL	13	164	AMBER	GREEN
SN	55	64	AMBER	AMBER
ST	3	7	GREEN	RED
TS	4	36	AMBER	RED
W.	4	5	AMBER	GREEN
WK	2	2	RED	RED
WP	11	19	GREEN	GREEN
WR	63	70	GREEN	GREEN

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
TOTAL	759	2268		

Table 9.12 – Summary of numbers of each species detected during wintering bird surveys inside the existing 500 m turbine area including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	1	1	GREEN	GREEN
BT	1	1	GREEN	GREEN
CH	2	2	GREEN	GREEN
CR	2	8	GREEN	GREEN
CT	1	2	GREEN	GREEN
GC	1	1	AMBER	GREEN
GP	4	8	RED	GREEN
HC	1	2	GREEN	GREEN
K.	2	3	AMBER	AMBER
MG	1	2	GREEN	GREEN
MP	32	42	RED	AMBER
PE	1	1	GREEN	GREEN
PW	1	1	GREEN	GREEN
R.	2	2	AMBER	GREEN
RG	3	4	RED	AMBER
RN	10	23	GREEN	GREEN
S.	2	2	AMBER	RED
SN	22	24	AMBER	AMBER
ST	1	1	GREEN	RED
W.	1	1	AMBER	GREEN
WR	4	5	GREEN	GREEN
TOTAL	95	136		

Table 9.13 – Summary of numbers of each species detected during wintering bird surveys inside the proposed 500 m turbine area including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	1	1	GREEN	GREEN
BT	1	1	GREEN	GREEN
CH	2	2	GREEN	GREEN
CR	4	16	GREEN	GREEN
CT	2	3	GREEN	GREEN
GC	2	3	AMBER	GREEN
GP	5	27	RED	GREEN
HC	1	2	GREEN	GREEN
K.	2	3	AMBER	AMBER
LR	1	2	GREEN	RED
MG	1	2	GREEN	GREEN
MP	52	82	RED	AMBER
PE	2	2	GREEN	GREEN
PW	1	1	GREEN	GREEN
R.	4	4	AMBER	GREEN
RG	6	8	RED	AMBER
RN	12	29	GREEN	GREEN
S.	9	11	AMBER	RED
SC	1	1	AMBER	GREEN
SL	1	3	AMBER	GREEN
SN	29	32	AMBER	AMBER
ST	1	1	GREEN	RED
W.	2	3	AMBER	GREEN
WP	1	2	GREEN	GREEN
WR	8	9	GREEN	GREEN
TOTAL	151	250		

3.3.3. Breeding Vantage Point Surveys

88. There were 36 hours observation completed at each of the four vantage points between March 2014 and August 2014 (**Tables 9.14 & 9.15**). Cumulative observation time from all vantage points over the survey area was 144 hours during the study period (**Table 9.15**). Survey times ranged from 05.45 hrs to 21.35 hrs (**Table 9.14**) and covered a wide range of weather conditions (**Table 9.16**).

Table 9.14 – Breeding vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
BVP	2	DR	3	18	2014	09:00	12:00	03:00
BVP	1	DR	3	18	2014	13:35	16:35	03:00
BVP	3	AM	3	18	2014	13:50	16:50	03:00
BVP	2	DR	3	27	2014	07:50	10:50	03:00
BVP	1	AM	3	27	2014	07:55	10:55	03:00
BVP	3	DR	3	31	2014	07:45	10:45	03:00
BVP	4	AM	3	31	2014	08:05	11:05	03:00
BVP	4	AM	3	31	2014	11:40	14:40	03:00
BVP	4	DR	4	3	2014	10:20	13:20	03:00

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
BVP	1	KH	4	9	2014	12:15	15:15	03:00
BVP	3	AM	4	9	2014	12:30	15:30	03:00
BVP	3	KH	4	24	2014	11:20	14:20	03:00
BVP	2	KH	4	24	2014	14:35	17:35	03:00
BVP	1	KH	4	28	2014	14:55	17:55	03:00
BVP	4	AM	4	28	2014	15:00	18:00	03:00
BVP	2	DR	4	28	2014	15:05	18:05	03:00
BVP	3	DR	5	8	2014	07:45	10:45	03:00
BVP	1	DR	5	8	2014	11:00	14:00	03:00
BVP	3	DR	5	15	2014	11:55	14:55	03:00
BVP	4	AM	5	15	2014	14:50	17:50	03:00
BVP	2	DR	5	15	2014	15:20	18:20	03:00
BVP	2	DR	5	21	2014	05:45	08:45	03:00
BVP	1	DR	5	21	2014	08:55	11:55	03:00
BVP	4	DR	5	28	2014	13:20	16:20	03:00
BVP	1	DR	6	2	2014	06:10	09:10	03:00
BVP	2	DR	6	2	2014	09:20	12:20	03:00
BVP	3	DR	6	18	2014	08:00	11:00	03:00
BVP	4	AM	6	18	2014	08:00	11:00	03:00
BVP	1	AM	6	25	2014	15:15	18:15	03:00
BVP	2	KH	6	25	2014	15:40	18:40	03:00
BVP	4	DR	6	29	2014	06:00	09:00	03:00
BVP	3	DR	6	29	2014	09:35	12:35	03:00
BVP	1	DR	7	2	2014	05:55	08:55	03:00
BVP	3	DR	7	2	2014	09:30	12:30	03:00
BVP	2	DR	7	7	2014	08:20	11:20	03:00
BVP	4	DR	7	18	2014	11:05	14:05	03:00
BVP	1	DR	7	24	2014	06:10	09:10	03:00
BVP	2	DR	7	24	2014	09:25	12:25	03:00
BVP	4	DR	7	30	2014	18:35	21:35	03:00
BVP	3	AM	7	30	2014	18:30	21:30	03:00
BVP	3	DR	8	7	2014	08:15	11:15	03:00
BVP	4	DR	8	7	2014	11:40	14:40	03:00
BVP	1	DR	8	14	2014	06:20	09:20	03:00
BVP	2	DR	8	14	2014	09:35	12:35	03:00
BVP	4	DR	8	29	2014	08:45	11:45	03:00
BVP	1	DR	8	29	2014	12:25	15:25	03:00
BVP	2	MR	8	29	2014	12:20	15:20	03:00
BVP	3	AM	8	29	2014	12:40	15:40	03:00
BVP	2	DR	3	18	2014	09:00	12:00	03:00

Table 9.15 – Breeding vantage point survey effort by month

VP No.	Mar	Apr	May	Jun	Jul	Aug	TOTAL
1	6	6	6	6	6	6	36
2	6	6	6	6	6	6	36
3	6	6	6	6	6	6	36
4	6	6	6	6	6	6	36
TOTAL	24	24	24	24	24	24	144

Table 9.16 – Breeding vantage point weather conditions

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D		0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
2	3	18	10	10	10	10	400	550	400	400	W4	W5	W6	W6	ILR	ILR	ILR	ILR	5	5	3	2.5	2
1	3	18	10	10	10	10	500	500	500	550	W5	W5	W5	W5	ILR	ILR	NIL	NIL	5	5	5	5	1
3	3	18	10	10	10	9	450	450	500	500	W3	W4	W5	W5	NIL	ILR	NIL	NIL	3	3	3	3	3
2	3	27	10	10	10	10	400	400	400	400	E3	E3	E3	E3	NIL	ILR	NIL	NIL	3	3	3	3	2
3	3	27	10	10	10	10	500	500	500	500	N4	NE4	NE5	NE5	ILR	ILR	CLR	ILR	5	5	5	5	3
1	3	27	10	10	10	10	500	500	500	500	E2	E3	E3	E3	NIL	ILR	ILR	ILR	5	5	5	5	1
3	3	31	8	8	9	9	500	500	500	500	E3	SE3	SE3	SE4	NIL	NIL	NIL	NIL	1.5	2	2	2	3
4	3	31	6	8	8	7	500	500	500	500	E4	SE4	SE4	SE4	NIL	NIL	NIL	NIL	4	3	3	3	4
4	3	31	5	5	7	8	500	500	500	500	SE4	SE4	SE4	SE4	NIL	NIL	NIL	NIL	4	4	4	4	4
4	4	3	10	10	10	10	300	350	400	400	E3	E3	E3	E3	IHM	NIL	ILM	NIL	0.5	1.5	1	1.5	4
1	4	9	10	9	9	10	500	500	500	500	SW5	SW5	SW5	SW5	NIL	NIL	NIL	NIL	5	5	5	5	1
3	4	9	10	10	10	10	600	600	600	600	SW5	SW5	SW5	SW5	NIL	NIL	NIL	NIL	5	5	5	5	3
3	4	24	7	7	6	7	600	600	600	600	SW4	SW4	SW4	SW4	NIL	NIL	NIL	NIL	5	5	5	5	3
2	4	24	7	8	7	7	600	600	600	600	SW3	SW3	SW3	SW3	NIL	NIL	NIL	NIL	5	5	5	5	2
1	4	28	10	10	10	10	400	400	400	400	E1	E2	E2	E2	NIL	NIL	NIL	NIL	4	4	4	4	1
4	4	28	10	10	10	10	400	400	400	400	E1	E1	E1	E1	NIL	NIL	NIL	NIL	4	3	3	3	4
2	4	28	10	10	10	10	400	400	400	400	E1	E1	E1	E1	NIL	CLM	NIL	NIL	2	2	1.5	1.5	2
3	5	8	10	10	10	10	400	400	400	400	SW1	SW2	SW2	SW2	NIL	CLR	NIL	ILR	3	3	3	2	3
1	5	8	10	10	10	10	500	500	500	500	SW1	SW1	SW1	SW1	NIL	ILR	ILR	NIL	3	3	3	3	1
3	5	15	6	6	5	4	750	750	750	750	W3	W3	W2	W2	NIL	NIL	NIL	NIL	5	5	5	5	3
4	5	15	6	6	4	3	1000	1000	1000	1200	SW3	SW3	W3	W4	NIL	NIL	NIL	NIL	5	5	5	5	4

VP & DATE				Cloud Cover			Cloud Height (m)				Wind - Direction & Speed					Precipitation			Visibility (km)			
2	5	15	4	3	3	3	750	750	750	750	SW2	W2	W3	W3	NIL	NIL	NIL	NIL	5	5	5	5	2
2	5	21	6	5	5	6	375	400	500	500	SW3	SW3	SW3	SW3	NIL	NIL	NIL	NIL	5	5	5	5	2
1	5	21	6	7	7	7	500	500	500	500	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	3	3	3	3	1
4	5	28	5	6	7	9	750	750	750	650	NE3	NE3	NE4	NE4	NIL	NIL	NIL	NIL	5	5	5	5	4
1	6	2	10	10	10	10	375	375	400	400	W3	W3	W4	W4	ILR	NIL	NIL	NIL	3	3	3	3	1
2	6	2	10	10	10	10	400	350	400	400	W4	W4	W4	W4	NIL	ILR	ILR	NIL	3	1.5	3	3	2
3	6	18	10	10	6	6	350	400	450	450	NW3	NW3	NW3	NW3	CLM	ILM	NIL	NIL	0.5	1	1.5	3	3
4	6	18	10	10	7	6	300	400	400	450	NW3	NW3	NW3	NW3	CLM	NIL	NIL	NIL	0.5	3	5	5	4
1	6	25	10	10	10	10	350	350	400	400	E2	E2	E2	E2	CLR	CLR	ILR	NIL	3	3	4	4	1
2	6	25	10	10	10	10	400	400	400	450	NE4	NE4	NE4	NE4	CLR	CLR	CLR	ILR	2	2	3	5	2
4	6	29	10	10	10	10	350	350	350	350	SW1	SW1	SW1	SW1	CHM	CHM	ILM	ILM	0.5	1	1	1	4
3	6	29	9	4	4	5	500	500	750	750	N2	NE2	NE2	NE2	ILM	NIL	NIL	NIL	1.5	2.5	5	5	3
1	7	2	10	10	10	10	750	750	750	750	SW3	SW3	SW3	SW3	NIL	NIL	NIL	NIL	5	5	5	5	1
3	7	2	10	9	10	9	750	750	750	1000	SW3	SW4	SW4	SW4	NIL	NIL	NIL	ILR	3	3	3	3	3
2	7	7	4	7	8	9	500	500	500	500	SW3	W3	W/3	W/3	NIL	NIL	NIL	NIL	5	5	5	5	2
4	7	18	8	8	10	10	750	750	750	750	E4	E4	E4	E4	NIL	NIL	NIL	NIL	3	3	3	3	4
1	7	24	5	5	3	2	1000	1000	1000	1000	SE2	SE2	SE2	SE2	NIL	NIL	NIL	NIL	3	3	3	3	1
2	7	24	3	3	1	1	1000	1000	1000	1000	SE3	SE3	SE4	SE3	NIL	NIL	NIL	NIL	3	3	3	3	2
4	7	30	10	10	10	10	600	600	500	600	W3	W3	W3	W3	NIL	NIL	ILR	NIL	2.5	2.5	1.5	1.5	4
3	7	30	9	10	10	10	800	800	800	800	SW2	SW2	SW2	W3	NIL	NIL	NIL	NIL	5	5	5	5	3
3	8	7	3	3	4	6	750	750	750	600	W3	W3	W3	W3	NIL	NIL	NIL	NIL	5	5	5	5	3
4	8	7	9	8	7	7	600	600	600	600	SW3	SW3	SW3	SW3	ILR	NIL	NIL	NIL	3	3	3	3	4
1	8	14	6	5	5	5	750	750	750	750	W2	W2	W2	W2	NIL	NIL	NIL	NIL	3	3	3	3	1
2	8	14	6	5	8	9	750	750	500	500	W2	NW3	MW4	NW4	NIL	NIL	ILR	NIL	3	3	3	3	2
4	8	29	10	10	10	10	300	300	500	500	S5	S5	SW6	SW6	CLR	CLR	ILR	CLR	1	1	1.5	1.5	4
1	8	29	10	10	10	10	500	450	400	400	S4	SW5	SW5	SW5	NIL	NIL	NIL	CLR	2.5	2.5	2	2	1
2	8	29	10	10	10	10	550	600	600	700	W5	W4	W4	W4	NIL	NIL	ILR	NIL	2	2	2	2	2
3	8	29	10	10	10	10	450	450	400	400	SW4	SW4	W5	W5	NIL	NIL	ILR	NIL	5	5	3	3	3

89. There were 13 target species (**Table 9.1**) recorded inside the survey area and 500 m buffer; buzzard, greater black-backed gull, heron, hen harrier, kestrel, lesser black-backed gull, merlin, peregrine, red grouse, raven, sparrowhawk, snipe and whooper swan (**Tables 9.17 & 9.18**). The occurrence rate of the detected species was less than 2% of total observation time for five species, and greater than 2% for eight species (**Table 9.18**) with most frequently recorded were raven and lesser black-backed gull accounting for 75% of the observation duration. As requested by NIEA, buzzard, kestrel and raven flights were additionally mapped (**Figures 9.14; 9.15 & 9.16**, see also Section 9.3.3.4).

90.

Table 9.17 – Breeding vantage point sightings records recorded within the survey area and 500 m buffer.

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	3	18	2014	2	RN	7	09:00	1	
2	3	18	2014	2	LB	3	09:10	1	
2	3	18	2014	2	RN	7	10:00	1	
2	3	18	2014	2	RN	7	11:00	1	
2	3	18	2014	2	LB	2	01:15	1	
2	3	18	2014	2	LB	1	11:40	1	
2	3	18	2014	2	RN	7	11:55	1	
3	3	18	2014	2	LB	1	14:10	1	Flew uphill low then out west very high
3	3	18	2014	2	RN	1	15:25	1	
3	3	18	2014	2	BZ	1	15:35	1	
3	3	18	2014	2	SH	1	15:50	1	Direct flight through windfarm and over forest
3	3	18	2014	2	RN	1	16:15	1	
3	3	18	2014	2	RN	4	16:20	1	
3	3	18	2014	2	RN	3	16:25	1	
1	3	18	2014	2	RN	1	14:00	1	
1	3	18	2014	2	BZ	1	14:30	1	
1	3	18	2014	2	SH	1	15:40	1	
1	3	18	2014	2	RN	3	16:05	1	
1	3	18	2014	2	RN	4	16:15	1	
2	3	27	2014	2	RN	2	08:15	1	
2	3	27	2014	2	RN	1	08:40	1	
2	3	27	2014	2	RN	3	09:15	1	
2	3	27	2014	1	PE	1	09:40	1	
1	3	27	2014	2	RN	1	08:20	1	NE along Terrydoo
3	3	31	2014	2	SN	1	07:45	1	
3	3	31	2014	2	RN	2	08:20	1	
3	3	31	2014	1	PE	1	09:20	1	
3	3	31	2014	1	WS	17	09:40	1	
3	3	31	2014	2	RN	1	10:05	1	
3	3	31	2014	2	RN	1	10:35	1	
4	3	31	2014	2	RN	2	08:25	1	South of VP calling through site
4	3	31	2014	1	WS	17	09:45	1	Flying N,NW towards Binevenagh, lost in haze
4	3	31	2014	2	SH	1	13:35	1	East to west in front of VP
4	4	3	2014	2	RN	2	11:10	1	
4	4	3	2014	2	BZ	1	11:40	1	
1	4	9	2014	2	BZ	1	13:10	1	Flying S-N over farmland
1	4	9	2014	2	BZ	3	14:30	1	Soaring and displaying over forest
1	4	9	2014	2	BZ	2	14:50	1	Across site, landed in trees next to farm buildings

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
3	4	9	2014	2	RN	1	12:45	1	W,SW of VP
3	4	9	2014	1	ML	1	12:55	1	Male near from VP, very low and fast
3	4	9	2014	2	RN	2	14:50	1	
3	4	24	2014	2	RN	1	12:20	1	Through and over windfarm, calling and displaying
3	4	24	2014	2	SN	1	12:35	1	Chipping
2	4	24	2014	2	RN	1	15:25	1	Flying and calling
2	4	28	2014	2	RN	1	15:20	1	
2	4	28	2014	2	RN	1	16:20	1	
2	4	28	2014	2	SN	1	16:55	1	
2	4	28	2014	2	RN	1	17:10	1	
3	5	8	2014	2	RG	1	08:20	1	
3	5	8	2014	2	RG	2	08:30	1	
3	5	8	2014	2	RG	1	09:25	1	Heard calling
1	5	8	2014	2	BZ	1	11:50	1	
3	5	15	2014	2	RN	1	12:20	1	Over ridgeline
3	5	15	2014	2	RG	1	14:15	1	
3	5	15	2014	2	RN	1	14:40	1	
4	5	15	2014	2	BZ	1	17:40	1	2 dives at something out of sight over corner of forest
2	5	15	2014	2	BZ	1	16:45	1	Landed in tree
2	5	15	2014	2	RN	2	18:15	1	
2	5	21	2014	2	RN	1	06:30	1	
2	5	21	2014	2	RN	1	06:50	1	
2	5	21	2014	2	RN	1	07:10	1	
2	5	21	2014	2	RN	2	07:30	1	
2	5	21	2014	1	HH	1	08:40	1	Male low flight through site, mobbed by RN and HC
2	5	21	2014	2	RN	2	08:40	1	Mobbing HH
2	5	21	2014	2	BZ	1	08:45	1	
2	5	21	2014	2	SN	1	08:45	1	
2	5	21	2014	2	RN	2	08:45	1	
1	5	21	2014	2	RN	1	09:15	1	
1	5	21	2014	2	BZ	1	09:25	1	
1	5	21	2014	2	RN	1	10:10	1	
4	5	28	2014	1	ML	1	13:30	1	
4	5	28	2014	1	ML	1	13:30	1	
4	5	28	2014	2	BZ	1	14:15	1	
4	5	28	2014	2	RG	1	14:45	1	Heard calling
4	5	28	2014	2	RG	1	16:05	1	
1	6	2	2014	2	BZ	1	07:05	1	
1	6	2	2014	2	RN	2	08:25	1	
2	6	2	2014	2	RN	2	09:40	1	
2	6	2	2014	2	RN	1	09:55	1	
2	6	2	2014	2	RN	1	10:15	1	
2	6	2	2014	2	K.	1	11:05	1	
3	6	18	2014	2	RG	1	09:20	1	Heard calling
3	6	18	2014	2	RN	1	10:10	1	
4	6	29	2014	2	RG	1	06:45	1	Heard calling
4	6	29	2014	2	RN	1	07:25	1	Heard calling
3	6	29	2014	2	RN	1	09:45	1	
3	6	29	2014	2	BZ	1	09:55	1	
3	6	29	2014	2	RN	2	10:30	1	
3	6	29	2014	2	K.	1	11:20	1	Hunting
1	7	2	2014	2	BZ	1	06:25	1	
1	7	2	2014	2	RN	1	06:45	1	
1	7	2	2014	2	LB	5	07:40	1	
1	7	2	2014	2	LB	2	07:55	1	
1	7	2	2014	2	SH	1	08:25	1	
3	7	2	2014	2	RN	4	10:05	1	
3	7	2	2014	2	RG	1	10:40	1	
3	7	2	2014	2	RN	1	15:10	1	
2	7	7	2014	2	RN	3	09:10	1	
2	7	7	2014	2	RN	1	09:20	1	
2	7	7	2014	2	RN	3	09:25	1	
2	7	7	2014	2	LB	1	09:55	1	
2	7	7	2014	2	RN	1	10:45	1	
2	7	7	2014	2	RN	1	11:00	1	
4	7	18	2014	2	RN	1	12:25	1	
4	7	18	2014	2	BZ	1	12:50	1	
1	7	24	2014	2	LB	4	06:30	1	
1	7	24	2014	2	RN	1	06:55	1	
1	7	24	2014	2	BZ	1	07:40	1	Juvenile perched in tree calling then flew off, 50m landed in hedgerow again.
1	7	24	2014	2	LB	2	08:15	1	
2	7	24	2014	2	RN	1	09:30	1	
2	7	24	2014	1	HH	1	09:35	1	Female hunting
2	7	24	2014	1	HH	1	09:45	1	Female hunting
2	7	24	2014	2	K.	1	10:15	1	Hover hunting
2	7	24	2014	2	RN	1	11:05	1	
3	7	30	2014	2	RN	2	18:35	2	Flew to perch on fence, RN (14) on fence and ground

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
3	7	30	2014	2	RN	1	18:50	1	All RN short flights hopping from post to post, or to ground
3	7	30	2014	2	RN	1	18:55	1	
3	7	30	2014	2	RN	2	19:00	1	
3	7	30	2014	2	RN	2	19:10	1	Chasing each other
3	7	30	2014	2	RN	4	19:10	1	Flew into forest
3	7	30	2014	2	RN	3	19:15	1	Followed previous 4 into forest
3	7	30	2014	2	RN	6	19:30	1	Also flew into forest calling and tumbling
3	7	30	2014	1	HH	1	20:15	1	Female flying just above heather, turned and flew SE when she saw me. Patchy wings (in moult)
3	7	30	2014	2	RN	1	20:20	1	East through turbines
3	7	30	2014	2	RN	1	20:55	1	Lifted from mast behind VP, along forest edge then east into forest
4	7	30	2014	2	RN	2	18:55	1	
4	7	30	2014	2	RN	2	20:20	1	Birds split into two flight paths
4	7	30	2014	2	RN	4	21:15	1	
3	8	7	2014	2	RN	1	09:05	1	
3	8	7	2014	2	RN	1	09:30	1	
3	8	7	2014	2	BZ	1	09:45	1	Circling, hovering
3	8	7	2014	2	K.	1	09:50	1	
4	8	7	2014	2	SH	1	11:50	1	Female
1	8	14	2014	2	RN	1	06:45	1	
1	8	14	2014	2	BZ	1	07:10	1	
1	8	14	2014	2	RN	2	07:40	1	
1	8	14	2014	2	SH	1	08:05	1	Female
1	8	14	2014	2	LB	4	08:50	1	
2	8	14	2014	2	RN	4	09:40	1	
2	8	14	2014	2	RN	1	09:50	1	
2	8	14	2014	1	HH	1	10:10	1	Female
2	8	14	2014	2	LB	2	11:10	1	
2	8	14	2014	2	RN	2	11:25	1	
2	8	14	2014	2	RN	3	11:40	1	
2	8	14	2014	2	RN	1	11:45	1	
4	8	29	2014	2	RN	1	10:35	1	
4	8	29	2014	2	RN	4	10:55	1	
4	8	29	2014	2	RN	3	11:30	1	
4	8	29	2014	2	RN	2	11:35	1	
4	8	29	2014	1	PE	1	11:44	1	Adult in moult
1	8	29	2014	2	LB	1	12:40	1	
1	8	29	2014	2	RN	1	13:00	1	
1	8	29	2014	2	SH	1	13:50	1	Female
1	8	29	2014	2	RN	2	14:55	1	
1	8	29	2014	2	H.	1	15:25	1	
2	8	29	2014	2	BZ	1	12:25	1	
2	8	29	2014	2	BZ	1	12:25	1	
2	8	29	2014	2	BZ	1	12:30	1	
2	8	29	2014	2	RN	3	13:50	1	
2	8	29	2014	2	GB	1	13:50	1	
2	8	29	2014	2	RN	1	13:55	1	

Table 9.18 – Breeding vantage point aggregated species sightings records within the survey area and 500 m buffer.

Species	Number of detections	%	Number of five minute intervals	%
BZ	22	13.7	22	13.6
GB	1	0.6	1	0.6
H.	1	0.6	1	0.6
HH	5	3.1	5	3.1
K.	4	2.5	4	2.5
LB	12	7.5	12	7.4
ML	3	1.9	3	1.9
PE	3	1.9	3	1.9
RG	9	5.6	9	5.6
RN	88	54.7	89	54.9
SH	7	4.3	7	4.3
SN	4	2.5	4	2.5
WS	2	1.2	2	1.2
TOTAL	161		162	

91. Four target 1 species (**Table 9.18**) were recorded (**Tables 9.18 & 9.19**); hen harrier (5) and peregrine (3) and whooper swan had flying height(s) recorded (**Table 9.20**) and were mapped (**Figure 9.17**).

92. There was one additional (male) merlin flight recorded beyond the 500m survey area and a golden plover flight (10 birds) was also recorded beyond the 500m survey area (**Figure 9.17**).

93. Most frequently recorded target 1 species flights were hen harrier (**Table 9.19; Figure 9.17**), which were observed in the later summer period (July to August 2014) and whooper swans were observed in spring (March 2014), merlin in spring (April to May 2014). Peregrine were seen in the spring (March) and late summer (August 2014).

94. Whooper swans were likely migrant birds in the spring and no regular foraging / commuting routes were identified. Peregrine, hen harrier and merlin flights (**Figure 9.17**) all originated from known breeding sites nearby and for peregrines included sightings of juveniles post-fledging (**Tables 9.17 & 9.19**).

95. There were 93 seconds of whooper swan flights. All of these were above rotor swept height (>140 m) and therefore no potential collision risk. There were 50 seconds of merlin flights. All of these were below rotor swept height (<15 m) and therefore no potential collision risk.

96. There were 183 seconds of peregrine flight recorded within the survey area and 500 m buffer (**Table 9.20**). There were 42 seconds (23%) below indicative rotor height (<15 m) and 141 seconds (77%) at collision risk height (15 m – 140 m).

97. Hen harrier flights within the survey area and 500 m buffer were 375 seconds in duration with 280 seconds (74.7%) below potential collision height (PCH) with 95 seconds (25.3%) within PCH but all flights were below 25 m a.g.l.

Table 9.19 – Breeding vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Mar	Apr	May	Jun	Jul	Aug	TOTAL
BZ	2	4	6	2	3	5	22
GB						1	1
H.						1	1
HH			1		3	1	5
K.				2	1	1	4
LB	4				5	3	12
ML		1	2				3
PE	2					1	3
RG			6	2	1		9
RN	19	8	11	8	25	17	88
SH	3				1	3	7
SN	1	2	1				4
WS	2						2
TOTAL	33	15	27	14	39	33	161

Table 9.20 – Breeding vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	50-100m	100-125m	125-140m	>140 m	Notes
2	3	27	2014	PE	1	09:38:00	113	30	30	30	13	10				
3	3	31	2014	PE	1	09:18:00	43			43						
3	3	31	2014	WS	17	09:40:00	53								53	
4	3	31	2014	WS	17	09:41:00	41								41	
3	4	9	2014	ML	1	12:53:00	12	12								Male
2	5	21	2014	HH	1	08:40:00	155	105	50							Male
4	5	28	2014	ML	1	13:26:00	15	15								Male
4	5	28	2014	ML	1	13:27:00	23	23								Male
2	7	24	2014	HH	1	09:33:00	42	42								Female
2	7	24	2014	HH	1	09:41:00	78	48	30							Female
3	7	30	2014	HH	1	20:14:00	15	15								Female
2	8	14	2014	HH	1	10:08:00	85	70	15							Female undulating hunting flight
4	8	29	2014	PE	1	11:44:00	27	12	7	8						Adult in moult

3.3.4. Wintering Vantage Point Surveys

98. There were 39 hours observation completed at each of the four vantage points between September 2014 and March 2015 (**Tables 9.21 & 9.22**). Cumulative observation time from all vantage points over the survey area was 156 hours during the study period (**Table 11.14**). Survey times ranged from 06.55hrs to 19.40hrs (**Table 9.21**) and covered a wide range of weather conditions (**Table 9.23**).

Table 9.21 – Wintering vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
WVP	3	DCR	9	4	2014	07:50	10:50	03:00
WVP	2	DCR	9	4	2014	11:10	14:10	03:00
WVP	4	DCR	9	11	2014	09:45	12:45	03:00
WVP	3	DCR	9	19	2014	07:55	10:55	03:00
WVP	1	DCR	9	19	2014	11:25	14:25	03:00
WVP	4	DCR	9	24	2014	11:30	14:30	03:00
WVP	2	MR	9	30	2014	11:05	14:05	03:00
WVP	1	MR	9	30	2014	14:20	17:20	03:00
WVP	4	DCR	10	9	2014	15:20	18:20	03:00
WVP	2	AM	10	14	2014	08:20	11:20	03:00
WVP	3	DCR	10	14	2014	11:10	14:10	03:00
WVP	2	AM	10	22	2014	07:50	10:50	03:00
WVP	1	DCR	10	22	2014	07:45	10:45	03:00
WVP	3	AM	10	24	2014	08:05	11:05	03:00
WVP	4	DCR	10	24	2014	08:10	11:10	03:00
WVP	1	AM	10	29	2014	08:45	11:45	03:00
WVP	2	DCR	11	5	2014	10:05	13:05	03:00
WVP	4	DCR	11	10	2014	07:05	10:05	03:00
WVP	3	KH	11	19	2014	08:20	11:20	03:00

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
WVP	1	AM	11	19	2014	08:25	11:25	03:00
WVP	1	MR	11	24	2014	12:15	15:15	03:00
WVP	3	KH	11	24	2014	09:30	12:30	03:00
WVP	2	KH	11	24	2014	12:45	15:45	03:00
WVP	4	AM	11	24	2014	09:10	12:10	03:00
WVP	1	AM	12	3	2014	08:35	11:35	03:00
WVP	3	KH	12	3	2014	08:30	11:30	03:00
WVP	2	AM	12	9	2014	09:10	12:10	03:00
WVP	4	KH	12	22	2014	09:40	12:40	03:00
WVP	3	KH	12	22	2014	13:20	16:20	03:00
WVP	1	MR	12	31	2014	12:05	15:05	03:00
WVP	2	MR	12	31	2014	08:50	11:50	03:00
WVP	4	KH	12	31	2014	08:45	11:45	03:00
WVP	3	DCR	1	7	2015	09:45	12:45	03:00
WVP	2	DCR	1	7	2015	13:05	16:05	03:00
WVP	1	DCR	1	15	2015	10:05	13:05	03:00
WVP	4	AM	1	15	2015	09:50	12:50	03:00
WVP	2	DCR	1	15	2015	13:15	16:15	03:00
WVP	3	DCR	1	20	2015	09:15	12:15	03:00
WVP	1	DCR	1	20	2015	12:30	15:30	03:00
WVP	4	DCR	1	26	2015	08:15	11:15	03:00
WVP	3	DCR	2	5	2015	07:45	10:45	03:00
WVP	1	DCR	2	5	2015	11:05	14:05	03:00
WVP	4	DCR	2	12	2015	07:25	10:25	03:00
WVP	2	DCR	2	12	2015	10:40	13:40	03:00
WVP	3	DCR	2	18	2015	08:35	11:35	03:00
WVP	4	DCR	2	24	2015	06:55	09:55	03:00
WVP	1	DCR	2	24	2015	10:10	13:10	03:00
WVP	2	DCR	2	25	2015	08:05	11:05	03:00
WVP	2	DR	3	19	2015	13:10	16:10	03:00
WVP	3	DR	3	19	2015	16:40	19:40	03:00
WVP	4	AM	3	25	2015	08:00	11:00	03:00
WVP	1	AM	3	25	2015	11:35	14:35	03:00

Table 9.22 – Wintering vantage point survey effort by month

VP No.	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
1	6	6	6	6	6	6	3	39
2	6	6	6	6	6	6	3	39
3	6	6	6	6	6	6	3	39
4	6	6	6	6	6	6	3	39
TOTAL	24	24	24	24	24	24	12	156

Table 9.23 – Wintering vantage point weather conditions

VP & DATE			Cloud Cover					Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D		0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
3	9	4	10	10	10	10	600	600	600	600	SE1	SE1	SE2	SE2	NIL	NIL	NIL	NIL	2.5	2.5	2.5	2	3
2	9	4	10	10	10	10	600	600	600	600	SE2	SE2	SE2	SE2	NIL	NIL	NIL	NIL	2.5	2.5	2.5	2.5	2
4	9	11	3	3	4	3	750	1000	1000	1000	S1	S1	SE1	S1	ILM	NIL	NIL	NIL	2.5	3	3	3	4
3	9	19	10	10	10	10	350	350	375	400	S2	S2	SW1	SW1	CLM	CLM	CLM	CLM	1	1	1	1.5	3
1	9	19	10	10	10	10	400	400	400	450	SW1	W1	W1	W1	NIL	NIL	NIL	NIL	2	2	2	2	1
4	9	24	10	10	10	8	600	600	600	600	NW3	NW3	NW3	NW3	NIL	NIL	NIL	NIL	3	3	3	3	4
2	9	30	8	8	8	8	1200	1200	1200	1200	SW2	SW1	SW2	SW1	NIL	NIL	NIL	NIL	2	2	2	2	2
1	9	30	8	9	10	10	1200	900	450	600	SW2	SW1	SW2	SW2	NIL	NIL	NIL	NIL	2	2	2	2	1
4	10	9	7	8	8	8	600	500	500	500	NW3	NW3	NW3	NW3	NIL	NIL	NIL	NIL	5	3	3	3	4
2	10	14	2	2	1	1	600	600	600	600	E2	E2	E2	E2	NIL	NIL	NIL	NIL	5	5	5	5	2
3	10	14	2	5	4	4	800	500	600	600	E3	E3	E2	E2	NIL	NIL	NIL	NIL	5	5	5	5	3
2	10	22	10	10	10	10	350	375	375	375	SW2	SW2	SW3	SW4	ILR	NIL	NIL	NIL	4	5	5	5	2
1	10	22	10	10	10	10	375	375	400	400	SW1	SW2	SW2	SW2	CLR	CLR	NIL	ILR	2	2	2	2	1
3	10	24	10	8	10	10	800	800	800	800	SW4	SW4	SW4	SW4	NIL	NIL	NIL	NIL	5	5	5	5	3
4	10	24	6	8	9	10	600	500	600	600	SW4	SW4	SW4	SW4	NIL	NIL	NIL	NIL	5	5	5	5	4
1	10	29	2	3	3	3	1500	1500	1500	1500	-	-	SE1	SE1	NIL	NIL	NIL	NIL	5	5	5	5	1
2	11	5	4	3	4	4	600	750	750	750	NE1	-	-	E1	NIL	NIL	NIL	NIL	5	5	5	5	2
4	11	10	10	5	7	6	350	375	375	375	SE3	SE3	SE3	SE3	CHM	IHM	ILM	ILM	0.5	1.5	1.5	1.5	4
3	11	19	10	10	10	10	500	500	500	500	E5	E5	E5	E5	ILR	ILR	ILR	NIL	5	5	5	5	3
1	11	19	10	10	8	8	500	500	500	500	E3	E3	E2	E2	NIL	NIL	NIL	NIL	5	5	5	5	1
1	11	24	6	8	8	9	1500	1200	800	700	S1	S1	S1	S1	NIL	NIL	NIL	NIL	2	2	2	2	1
3	11	24	10	9	9	9	600	600	600	600	S4	SW4	SW5	SW5	NIL	NIL	NIL	NIL	5	5	5	5	3
2	11	24	9	9	9	9	600	600	600	600	W5	W4	W4	W4	NIL	NIL	NIL	NIL	5	5	5	5	2
4	11	24	8	8	6	6	1000	1000	1000	1000	S3	S3	S3	S3	NIL	NIL	NIL	NIL	5	5	5	5	4
1	12	3	8	10	9	8	400	300	500	400	SW1	SW1	SW2	SW2	NIL	ILR	NIL	NIL	5	5	5	5	1
3	12	3	9	9	8	7	400	400	400	400	SW4	SW4	SW4	SW4	ILR	ILR	NIL	NIL	2	2	5	5	3

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed					Precipitation				Visibility (km)			
2	12	9	10	10	10	10	500	500	500	500	SW5	SW5	SW5	SW5	NIL	NIL	NIL	NIL	5	5	5	5	2
4	12	22	10	10	10	10	100	100	100	100	SW5	SW5	SW5	SW5	CLR	CLR	CLR	CLR	0.1	0.2	0.2	0.2	4
3	12	22	10	10	10	10	100	100	100	400	SW4	SW4	SW4	SW5	CLR	CLR	CLR	CLR	0.3	0.3	0.3	1.5	3
1	12	31	8	8	8	8	550	650	700	700	SW4	SW3	SW3	SW3	NIL	NIL	NIL	NIL	2	2	2	2	1
2	12	31	9	9	10	10	500	500	500	500	SW4	SW3	SW4	SW4	NIL	NIL	NIL	NIL	2	2	2	2	2
4	12	31	10	10	10	10	500	500	500	500	SE6	SE6	SE6	SE6	CLR	NIL	ILR	NIL	3	3	3	3	4
3	1	7	10	10	10	10	400	400	400	400	S5	S5	S5	S5	NIL	NIL	ILR	CLR	2.5	2.5	2.5	2.5	3
2	1	7	10	10	10	10	375	375	400	375	S5	S5	S5	S5	ILR	CHR	ILR	NIL	2	1.5	2	1.5	2
1	1	15	9	10	10	10	550	400	400	400	SW4	SW4	SW4	SW4	ILR	ILS	CHR	CHR	2	1.5	1.5	1.5	1
4	1	15	10	10	10	10	450	400	400	380	SW7	SW7	SW7	SW6	CLS	CLS	CHS	CLS	4	2	0.5	3	4
2	1	15	10	8	8	8	400	400	400	400	SW4	SW4	SW5	SW3	NIL	ILR	ILR	NIL	2.5	2.5	2	2	2
3	1	20	10	10	9	10	600	350	500	500	SE3	SE3	S3	S3	NIL	CHM	NIL	NIL	2.5	0.5	2.5	2.5	3
1	1	20	10	10	10	10	500	500	400	400	S3	S3	S3	S3	NIL	ILR	NIL	NIL	2.5	2.5	2.5	2.5	1
4	1	26	10	10	9	9	600	600	600	600	W4	W4	W4	W4	NIL	ILR	NIL	NIL	1.5	1.5	1.5	1.5	4
3	2	5	10	10	10	10	500	350	350	400	NW2	NW2	NW2	NW2	IHM	CHM	CHM	IHM	1.5	0.5	0.5	1.5	3
1	2	5	10	10	10	10	375	375	400	375	NW2	NW2	N2	N2	ILR	ILR	NIL	NIL	1.5	1.5	1.5	1.5	1
4	2	12	10	10	10	10	500	400	400	400	SE2	SE2	SE2	SE2	CHM	NIL	NIL	ILM	0.5	1.5	1.5	1.5	4
2	2	12	10	8	8	7	450	500	500	500	SE2	S2	S2	S2	ILM	NIL	NIL	NIL	1.5	2.5	2.5	2.5	2
3	2	18	10	10	10	10	450	450	400	350	SW4	SW4	W4	W4	NIL	NIL	NIL	ILM	3	3	3	1.5	3
4	2	24	8	7	5	7	750	750	750	750	W4	W4	W4	W4	NIL	ILS	NIL	NIL	1.5	2	2	2	4
1	2	24	8	8	7	8	750	600	600	600	W3	W3	W3	W3	NIL	IHR	IHR	ILR	2.5	1.5	2	2	1
2	2	25	9	10	10	10	375	375	400	400	SW2	SW2	SW2	SW2	NIL	ILR	NIL	NIL	2.5	2.5	2.5	2	2
2	3	19	3	5	8	5	900	900	900	900	SW3	SW3	SW2	SW1	NIL	NIL	NIL	NIL	5	5	5	5	2
3	3	19	5	4	4	4	900	900	900	900	SW2	SW2	SW1	SW1	NIL	NIL	NIL	NIL	5	5	5	5	3
4	3	25	6	6	6	6	600	600	600	600	SW1	SW1	SW1	SE2	NIL	NIL	NIL	NIL	5	5	5	5	4
1	3	25	6	6	6	6	600	600	600	600	SW1	SW1	SW1	SE2	NIL	NIL	NIL	NIL	5	5	5	5	1

99. There were 14 target species (**Table 9.24**) recorded inside the survey area and 500 m buffer during the wintering period; buzzard, greater black-backed gull, greylag goose, golden plover, heron, hen harrier, kestrel, lesser black-backed gull, merlin, peregrine, red grouse, raven, sparrowhawk and snipe.

100. The occurrence rate of the detected species ranged from 0.5% - 59.9% with four species which were recorded more than 3% of total observation time namely buzzard (10.1%), kestrel (6.7%), raven (61.1%) and snipe (7.7%) (**Tables 9.24 & 9.25**) and detection rates varied across the season (**Table 9.26**). As requested by NIEA (see **Chapter 9**) buzzard, kestrel and raven flights were additionally mapped (**Figures 9.14; 9.15 & 9.16**, see also **Section 9.3.3.4**).

101.

Table 9.24 – Wintering vantage point sightings records recorded within the survey area and 500 m buffer.

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
3	9	4	2014	2	RN	2	08:45	1	
3	9	4	2014	2	RN	1	09:25	1	
2	9	4	2014	2	RN	2	11:40	1	
2	9	4	2014	2	BZ	1	12:25	1	
2	9	4	2014	2	RN	1	12:40	1	
4	9	11	2014	2	RN	1	09:55	1	
4	9	11	2014	2	RN	3	10:05	1	
4	9	11	2014	2	RN	1	10:50	1	
4	9	11	2014	2	H.	1	11:15	1	
3	9	19	2014	2	RN	1	08:30	1	
3	9	19	2014	2	RG	1	09:40	1	Heard calling
1	9	19	2014	2	RN	3	11:55	1	
1	9	19	2014	1	PE	1	13:45	2	Female mobbed by several rooks and pipits for whole duration of sighting
4	9	24	2014	2	H.	1	11:50	1	Mobbed by crows
4	9	24	2014	2	RN	2	12:00	1	
4	9	24	2014	2	RN	1	12:10	1	
4	9	24	2014	2	RN	1	12:55	1	
2	9	30	2014	2	RN	1	11:20	1	
2	9	30	2014	2	RN	5	11:35	1	
2	9	30	2014	2	RN	5	11:40	1	Circling area and landing on fence posts
2	9	30	2014	2	RN	3	12:00	1	
2	9	30	2014	2	RN	1	12:10	1	
2	9	30	2014	2	RN	1	12:10	1	
2	9	30	2014	2	RN	1	12:15	1	
2	9	30	2014	2	RN	3	12:30	1	
2	9	30	2014	2	RN	3	12:45	1	
2	9	30	2014	2	RN	1	12:45	1	
2	9	30	2014	2	RN	11	12:55	9	RN circling
2	9	30	2014	2	RN	3	13:00	1	Flew from site to chase PE

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
									over Donalds hill
2	9	30	2014	2	RN	2	13:50	1	Flew from site to Donalds hill chasing each other and PE
2	9	30	2014	2	RN	3	13:55	1	
2	9	30	2014	2	RN	1	14:05	1	
1	9	30	2014	2	RN	2	14:45	1	
1	9	30	2014	2	LB	1	16:05	1	Juvenile
1	9	30	2014	2	RN	1	16:15	1	
1	9	30	2014	2	RN	2	16:20	1	300-400 RO + 100-200 JD lifted from field - disturbed also 2 RN
1	9	30	2014	2	BZ	1	16:30	1	
1	9	30	2014	2	BZ	1	16:45	1	BZ perched, perched beside two smouldering tires
4	10	9	2014	2	SN	2	15:25	1	
4	10	9	2014	2	RN	1	15:40	1	
4	10	9	2014	2	RN	3	15:45	1	
4	10	9	2014	2	GJ	5	16:00	1	
4	10	9	2014	1	ML	1	16:25	1	Female
4	10	9	2014	2	RN	2	16:35	1	
4	10	9	2014	2	RN	4	17:25	1	
4	10	9	2014	2	RN	4	17:35	1	
4	10	9	2014	2	RN	1	17:35	1	
4	10	9	2014	2	BZ	1	17:40	1	
4	10	9	2014	2	SN	1	18:00	1	
2	10	14	2014	1	GP	4	08:45	1	Lost in haze
2	10	14	2014	2	SN	2	09:35	1	
2	10	14	2014	1	GP	8	09:40	1	
2	10	14	2014	2	SN	4	10:10	1	1 lifted calling, 2 others lifted and joined flight followed by 4th SN from below VP
3	10	14	2014	2	SN	1	11:15	1	
3	10	14	2014	2	RN	2	11:50	1	
3	10	14	2014	2	RN	4	12:45	1	
3	10	14	2014	1	GP	4	13:05	1	
3	10	14	2014	2	RG	1	13:20	1	Heard calling
3	10	14	2014	2	RN	3	13:35	1	
2	10	22	2014	2	RN	1	08:15	1	Called and tumbling
2	10	22	2014	1	PE	1	09:40	1	Appeared from low cloud, mobbed by HC
1	10	22	2014	2	RN	2	08:35	1	
1	10	22	2014	2	RN	1	08:50	1	
3	10	24	2104	2	K.	1	09:25	1	Hover hunting between vp and turbines.
3	10	24	2104	2	K.	1	09:30	1	Hover hunting between vp and turbines.
3	10	24	2014	2	LB	1	10:25	1	Flew west over forest and into distance at height
3	10	24	2014	2	K.	1	10:50	1	Hunting in same location
4	10	24	2014	2	SN	1	09:15	1	
4	10	24	2014	2	RN	2	09:50	1	
4	10	24	2014	2	SN	1	11:10	1	
1	10	29	2014	2	RN	1	09:20	1	North across Terrydoo walker
1	10	29	2014	2	RN	1	09:25	1	Different bird, flying SW over improved grassland
1	10	29	2014	2	RN	2	10:20	1	Over vp SE
1	10	29	2014	2	RN	1	10:20	1	W over Little Derry
1	10	29	2014	2	RN	1	10:25	1	Reappeared flying NW calling
1	10	29	2014	2	RN	1	11:00	1	SW past vp

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
1	10	29	2014	2	RN	1	11:00	1	SW past vp calling
1	10	29	2014	2	RN	1	11:30	1	Flew from tree to pole then N (among HC and RO)
1	10	29	2014	2	RN	1	11:35	1	S, SW along road
1	10	29	2014	2	RN	1	11:45	1	Lifted from tree flew across road
2	11	5	2014	2	RN	2	10:40	1	
2	11	5	2014	1	PE	1	10:55	1	
2	11	5	2014	2	RN	1	11:20	1	
2	11	5	2014	2	BZ	1	12:05	1	
4	11	10	2014	2	RN	1	09:05	1	
1	11	19	2014	2	RN	1	09:35	1	Flew around bottom edge of forest, calling
1	11	19	2014	2	SN	1	10:40	1	Lifted alarming SE of vp from improved grassland
1	11	24	2014	2	BZ	1	13:00	1	Perched in conifer trees south of vp
1	11	24	2014	2	BZ	1	13:20	1	
1	11	24	2014	2	BZ	1	13:50	1	
1	11	24	2014	2	RN	1	14:00	1	Mobbed BZ
1	11	24	2014	2	RN	1	14:00	1	Mobbed BZ
1	11	24	2014	2	BZ	1	14:05	1	
1	11	24	2014	2	RN	1	14:35	1	
1	11	24	2014	2	K.	1	14:35	1	
1	11	24	2014	2	RN	2	14:45	1	Chasing each other + rolling 44s
1	11	24	2014	2	RN	2	15:00	1	
1	11	24	2014	2	H.	1	15:00	1	
3	11	24	2014	2	K.	1	09:50	1	Hover hunting over site
3	11	24	2014	2	K.	1	10:20	1	Hover hunting across site
3	11	24	2014	2	K.	1	11:35	1	Hover hunting over site
2	11	24	2014	2	K.	1	14:55	1	Hover hunting
2	11	24	2014	2	RN	1	15:20	1	Flying and calling
4	11	24	2014	2	SN	1	09:35	1	Lifted behind vp calling
4	11	24	2014	2	SN	1	09:40	1	Different bird flew to same location
4	11	24	2014	2	K.	1	10:10	1	Hunting beside met mast
4	11	24	2014	2	K.	1	10:45	1	Hunting beside met mast
4	11	24	2014	2	K.	1	10:55	1	Hunting beside met mast
4	11	24	2014	2	K.	1	11:40	1	Flew to perch on track pole
4	11	24	2014	2	K.	1	11:45	2	Hunting between turbines
4	11	24	2014	2	RN	2	11:50	1	At met mast
1	12	3	2014	2	RN	2	09:10	1	South over Cam into windfarm
1	12	3	2014	2	RN	1	09:30	1	Calling and tumbling, fromm NW up into windfarm
1	12	3	2014	2	BZ	1	10:45	1	Male flew across road to perch on telegraph pole in field
1	12	3	2014	2	BZ	1	11:00	1	Flew from perch, flew N
1	12	3	2014	2	RN	2	11:15	1	Flying SW, low over farmyard from windfarm
3	12	3	2014	1	PE	1	08:45	1	Perched on fence post, flew south. Adult
3	12	3	2014	2	RN	1	10:55	1	Calling and flying over vp
2	12	9	2014	2	RN	1	09:25	1	Flew down from windfarm

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
									then S to Donald's hill
2	12	9	2014	2	RN	1	09:45	1	Same bird
2	12	9	2014	2	BZ	1	11:20	1	Circling over 1 G W, SW of vp
1	12	31	2014	2	RN	1	12:30	1	
1	12	31	2014	2	BZ	1	12:50	1	Hovering into wind, landed on tree
1	12	31	2014	2	BZ	1	13:05	1	From one tree to another chased by 7-8 HC
1	12	31	2014	2	RN	1	13:35	1	
1	12	31	2014	2	GB	1	13:50	1	
1	12	31	2014	2	RN	1	14:50	1	
1	12	31	2014	2	RN	1	15:05	1	
2	12	31	2014	2	BZ	1	09:00	1	
2	12	31	2014	2	RN	1	09:45	1	
2	12	31	2014	2	RN	1	09:50	1	
2	12	31	2014	2	RN	1	10:05	1	
2	12	31	2014	2	RN	1	10:20	1	
2	12	31	2014	2	RN	1	10:55	2	
2	12	31	2014	2	RN	1	11:45	1	
3	1	7	2015	2	RN	2	09:55	1	
3	1	7	2015	2	RN	1	10:20	1	
3	1	7	2015	2	RN	4	11:20	1	
3	1	7	2015	2	RN	1	11:55	1	
2	1	7	2015	2	RN	1	13:10	1	
2	1	7	2015	2	RN	2	13:55	1	
2	1	7	2015	2	RN	3	14:10	1	
2	1	7	2015	2	RN	1	15:00	1	
2	1	7	2015	2	RN	1	15:30	1	
1	1	15	2015	2	LB	2	11:10	1	
4	1	15	2015	2	RN	4	10:10	1	
4	1	15	2015	2	SH	1	10:20	1	Straight down track into forest high-speed with the wind
2	1	15	2015	2	RN	3	13:30	1	
2	1	15	2015	2	RN	1	13:45	1	
2	1	15	2015	2	RN	2	14:30	1	
2	1	15	2015	2	RN	1	14:55	1	
2	1	15	2015	2	RN	5	15:25	1	
2	1	15	2015	2	RN	1	15:40	1	
3	1	20	2015	2	SN	1	09:40	1	
3	1	20	2015	2	RN	2	10:05	1	
3	1	20	2015	2	RN	1	10:20	1	
3	1	20	2015	1	HH	1	10:45	1	Female
3	1	20	2015	2	RN	4	11:35	1	
1	1	20	2015	2	BZ	1	13:30	1	
1	1	20	2015	2	BZ	1	14:05	1	
4	1	26	2015	2	RN	1	09:20	1	
3	2	5	2015	1	HH	1	07:55	1	Female low slow hunting flight
3	2	5	2015	1	HH	1	08:10	1	Female
3	2	5	2015	2	RN	1	08:45	1	Heard calling
3	2	5	2015	2	RN	2	09:10	1	Heard calling
3	2	5	2015	2	RN	2	10:25	1	
1	2	5	2015	2	LB	2	11:35	1	
1	2	5	2015	2	LB	3	12:05	1	
1	2	5	2015	2	BZ	1	12:30	1	
4	2	12	2015	2	RN	1	08:00	1	
4	2	12	2015	2	BZ	2	08:55	1	Displaying
4	2	12	2015	2	SN	1	09:10	1	
2	2	12	2015	2	RN	3	11:00	1	
2	2	12	2015	2	RN	2	11:15	1	
2	2	12	2015	2	RN	1	11:50	1	
2	2	12	2015	2	RN	1	12:10	1	
2	2	12	2015	2	SH	1	13:05	1	Female
2	2	12	2015	2	RN	1	13:15	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
3	2	18	2015	2	SN	1	09:00	1	
3	2	18	2015	2	SN	1	09:05	1	
3	2	18	2015	1	GP	1	09:10	1	
3	2	18	2015	1	GP	1	09:40	1	
3	2	18	2015	2	RN	1	09:55	1	
3	2	18	2015	2	RN	2	10:20	1	
3	2	18	2015	2	SN	1	11:20	1	
4	2	24	2015	2	RN	1	07:25	1	
4	2	24	2015	2	RN	2	08:00	1	
4	2	24	2015	2	SN	1	08:20	1	
4	2	24	2015	2	RN	1	09:10	1	
1	2	24	2015	2	RN	1	10:20	1	
1	2	24	2015	2	BZ	1	11:20	1	
1	2	24	2015	2	LB	4	12:10	1	
2	2	25	2015	2	BZ	1	09:25	1	
2	2	25	2015	2	RN	1	09:25	1	
2	2	25	2015	2	RN	2	10:20	1	
4	3	25	2015	2	RN	1	09:20	1	
4	3	25	2015	2	RG	1	10:20	1	Near vp

Table 9.25 – Wintering vantage point aggregated species sightings records within the survey area and 500 m buffer.

Species	Number of detections	%	Number of five minute intervals	%
BZ	21	10.7	21	10.1
GB	1	0.5	1	0.5
GJ	1	0.5	1	0.5
GP	5	2.5	5	2.4
H.	3	1.5	3	1.4
HH	3	1.5	3	1.4
K.	13	6.6	14	6.7
LB	6	3.0	6	2.9
ML	1	0.5	1	0.5
PE	4	2.0	5	2.4
RG	3	1.5	3	1.4
RN	118	59.9	127	61.1
SH	2	1.0	2	1.0
SN	16	8.1	16	7.7
Total	197		208	

Table 9.26 – Wintering vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
BZ	3	1	5	6	2	4		21
GB				1				1
GJ		1						1
GP		3				2		5
H.	2		1					3
HH					1	2		3
K.		3	10					13
LB	1	1			1	3		6
ML		1						1
PE	1	1	1	1				4
RG	1	1					1	3
RN	30	23	11	16	20	17	1	118
SH					1	1		2
SN		7	3		1	5		16
Total	38	42	31	24	26	34	2	197

102. Four target 1 species flights (**Table 9.1**) were recorded (**Table 9.26**); greylag goose (n = 1), golden plover (n = 5), hen harrier (n = 3), merlin (n = 1) and peregrine (n = 4) and had flying height(s) recorded (**Table 9.27**) and were mapped (**Figures 9.18**).

103. The hen harrier flights were detected in the later part of the winter from vantage point locations and there was further evidence of hen harriers roosting in the wider area (see Section 9.3.3.7) during the winter period. Golden plover and greylag were observed during autumn / spring migration seasons and golden plover did not appear to over-winter at the site.

104. Greylag geese were recorded at high elevation in the upper range of potential collision risk height for 32 seconds. Hen harriers flights, comprised 186 seconds of flight with all flights recorded below potential collision risk height (<15m), similarly merlin recorded for 18 seconds were also below collision risk height. Peregrine flights were recorded for 369 seconds of flight observed with 5.9 below rotor height (<15m), 46.6% within potential collision risk height (15m – 140m) and 47.4% above potential collision risk height.

Table 9.27 – Breeding vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25 m	25-50 m	50-75 m	50-100 m	100-125 m	125-140 m	>140 m	Notes
1	9	19	2014	PE	1	13:43:00	235						30	30	175	Female mobbed by several rooks and pipits for whole duration of sighting
4	10	9	2014	GJ	5	15:56:00	32							32		
4	10	9	2014	ML	1	16:23:00	18	18								Female
2	10	14	2014	GP	4	08:43:00	63	15	10	5	10	5			18	
2	10	14	2014	GP	8	09:36:00	39	39								
3	10	14	2014	GP	4	13:03:00	23	8	5	10						
2	10	14	2014	PE	1	09:36:00	28				14	14				
2	11	5	2014	PE	1	10:53:00	87	17	45	25						
3	12	3	2014	PE	1	08:41:00	19	5	9	5						Adult
3	1	20	2015	HH	1	10:44:00	47	47								Female
3	2	5	2015	HH	1	07:53:00	105	105								Female low slow hunting flight
3	2	5	2015	HH	1	08:08:00	34	34								Female
3	2	18	2015	GP	1	09:08:00	17	17								
3	2	18	2015	GP	1	09:38:00	42	27	10	5						

105. Cumulative data for all species detected during winter and summer vantage points (**Table 9.28**) over the 12-month study shows that buzzard (12%), kestrel (4.7%), lesser black-backed gull (5%), raven (58.6%) and snipe (5.6%) were the most frequently detected species. Two species (raven and buzzard) were recorded throughout every month of the study (**Table 9.28**). Greylag geese and golden plover were only observed in the 500 m survey area during the winter. Buzzards were detected in all months except September whilst curlew and peregrine activity declined between summer and winter. Kestrels and peregrine were observed more often during the autumn (**Table 9.28**).

106. There was only one species recorded during the breeding season that was not recorded during the winter, namely whooper swan, though this was seen during the migration season whilst all other species were detected during both breeding and wintering seasons in the 500 m survey buffer in various months and frequencies (**Table 9.28**).

Table 9.28 – Cumulative breeding and wintering vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL	% of detections
BZ	2	4	6	2	3	5	3	1	5	6	2	4		43	12.0
GB						1				1				2	0.6
GJ								1						1	0.3
GP								3				2		5	1.4
H.						1	2		1					4	1.1
HH			1		3	1					1	2		8	2.2
K.				2	1	1		3	10					17	4.7
LB	4				5	3	1	1			1	3		18	5.0
ML		1	2					1						4	1.1
PE	2					1	1	1	1	1				7	2.0
RG			6	2	1		1	1					1	12	3.4
RN	19	8	11	8	25	17	30	23	11	16	20	17	1	206	57.5
SH	3				1	3					1	1		9	2.5
SN	1	2	1					7	3		1	5		20	5.6
WS	2													2	0.6
TOTAL	33	15	27	14	39	33	38	42	31	24	26	34	2	358	

3.3.5. Migration Vantage Point Surveys

107. There were 36 hours observation completed at each vantage point in the spring (SMVP) between January 2014 and April 2014 and in the autumn (AMVP) between September 2014 and November 2014 (**Tables 9.29 & 9.30**) with a total of 72 hours completed during migration seasons. Survey times ranged from 06.50hrs to 18.30hrs (**Table 9.29**) and covered a wide range of weather conditions (**Table 9.31).**

Table 9.29 – Migration season vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
SMVP	MIG	MR	1	29	2014	13:55	16:55	03:00
SMVP	MIG	MR	1	30	2014	15:00	18:00	03:00
SMVP	MIG	MR	2	10	2014	15:00	18:00	03:00
SMVP	MIG	AM	2	13	2014	08:55	11:55	03:00
SMVP	MIG	AM	2	18	2014	08:20	11:20	03:00
SMVP	MIG	AM	2	26	2014	11:55	14:55	03:00
SMVP	MIG	AM	3	7	2014	11:10	14:10	03:00
SMVP	MIG	AM	3	18	2014	10:00	13:00	03:00
SMVP	MIG	KH	3	27	2014	07:55	10:55	03:00
SMVP	MIG	DCR	3	31	2014	11:35	14:35	03:00
SMVP	MIG	AM	4	3	2014	10:30	13:30	03:00
SMVP	MIG	KH	4	14	2014	13:15	16:15	03:00
AMVP	MIG	DCR	9	11	2014	06:35	09:35	03:00
AMVP	MIG	AM	9	19	2014	11:20	14:20	03:00
AMVP	MIG	AM	9	24	2014	11:30	14:30	03:00
AMVP	MIG	MR	9	26	2014	14:25	17:25	03:00
AMVP	MIG	DCR	10	6	2014	11:35	14:35	03:00
AMVP	MIG	AM	10	9	2014	15:20	18:20	03:00

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
AMVP	MIG	MR	10	21	2014	16:25	19:25	03:00
AMVP	MIG	DCR	10	30	2014	07:05	10:05	03:00
AMVP	MIG	DCR	11	5	2014	06:50	09:50	03:00
AMVP	MIG	DCR	11	10	2014	10:20	13:20	03:00
AMVP	MIG	AM	11	19	2014	11:40	14:40	03:00
AMVP	MIG	MR	11	22	2014	14:15	17:15	03:00

Table 9.30 – Migration vantage point survey effort by month

VP No.	Jan	Feb	Mar	Apr		Sep	Oct	Nov	TOTAL
Spring Migration	6	12	12	6					36
Autumn Migration	-	-	-	-		12	12	12	36
TOTAL	6	12	12	6		12	12	12	72

Table 9.31 – Migration vantage point weather conditions

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D	Y	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
MIG	1	29	14	10	10	10	10	400	350	550	550	E3	E3	E3	E3	NIL	NIL	NIL	NIL	2	1	2	2
MIG	1	30	14	10	10	10	10	700	800	800	800	SE2	SE3	SE3	SE3	NIL	NIL	NIL	NIL	2	3	3	3
MIG	2	10	14	10	10	10	5	750	450	600	1200	W2	SW2	SW3	SW2	NIL	NIL	ILF	NIL	2	2	2	2
MIG	2	13	14	10	10	10	10	350	420	400	400	SW3	SW3	SW5	SW5	ILS	NIL	ILS	ILS	5	5	5	3
MIG	2	18	14	10	10	10	10	300	300	300	300	SW4	SW4	SW4	SW4	ILR	NIL	ILR	ILR	0.5	0.5	1	1
MIG	2	26	14	10	10	9	8	450	550	600	600	W5	W6	W5	W5	ILR	NIL	NIL	NIL	5	5	5	5
MIG	3	7	14	2	10	4	2	800	300	600	800	W6	W6	W6	W6	NIL	CLS	NIL	NIL	5	0.5	5	5
MIG	3	18	14	10	10	10	10	420	400	450	450	W5	W5	W6	W6	NIL	ILR	ILR	ILR	5	3	5	5
MIG	3	27	14	10	10	10	10	500	500	500	500	N4	NE4	NE5	NE5	ILR	ILR	CLR	ILR	5	5	5	5
MIG	3	31	14	6	5	5	4	500	500	500	500	SE4	SE4	SE4	SE4	NIL	NIL	NIL	NIL	2	2	2	2
MIG	4	3	14	10	10	10	10	300	300	370	400	E4	E4	E4	E4	NIL	NIL	NIL	NIL	0.5	1.5	1.5	1.5
MIG	4	14	14	8	8	8	8	700	800	800	800	W4	W4	W4	W4	NIL	NIL	NIL	NIL	5	5	5	5
MIG	9	11	14	2	2	4	4	1000	1000	1000	1000	S1	S1	S1	S1	NIL	NIL	ILM	ILM	2.5	5	2.5	3
MIG	9	24	14	10	10	10	10	600	600	650	650	NW3	NW3	NW3	NW3	NIL	NIL	NIL	NIL	5	5	5	5
MIG	9	19	14	10	10	10	10	450	450	450	500	SE2	SE2	SE2	SE1	NIL	NIL	NIL	NIL	2.5	2.5	3	4
MIG	9	26	14	8	8	8	8	2000	1500	1500	1500	W3	W4	W4	W4	NIL	NIL	NIL	NIL	2	2	2	2
MIG	10	6	14	5	6	5	5	600	600	500	600	SW4	SW4	SW4	SW4	NIL	NIL	NIL	NIL	5	5	5	5
MIG	10	9	14	7	8	8	6	600	600	600	600	NW3	NW3	NW3	NW3	NIL	NIL	NIL	NIL	5	5	5	5
MIG	10	21	14	5	5	4	4	950	1000	1000	1000	NW5	NW4	NW4	NW4	NIL	NIL	NIL	NIL	2	2	2	2
MIG	10	30	14	10	10	9	10	400	450	450	450	S3	S3	S3	S3	ILM	NIL	ILR	NIL	1	2.5	3	3
MIG	11	5	14	4	3	3	4	600	600	600	600	NE1	NE1	NE1	NE1	NIL	NIL	NIL	NIL	3	5	5	5
MIG	11	10	14	6	8	8	6	375	375	400	400	SE3	SE3	SE3	SE3	IHM	ILM	NIL	NIL	0.5	1.5	1.5	2.5
MIG	11	19	14	10	10	10	10	600	600	600	600	SE4	SE4	SE4	SE4	NIL	NIL	NIL	NIL	5	5	5	5
MIG	11	22	14	8	8	8	8	900	900	900	900	W1	W1	W1	W1	NIL	NIL	NIL	NIL	2	2	2	2

108. There were 11 target species (**Table 9.1**) were recorded inside the survey area and 500 m buffer; buzzard; greylag goose, golden plover; hen harrier; kestrel; lesser black-backed gull; peregrine falcon, red grouse, raven, snipe and woodcock (**Tables 9.32 & 9.33**).

109. Raven (80.5%), kestrel (4.2%), buzzard (2.5%), snipe (2.5%) and lesser black-backed gull (2.5%) were the most frequently recorded species during the migration vantage point observations. Greylag geese were recorded once during autumn migration and raven were the most frequently recorded species with a marginally greater level of activity in the spring period (**Table 9.34**) than during the autumn (**Table 9.34**).

Table 9.32 – Migration vantage point sightings records recorded within the 500 m survey boundary.

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
SMIG	1	29	2014	2	RN	1	16:10	2	
SMIG	1	30	2014	2	RN	1	16:05	1	
SMIG	1	30	2014	2	RN	1	16:25	1	Onto fence
SMIG	1	30	2014	2	RN	4	16:25	1	
SMIG	1	30	2014	2	RN	1	16:35	1	
SMIG	1	30	2014	2	RN	2	16:35	1	
SMIG	1	30	2014	2	RN	2	16:35	1	
SMIG	1	30	2014	2	WK	1	17:55	1	Between turbines
SMIG	2	10	2014	2	RN	19	15:05	2	Lifted from near VP, circled and all dispersed into windfarm and forest gradually
SMIG	2	10	2014	2	RN	11	15:15	1	
SMIG	2	10	2014	2	RN	6	15:20	3	
SMIG	2	10	2014	2	RN	3	15:55	1	
SMIG	2	10	2014	2	RN	1	16:10	1	
SMIG	2	10	2014	2	RN	1	16:40	1	
SMIG	2	10	2014	2	RN	3	16:45	2	
SMIG	2	10	2014	2	RN	1	16:50	1	
SMIG	2	10	2014	2	RN	7	16:55	1	
SMIG	2	10	2014	2	RN	8	16:55	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
SMIG	2	10	2014	2	RN	15	17:00	2	All along ridge/plateau, occasionally below turbines
SMIG	2	10	2014	2	RN	13	17:10	1	
SMIG	2	10	2014	2	RN	2	17:10	1	
SMIG	2	10	2014	2	RN	2	17:25	1	Displaying below turbines
SMIG	2	10	2014	2	RN	3	17:35	1	
SMIG	2	10	2014	2	RN	1	09:10	1	
SMIG	2	13	2014	2	RN	2	09:15	2	
SMIG	2	13	2014	2	RN	4	09:35	1	1 pair soaring, 2nd pair flying across plateau
SMIG	2	13	2014	2	RN	2	09:40	1	
SMIG	2	13	2014	2	RN	7	10:20	1	Calling and tumbling, flew in together from south
SMIG	2	13	2014	2	RN	1	10:25	1	
SMIG	2	13	2014	2	RN	3	10:35	1	Single bird and pair
SMIG	2	13	2014	2	RN	5	10:40	2	In flock, tumbling and calling, slpit into 2 pairs and single. 2+1 flew north, lost over ridge, other pair flew off site SW
SMIG	2	13	2014	2	RN	2	10:50	1	
SMIG	2	13	2014	2	RN	1	11:25	1	Flew to perch on stone derelict, then flew south off site
SMIG	2	18	2014	2	RN	1	09:40	1	Heard only in low cloud
SMIG	2	26	2014	2	RN	1	12:00	1	Over VP
SMIG	2	26	2014	2	BZ	3	13:20	2	Soaring very high together, 2 males stooping at each other, 1 male flew north, pair flew SW
SMIG	2	26	2014	2	RN	1	13:35	1	Flying S-N
SMIG	2	26	2014	2	BZ	2	13:50	1	Pair flew up from farmland together, continued hunting together, then flew back down into improved
SMIG	2	26	2014	2	RN	6	14:00	1	Flying and displaying in pairs across face of Rigged Hill S-N
SMIG	2	26	2014	2	RN	2	14:05	1	Flew past VP
SMIG	2	26	2014	2	RN	1	14:15	3	Flew past VP
SMIG	2	26	2014	2	RN	2	14:15	1	Soaring on face of Rigged Hill
SMIG	3	7	2014	2	RN	1	11:10	1	Over fields below VP
SMIG	3	7	2014	2	RN	6	11:15	1	1 joined 5 SW of VP, flew down into improved ground
SMIG	3	7	2014	2	RN	2	11:25	2	NW of VP, tumbling together
SMIG	3	7	2014	2	K.	1	11:40	1	Male across Vp in strong winds, flew fast NE into windfarm and over forest
SMIG	3	7	2014	2	RN	2	12:15	3	N-S across low ground, flying together, all flew north out of sight
SMIG	3	7	2014	2	RN	1	12:55	2	From SE, over fields below VP
SMIG	3	18	2014	2	RN	1	10:10	1	Flew in from south
SMIG	3	18	2014	2	RN	3	10:15	1	2 joined 1 from same direction
SMIG	3	18	2014	2	RN	1	10:50	1	Flew past VP
SMIG	3	18	2014	2	RN	2	11:05	2	Flying below VP 3
SMIG	3	18	2014	2	LB	1	11:10	1	
SMIG	3	18	2014	2	RN	3	11:20	1	
SMIG	3	18	2014	2	LB	2	11:25	1	
SMIG	3	18	2014	2	RN	1	11:35	1	
SMIG	3	18	2014	2	LB	2	12:05	1	
SMIG	3	18	2014	2	RN	1	12:05	1	
SMIG	3	27	2014	1	GP	12	08:35	1	Flew E to W past vp
SMIG	3	31	2014	2	RN	1	12:25	1	
SMIG	4	14	2014	2	RN	2	14:00	1	Flying W-E
SMIG	4	14	2014	2	SN	2	15:55	1	Chipping birds in 2 locations
AMIG	9	11	2014	2	RN	3	07:45	1	
AMIG	9	11	2014	2	BZ	1	08:40	1	
AMIG	9	24	2014	2	RN	2	11:45	1	Calling flying south
AMIG	9	24	2014	2	RN	1	12:10	1	Flying north
AMIG	9	24	2014	2	RN	4	12:55	2	Tumbling together
AMIG	9	24	2014	2	RN	1	13:05	1	Flying north along plateau
AMIG	9	19	2014	1	HH	1	13:35	1	Male getting mobbed by MP (30+) mobbing and alarming
AMIG	9	26	2014	2	RN	2	14:30	1	
AMIG	9	26	2014	2	RN	3	14:35	1	
AMIG	9	26	2014	2	RN	3	14:40	1	
AMIG	9	26	2014	2	RN	1	15:25	1	
AMIG	9	26	2014	2	RN	1	15:40	1	
AMIG	9	26	2014	2	RN	3	15:45	7	Continuous circling by RN
AMIG	9	26	2014	2	RN	1	16:25	1	
AMIG	9	26	2014	1	GP	1	16:50	1	
AMIG	9	26	2014	2	RN	3	17:25	1	
AMIG	10	6	2014	2	RN	1	11:35	1	
AMIG	10	6	2014	2	RN	2	11:40	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
AMIG	10	6	2014	2	K.	1	11:55	1	
AMIG	10	6	2014	2	RN	2	12:05	1	
AMIG	10	6	2014	2	RN	5	12:20	1	
AMIG	10	6	2014	2	K.	2	13:05	1	
AMIG	10	6	2014	2	RN	1	13:25	1	
AMIG	10	9	2014	2	RN	1	15:40	1	
AMIG	10	9	2014	2	RN	3	15:45	1	
AMIG	10	9	2014	2	GJ	5	15:55	1	Flying NE
AMIG	10	9	2014	2	K.	1	17:05	1	Male hover hunting over heather and rough grazing
AMIG	10	9	2014	2	RN	4	17:15	1	
AMIG	10	21	2014	2	RN	4	16:35	1	
AMIG	10	21	2014	2	RN	1	16:55	1	
AMIG	10	21	2014	2	RN	4	17:15	2	
AMIG	10	21	2014	2	RN	2	17:15	2	
AMIG	10	21	2014	2	RN	3	17:20	2	3 Different groups - all chasing/ rolling
AMIG	10	21	2014	2	RN	2	17:25	1	2 different birds
AMIG	10	21	2014	2	RN	7	17:30	2	Between and around turbines, 5 went north, one went south, one south west
AMIG	10	21	2014	2	RN	2	17:40	1	
AMIG	10	21	2014	2	SN	1	18:50	1	
AMIG	10	30	2014	2	RN	1	07:40	1	
AMIG	10	30	2014	2	RN	4	08:20	1	
AMIG	10	30	2014	2	K.	1	09:05	1	
AMIG	11	5	2014	2	RN	1	07:20	1	
AMIG	11	5	2014	2	RN	2	07:45	1	
AMIG	11	5	2014	2	RN	1	08:25	1	
AMIG	11	5	2014	2	RN	1	09:05	1	
AMIG	11	10	2014	2	RG	1	10:25	1	On ground
AMIG	11	10	2014	2	RN	2	11:15	1	
AMIG	11	10	2014	2	RN	1	11:50	1	
AMIG	11	10	2014	2	SN	1	13:15	1	Disturbed
AMIG	11	22	2014	2	RN	2	14:30	1	
AMIG	11	22	2014	1	PE	1	14:40	1	Juvenile male
AMIG	11	22	2014	1	PE	1	14:40	1	Adult female
AMIG	11	22	2014	2	RN	1	15:10	1	
AMIG	11	22	2014	2	RN	4	15:40	4	Around turbines
AMIG	11	22	2014	2	RN	1	16:05	1	
AMIG	11	22	2014	2	RN	2	16:25	2	
AMIG	11	22	2014	2	RG	1	16:45	1	Calling and flew from ground

Table 9.33 – Migration vantage point aggregated species sightings records within the survey area and 500 m buffer.

Species	Number of detections	%	Number of five minute intervals	%
BZ	3	2.5	4	2.7
GJ	1	0.8	1	0.7
GP	2	1.7	2	1.3
HH	1	0.8	1	0.7
K.	5	4.2	5	3.4
LB	3	2.5	3	2.0
PE	2	1.7	2	1.3
RG	2	1.7	2	1.3
RN	95	80.5	125	83.9
SN	3	2.5	3	2.0
WK	1	0.8	1	0.7
TOTAL	118		149	

Table 9.34 – Migration vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Jan	Feb	Mar	Apr		Sep	Oct	Nov	TOTAL
BZ		2				1			3
GJ							1		1
GP			1			1			2
HH						1			1
K.			1				4		5
LB			3						3
PE								2	2
RG								2	2
RN	7	32	13	1		13	18	11	95

Species	Jan	Feb	Mar	Apr		Sep	Oct	Nov	TOTAL
SN				1			1	1	3
WK	1								1
Total	8	34	18	2		16	24	16	118

110. Three target 1 species flights (**Table 9.1**) were recorded (**Tables 9.33 & 9.34**); greylag goose (n = 1), hen harrier (n = 1), peregrine (n = 2) and golden plover (n = 2) and had flying height(s) recorded (**Table 9.35**) and were mapped (**Figure 9.19**).

111. Golden plover movements were recorded in both spring and autumn migration season but did not over-winter at the site (see Section 9.3.3.4). One group of five greylag were recorded to pass over during the autumn migration although were recorded heading north rather than arrival expected from the north if these were continental migrants and therefore may have been localised movements rather than migrating birds. No regular wildfowl / goose/ swan migration routes were observed.

Table 9.35 – Breeding vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time detected	Duration (secs)	<15 m	15-25 m	25-50 m	50-75 m	50-100 m	100-125 m	125-140 m	>140 m	Notes
SMIG	3	27	2014	GP	12	08:34:00	9	9								
AMIG	9	19	2014	HH	1	13:34:00	29	29								Male hunting
AMIG	9	26	2014	GP	1	16:48:00	6		6							
AMIG	10	9	2014	GJ	5	15:54:00	114							69	45	
AMIG	11	22	2014	PE	1	14:40:00	57								57	Juvenile male
AMIG	11	22	2014	PE	1	14:40:00	63								64	Female

3.3.6. Breeding Priority Species Surveys

112. There were 126 hours and 45 minutes spent searching adjacent habitats for priority species (**Table 9.1; Table 9.36**) with efforts concentrated on hen harrier, merlin, red grouse and waders during the breeding season. Survey times ranged between 03.50hrs to 23.30hrs and covered a wide range of weather conditions (**Table 9.36**).

Table 9.36 Details of breeding priority species searches (PSS), including survey effort, weather

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	500 m	18	3	2014	09:40	13:10	03:30	10	450	NW	3	ILR	3
PSS	2 km	18	3	2014	13:25	16:30	03:05	10	500	W	3	ILR	3
PSS	500 m / 2 km / >2 km	18	3	2014	08:55	17:25	08:30	9	700	SW	4	ILR	2
PSS	2 km	14	4	2014	13:20	17:45	04:25	8	800	W	3	NIL	5
PSS	2 km	14	4	2014	16:30	17:45	01:15	6	800	W	3	NIL	5
PSS	2 km / >2 km	24	4	2014	09:15	11:15	02:00	2	500	SE	4	NIL	5
PSS	500 m / 2 km / >2 km	28	4	2014	14:55	18:15	03:20	10	1100	NIL	NIL	NIL	5
PSS	2 km	28	4	2014	18:40	19:40	01:00	10	600	E	1	NIL	3.5
RGS / SNS	500 m	28	4	2014	19:00	22:30	03:30	10	1100	NIL	NIL	NIL	5
RGS / SNS	500 m	28	4	2014	21:10	22:30	01:20	10	400	E	2	CLM	1-0
RGS / SNS	500 m	28	4	2014	21:00	22:30	01:30	10	370	SE	2	NIL	0.5
RGS / SNS	500 m	28	4	2014	21:10	22:30	01:20	10	350	E	3	NIL	0.5
RGS / SNS	500m	29	4	2014	03:50	05:45	01:55	10	500	E	2	NIL	2
RGS / SNS	500m	29	4	2014	03:50	05:45	01:55	10	500	E	2	NIL	2
RGS / SNS	500m	29	4	2014	03:50	05:45	01:55	10	500	E	2	NIL	2
PSS	500 m	8	5	2014	10:50	14:00	03:10	10	500	SW	3	ILR	5
PSS	500 m	15	5	2014	12:05	15:35	03:30	7	500	NE	2	NIL	3
PSS	2 km	15	5	2014	15:50	18:00	02:10	6	600	N	1	NIL	5
PSS	2 km	15	5	2014	19:10	20:00	00:50	6	1000	E	3	NIL	5
SNS / PSS	500 m	15	5	2014	19:50	23:00	03:10	9	900	E	1	NIL	5
SNS / PSS	500 m	15	5	2014	20:00	23:30	03:30	10	500	NE	2	NIL	5
SNS / PSS	500 m	15	5	2014	20:15	23:15	03:00	6	1000	E	3	NIL	5
SNS / PSS	500 m	15	5	2014	20:30	22:30	02:00	9	750	E	3	NIL	2.5
PSS	500 m / 2 km	28	5	2014	17:00	19:40	02:40	10	650	NE	3	NIL	3
PSS	2 km	28	5	2014	18:30	19:45	01:15	6	1000	NE	2	NIL	5
PSS	2 km	28	5	2014	18:30	20:15	01:45	8	900	NE	2	NIL	5
PSS	2 km	16	6	2014	14:00	19:00	05:00	5	900	NW	2	NIL	5
PSS	500 m / 2 km	18	6	2014	11:15	12:15	01:00	4	500	NW	2	NIL	1.5
PSS	2 km	18	6	2014	12:20	15:20	03:00	2	500	NW	2	NIL	3
PSS	2 km	18	6	2014	11:15	12:15	01:00	6	450	NW	3	NIL	5
PSS	2 km	18	6	2014	12:15	15:15	03:00	4	550	NW	2	NIL	5
PSS	800 m / 2 km	25	6	2014	08:00	16:40	08:40	100	400	E	2	ILR	4
PSS	2 km	2	7	2014	09:10	09:30	00:20	10	750	SW	3	NIL	5
PSS	2 km	7	7	2014	11:20	15:15	03:55	9	500	NW	3	ILR	3
PSS	> 2 km	7	7	2014	15:35	18:05	02:30	9	500	NW	3	ILR	4
PSS	2 km	18	7	2014	07:40	10:40	03:00	6	750	SE	3	NIL	3
PSS	2km / >2 km	18	7	2014	14:30	19:35	05:05	6	800	SE	3	NIL	5
PSS	2 km	30	7	2014	14:45	18:00	03:15	10	800	W	3	NIL	5
PSS	2 km	30	7	2014	14:45	17:45	03:00	10	800	W	3	NIL	5
PSS	500 m / 2 km / >2 km	30	7	2014	11:15	14:40	03:25	10	800	W	3	NIL	5

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
RGS / PSS	500 m / 2 km	7	8	2014	08:15	11:35	03:20	10	600	SW	3	ILR	5
PSS	2 km	7	8	2014	11:35	14:35	03:00	10	600	SW	3	ILR	5
RGS / PSS	500 m	29	8	2014	08:30	11:30	03:00	10	250	SW	4	CLR	1
RGS / PSS	500 m	29	8	2014	08:15	12:00	03:45	10	250	SW	4	ILR	1

113. There were 11 target species were recorded; namely buzzard, curlew, golden plover, hen harrier, kestrel, merlin, peregrine, raven, red grouse, snipe and sparrowhawk (**Table 9.37**). In addition, vantage point effort was 144 hours during the breeding season and breeding bird surveys comprised 132 hours. The sightings from all surveys were aggregated with priority species search effort to identify territory locations of target species (**Table 9.1**) and in particular to identify curlew, red grouse, snipe and raptor territories within the core survey areas (**Figure 9.20; Figure 9.20 CONFIDENTIAL**) and published avoidance distances (Ruddock & Whitfield, 2007[18]; Pearce-Higgins et al., 2009) (**Figure 9.21; Figure 9.21 CONFIDENTIAL**).

3.3.6.1. Raptor surveys

114. One raptor territory, merlin, was recorded within the 500 m turbine buffers of the proposed turbines. This comprised of a territory holding sub-adult during the early part of the season, but no subsequent breeding was confirmed, although this is a known historical site including during the operational life of the existing windfarm (M. Ruddock, personal observation). There was one species which was breeding inside the survey area and 500 m buffer (buzzard; n = 2) (**Figure 9.20; Figure 9.20 CONFIDENTIAL**) whilst in the wider area buzzard (n = 6), hen harrier (n = 1; failed), kestrel (n = 2), merlin (n = 1; failed), raven (n = 2), sparrowhawk (n = 4) were recorded in the 2 km survey area. The second merlin territory held a separate male to that identified to the north as the second bird was observed to have adult plumage. Neither site successfully fledged any young.

115. Three further buzzards were identified beyond 2 km along with two hen harrier territories (one failed / one successful), two peregrine territories, one kestrel territory and two sparrowhawk territories (**Figure 9.20 CONFIDENTIAL**). An additional three pair of ravens were recorded beyond 2 km from the survey area.

3.3.6.2. Red grouse surveys

116. Whilst some grouse (n = 4) were recorded within the wider 2 km survey area; these were systematically surveyed within the survey area and 500 m buffer although the much of the site boundary does not contain suitable habitat for this species in particular the improved pasture or coniferous woodland areas in the west and east respectively of the site. Within the survey area and 500 m buffer there were six red grouse territories recorded in 2014. All six of these were within the 500 m buffer of the existing turbines and within the 500 m buffer of the proposed turbines (**Figures 9.20 & 9.21**).

3.3.6.3. Wader surveys

117. There were no curlew within the survey area and 500 m buffer during 2014, although historically these are known to occur in the wider area (M. Ruddock, personal observation). A single curlew was observed during travelling to the site circa 5 - 6 km south-east, but no breeding behaviours were observed

118. There were extensive snipe records from the range of surveys conducted and snipe territory mapping revealed that there were 17 territories within the survey area and 500 m buffer, of which 12 were within the 500 m existing turbine and/or proposed turbine buffer (**Figure 9.20**). There were two of the five territories beyond the 500 m turbine buffers which were within 500 m of the proposed access track. The 400 m buffer of snipe territory locations (see Pearce-Higgins et al., 2009) (**Figure 9.21**) shows that all of the existing turbines are within 400 m of the snipe territories, whilst only six of the seven proposed turbines are within the 400 m buffer of the same aggregation of snipe territories whilst two of the turbines are more than 400 m away from any snipe (**Figure 9.21**).

[18] Ruddock, M. & Whitfield, D.P. (2007). A review of disturbance distances in selected bird species. Report from Natural Research (Projects) Ltd. to Scottish Natural Heritage. Natural Research, Banchory, UK.

Table 9.37 Details of breeding priority species searches (PSS), including survey dates and species detected

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	500 m	18	3	2014	RN, BZ	9:35 - BZ seen when arrived, displaying over trees. 9:48 - RN pair flew across over clearing. 11:42 - RN flew back and forth across clearing. 12:23 - BZ flying over trees. 12:42 - BZ flew back over tree from where lost to view
PSS	2 km	18	3	2014	RN	RN nest with 2+ young, BZ displaying and mewing to south
PSS	500 m / 2 km / >2 km	18	3	2014	RN, BZ, GP, SN, ML, Irish hare	9:01 - RN 2 birds displaying with another nearby. 9:25 - BZ flew from trees, building nest. 9:35 - BZ pair displaying + undulating on edge of clearfell. 9:50 - GP. 11:26 - BZ. 11:55 - SN flew from ground. 10:55 - Irish hare Just south of NW turbine. 12:40 - SN flushed on way to vp. 13:05 - SN flushed from side of road. ML sub-adult calling and undulating along forest edge at north of site
PSS	2 km	14	4	2014	HH, BZ, RN	13:25 - BZ pair flying and calling together. 13:30 - HH female seen at 100m over PT, circled up + soared at 500m. Male then seen circling up towards female, circled together gradually drifting S, SW around forest. Male seen briefly undulating in flight. Lost behind forest. 13:30 - BZ pair, came off forest edge when male HH appeared, disappeared into forest edge. 14:00 - RN flew to perch in dead trees in PT. 14:39 - HH male, flew in undulating display flight from W, SW. Displayed over same PT area for 4 mins, flew NW.
PSS	2 km	14	4	2014	BZ	17:00 - BZ perched in dead tree. Flew down - prey strike, out of sight on ground then lifted and flew off.
PSS	2 km / >2 km	24	4	2014	BZ, SN, ML	9:54 - BZ flew into dead spruce, mated and sat together then flew S into trees. 9:56 - BZ single BZ displaying briefly over trees. Same as the above BZ. 9:57 - BZ 3 birds soaring over forest edge, 1 displaying. 10:07 - SN flushed 1 SN and a 2nd chipping in wet rushy grassland. ML pair seen at southern forest edge, male with prey and other pluckings observed.
PSS	500 m / 2 km / >2 km	28	4	2014	HH, RN, K., BZ	14:52 - HH brief display then rose up over trees. 15:35 - RN Keady Mt 3Y in nest. 15:30 - K. droppings only. 16:25 - BZ.
PSS	2 km	28	4	2014	BZ	18:45 - BZ pair calling to each other, flying from tree to tree (courtship).
RGS / SNS	500 m	28	4	2014	BZ, RG, SN	19:45 - BZ defending nest. 21:35 - RG. 21:45 - RG. 21:56 - SN drumming briefly.
RGS / SNS	500 m	28	4	2014	SN, RG	21:28 - SN. 21:33 - SN. 21:42 - RG. 22:02 - SN. 22:05 - SN bleating.
RGS / SNS	500 m	28	4	2014	RG	21:37 - RG
RGS / SNS	500 m	28	4	2014	SN	21:34 - SN flying W & chipping at 5m height.
RGS / SNS	500m	29	4	2014	SN, RG, SH	Additional sighting at 10:58 - SH displaying at edge of forest in 2 km boundary
RGS / SNS	500m	29	4	2014	SN, RG	04:21 RG calling; 04:48 RG & SN (x 3) calling
RGS / SNS	500m	29	4	2014	SN, RG	04:13 SN; 04:22 SN; 04:34 RG; 04:51 SN

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	500 m	8	5	2014	BZ	10:52 - BZ in hedgerow trees, calling. Mobbed by 2 mg and flew SW. Appeared to be adult male and adult female. Nothing else seen at Ballycrum 11:00 - 14:00
PSS	500 m	15	5	2014	BZ, HH	13:01 - BZ spotted perched on tree then took off. 13:45 - HH female 48s flight 40-70m high. 13:56 - BZ. 14:33 - BZ. 14:54 - BZ flying along the same line as BZ 2, also heading same direction.
PSS	2 km	15	5	2014	None (CU)	None in survey buffers. CU calling seen on road on way to survey - outside survey area (> 5 km).
PSS	2 km	15	5	2014	HH, K.	19:13 - HH mobbed by K. 19:20 - K. hunting over heather.
SNS / PSS	500 m	15	5	2014	SN, RG	22:22 - SN. 22:24 - SN. 22:24 - SN. 22:26 - RG. 22:29 - SN. 22:46 - SN
SNS / PSS	500 m	15	5	2014	HH, BZ	20:28 - HH male 13s flight >10m. 21:13 - BZ.
SNS / PSS	500 m	15	5	2014	SN, RG	22:04 - SN. 22:11 - SN. 22:16 - SN distant. 22:18 - SN. 22:19 - SN. 22:20 - SN behind vp. 22:21 - SN. 22:22 - SN. 22:23 - SN. 22:24 - SN. 22:26 - SN. 22:35 - RG male single call alarming in dark. 22:45 - SN.
SNS / PSS	500 m	15	5	2014	SN, RG	22:07 - SN dusk. 22:18 - RG dusk. 22:27 - SN dusk.
PSS	500 m / 2 km	28	5	2014	RN	17:15 - RN. 17:50 - RN 3 birds flew to ground in front of forest foraged and socialised. One bird flew from ground onto forest. 17:58 - RN.
PSS	2 km	28	5	2014	BZ, SH, RN	BZ - male + female active nest. SH - mobbed BZ pair probable nest nearby. BZ - flew from one side of lacuna + perched. RN - possible nest nearby site. 1 recently flying. SH - flew into trees, carrying food. RN - 4 recently fledged young.
PSS	2 km	28	5	2014	None	
PSS	2 km	16	6	2014	PE, RN, K.	PE pair one site active nest; PE single in other site; RN, K. also seen
PSS	500 m / 2 km	18	6	2014	BZ	Active nest sites at 3 separate locations to east; calling and adults present
PSS	2 km	18	6	2014	SH	Calling and active
PSS	2 km	18	6	2014	SH, BZ	No sightings Ballycrum; SH and BZ at Cam Forest
PSS	2 km	18	6	2014	BZ	13:46 - BZ. Craiggore K active site; 2-3 SN calling to south of Freugh
PSS	800 m / 2 km	25	6	2014	PE, RN, HH, K., SH, BZ	PE single in quarry, RN used nest and K. site now appeared failed. Female HH dropped into heather near quarry, did not lift again, male seen separately to west, no interaction. Possible nest site in heather, SH site to west of site active and carrying prey into woodland, BZ site to north c500 m from road on edge of river valley
PSS	2 km	2	7	2014	HH	9:18 - HH low flying and foraging, seen whilst moving between vps
PSS	2 km	7	7	2014	K., RN	11:45 - K. 12:05 - WC. 12:50 - RN.
PSS	> 2 km	7	7	2014	HH	Hen harrier active nest site to south, delivering prey and kestrel nest still remains active
PSS	2 km	18	7	2014	SN, RN	SN - Freugh. RN - Freugh
PSS	2km / >2 km	18	7	2014	BZ, SH, HH	BZ 2y fledged; SH used nest and 2+ calling young heard. No activity seen at northern HH site; failed; southern site fledged 2 young and central site confirmed failed too
PSS	2 km	30	7	2014	RN, RG, K.	14:50 - K. 15:07 - RG Female. 16:15 - RN. 17:00 - RN. RN.
PSS	2 km	30	7	2014	RN, K.	K. - Craiggore. RN - Craiggore. RN - Donald's Hill. RN - Donald's pot. RN - Donald's pot. RN - Gortnarney. RN - Temain hill.
PSS	500 m / 2 km / >2 km	30	7	2014	BZ, K., HH,	BZ - Cam forest. BZ + 1J Fort View Lodge. K + 1J - Donald's Pot. BZ - failed nest, Tibaran MT. HH - male + female seen near nest area (failed - food pass and nest with eggs maximum breeding evidence), Baran. BZ + 2J - Terrydoo Walker. BZ + 1J - Little Derry.
RGS / PSS	500 m / 2 km	7	8	2014	None	
PSS	2 km	7	8	2014	RN, BZ, SH	12:05 - RN circling and tumbling around mast. 12:25 - BZ Hunting west of vp. 12:45 - SH male, flushed from hedgerow, flew north, mobbed by MG (2). 13:20 - BZ adult female seen soaring over deciduous trees, flew west, 2 juveniles flying tree to tree calling to each other.
RGS / PSS	500 m	29	8	2014	RG	9:13 - RG flushed male. 10:55 - RG roost site, several pellet piles.
RGS / PSS	500 m	29	8	2014	RG	RG seen at two locations during walkover and three young birds seen to south of 500 m buffer at Temain Hill

3.3.7. Wintering Priority Species Surveys

119. During the winter of 2014 to 2015 (September 2014 to February 2015) there were 51 hours spent searching adjacent habitats (**Figure 9.1**) for priority species (**Table 9.1; Table 9.38**) with efforts concentrated on hen harrier wintering sites and whooper swan during the wintering season. Survey times ranged between 05.55hrs to 18.15hrs and covered a wide range of weather conditions (**Table 9.38**).

Table 9.38 Details of wintering priority species searches (PSS), including survey effort, weather

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km	4	9	2014	07:45	10:45	03:00	10	600	SE	1	NIL	5
PSS	>2 km	29	9	2014	15:00	18:00	03:00	10	1000	SW	2	NIL	5
PSS	2 km / >2 km	6	10	2014	12:45	14:15	01:30	5	600	SW	4	NIL	5
WRS / PSS	2 km	14	10	2014	05:55	08:15	02:20	2	1000	E	3	NIL	5
PSS	2 km	14	10	2014	08:25	11:00	02:35	2	1000	E	3	NIL	5
PSS	2 km / 2 km	21	10	2014	14:00	16:05	02:05	5	1000	NW	4	NIL	2
WRS / PSS	2 km	26	10	2014	16:05	18:10	02:05	5	800	SW	3	ILR	2
WRS / PSS	2 km	27	10	2014	16:05	18:15	02:10	5	900	S	2	ILR	3
PSS	500 m / 2 km / >2 km	24	11	2014	08:25	12:10	03:45	9	1000	S	1	NIL	5
WRS / PSS	2 km / >2 km	24	11	2014	15:25	17:25	02:00	9	1000	S	1	NIL	5

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km	3	12	2014	08:25	12:00	03:35	8	400	SW	2	ILR	5
WRS / PSS	2 km	9	12	2014	07:05	09:05	02:00	10	500	SW	4	NIL	5
WRS / PSS	2 km / >2 km	9	12	2014	07:00	09:00	02:00	10	500	SW	5	NIL	5
PSS	2 km	22	12	2014	16:30	17:50	01:20	10	400	SW	5	CLR	1.5
PSS	500 m / 2 km	31	12	2014	07:45	08:50	01:05	8	500	SW	3	NIL	2
WRS / PSS	2 km / >2 km	31	12	2014	15:30	17:05	01:35	8	500	SW	3	NIL	2
PSS	2 km / >2 km	7	1	2015	07:15	09:00	01:45	10	400	S	4	NIL	1.5
PSS	2 km	15	1	2015	07:55	10:20	02:25	10	550	SW	5	ILR	2
PSS	2 km	15	1	2015	13:10	16:10	03:00	9	500	SW	5	ILR	2
PSS	2 km	20	1	2015	07:05	09:00	01:55	10	600	S	3	ILM	2.5
PSS	2 km	18	2	2015	08:35	11:25	02:50	10	600	SW	2	NIL	5
PSS	500 m	25	2	2015	08:00	11:00	03:00	10	350	SW	2	NIL	3
PSS	2 km	4	9	2014	07:45	10:45	03:00	10	600	SE	1	NIL	5
PSS	>2 km	29	9	2014	15:00	18:00	03:00	10	1000	SW	2	NIL	5
PSS	2 km / >2 km	6	10	2014	12:45	14:15	01:30	5	600	SW	4	NIL	5
WRS / PSS	2 km	14	10	2014	05:55	08:15	02:20	2	1000	E	3	NIL	5
PSS	2 km	14	10	2014	08:25	11:00	02:35	2	1000	E	3	NIL	5
PSS	2 km / 2 km	21	10	2014	14:00	16:05	02:05	5	1000	NW	4	NIL	2
WRS / PSS	2 km	26	10	2014	16:05	18:10	02:05	5	800	SW	3	ILR	2

120. There were 14 target species were recorded; namely raven, hen harrier, golden plover, kestrel, snipe, buzzard, sparrowhawk, peregrine, greylag goose, red grouse, woodcock, lesser black-backed gull, herring gull, common gull, (**Table 9.39**). In addition, wintering vantage point effort was 156 hours during the wintering season and wintering bird surveys comprised 42 hours and 20 minutes.

121. The sightings from all surveys were aggregated with priority species search effort to identify key wintering locations of target species (**Table 9.1**) and in particular to identify hen harrier and whooper swan locations within the core survey areas (**Figure 9.20; Figure 9.20 CONFIDENTIAL**) and published avoidance distances (e.g. Ruddock & Whitfield, 2007[19]; Pearce-Higgins et al., 2009) (**Figure 9.21; Figure 9.21 CONFIDENTIAL**).

122. Wintering priority species were recorded widely within 2 km (including buzzard, kestrel, gulls, whilst other species such as snipe and red grouse were more habitat specific). Gulls and frequently alongside buzzards were typically associated with the nearby agricultural / pasture fields.

123. Ravens were recorded roosting at the forest to the east with a maximum roost count of 39 birds. These are roosting in the mature conifer plantation along the eastern edge of the windfarm and were occasionally observed feeding on carrion in the site and also utilising nearby radio / communication mast and the existing met mast on the site for perching and roosting.

124. There were no wintering swan or geese roosting or foraging areas recorded within 2 km or 5 km during 2014. Two flocks of greylag geese were recorded passing through the 2 km buffer in December (**Table 9.39**). There are no known traditional swan / goose roost sites within 5 km (**Figures 9.20; 9.21**) and no roosting / foraging / commuting routes were identified.

125. Hen harrier winter roost areas were identified within 2 km (**Figure 9.20 & 9.21 CONFIDENTIAL**) and the maximum roost count was three birds (female and two males) and was used regularly over the winter survey period at a discrete number of different locations. Several other suitable areas of roosting habitat occurred within 2 km and just beyond 2 km but no hen harriers were observed there although a further roost site was suspected beyond 2 km to the north.

Table 9.39 Details of wintering priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	2 km	4	9	2014	RN	9:41 – RN feeding on carrion
PSS	>2 km	29	9	2014	None	WS searches in wider 5 km, none detected
PSS	2 km / >2 km	6	10	2014	RN, K.	RN - flying along ridgeline. K. - hunting and playing through windfarm, flew to avoid turbines. RN
WRS / PSS	2 km	14	10	2014	HH	Adult male HH out from roost site 07:19
PSS	2 km	14	10	2014	K., SN, RN,	8:50 - K. flying. 9:05 - SN flew from ground. 9:20 - RN flying. 9:25 RN flying. 9:50 - RN flying. 10:00 - RN flying. 10:15 - RN flying. 10:40 - RN flying. 10:50 - RN flying.
PSS	2 km / 2 km	21	10	2014	HH	Female seen near roost site; no WS recorded in 2 km or eastern part of 5 km zone
WRS / PSS	2 km	26	10	2014	HH	Male seen 17:05 on northern side but heading over forest towards direction of Springwell and not seen to roost
WRS / PSS	2 km	27	10	2014	K.	No HH seen at south eastern roost site. K seen hunting near known nest site along river valley
PSS	500 m / 2 km / >2 km	24	11	2014	RG, K., RN, PE, BZ	9:12 - RG. 9:19 - K. hunting along ridge immediately in front of turbines. 9:25 - RN. 10:03 – RN feeding on carrion. 10:25 - PE sighting on Donald's hill crag. 10:43 - RN. 11:51 - BZ. No WS in 5 km zone
WRS / PSS	2 km / >2 km	24	11	2014	HH, RN	16:43 1 female and 2 adult males seen going to roost sites on southern side of site. RN roost - 36 birds seen passing north at various times heading towards Cam Forest roosting area
PSS	2 km	3	12	2014	GJ, BZ, PE	8:20 - GJ 2 flocks 25 + 12 passing through 2 km boundary. 8:30 - PE adult on fence post at road side. 11:55 - BZ perched on pole.
WRS / PSS	2 km	9	12	2014	BZ	BZ - Gortnarney.

[19] Ruddock, M. & Whitfield, D.P. (2007). A review of disturbance distances in selected bird species. Report from Natural Research (Projects) Ltd. to Scottish Natural Heritage. Natural Research, Banchory, UK.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
WRS / PSS	2 km / >2 km	9	12	2014	HH	Adult male out from southern roost site @ 08:26
PSS	2 km	22	12	2014	HH, GP, SN	16:47 - HH flew in front of vp at 5m height, heading NE. Lost over ridge into roost. Fading light. 16:56 - HH flew directly across front of vp, heading N/ NE at 5m height. Lost over ridge line, vis down to - 500m due to light levels. 16:58 - GP flew 50m height in front of vp, flying NE, calling intermittently. 17:00 - SN flying behind vp calling.
PSS	500 m / 2 km	31	12	2014	LB	LB - Lislane bridge; No WS seen along eastern side of 2 km and in towards site
WRS / PSS	2 km / >2 km	31	12	2014	None	No sightings and no swans seen on western side of 2 km / 5 km
PSS	2 km / >2 km	7	1	2015	SN, WK, SH	7:30/45 - SN. 7:30/45 - WK. 8:40 - SH
PSS	2 km	15	1	2015	None	No WS recorded inside 2 km or 5 km on western and southern side
PSS	2 km	15	1	2015	RN, HG, CM, PE	13:20 - RN flying towards Donald's hill. 13:50 - RN. 13:18 - HG. 14:30 - CM Foraging on ground with RO + JD. 14:30 - CM. 15:06 - CM. 16:06 - PE.
PSS	2 km	20	1	2015	RN	8:45 - RN out from roost site (39 birds maximum count)
PSS	2 km	18	2	2015	RN, BZ	8:40 - RN Temain hill - Donald's hill. 8:50 - RN flying and tumbling together over Donald's hill. 9:27 - BZ female, perched at forest edge opposite cricket ground entrance. 9:45 - BZ female perched at forest edge opposite cricket ground entrance. 9:55 - RN carrying wool into Keady quarry. 11:15 - BZ calling, mobbed by HC (4) over ridgeline. 11:17 - RN flying up towards Keady quarry. No WS recorded and scanned from top of mountain throughout 2 km and 5 km boundary
PSS	500 m	25	2	2015	HH, SN, GP, BZ, RN,	8:40 - HH flying from forest, turned when it saw me and flew NE towards Cam. 8:50 - SN flushed, flew SE rose to >100m. 9:10 - GP flew from ground, flew <10m S. 10:09 - BZ mobbed by RN (1), Temain hill - NW into site. 10:23 - RN on rock face, 7 RN lifted, no nest visible from south side, shallow ledges, 1 bird carrying nest material, west side to steep. 10:30 - RN concentration of RN regurgitated pellets on ground around mast. 10:40 - SN flushed flew west <5m. S. heard singing / displaying.

3.4. Field Surveys 2015

126. There were additional priority species surveys carried out between March 2015 to August 2015 which included a series of walkover, vantage point observations and snipe surveys in particular focusing on breeding and wintering priority species particularly swans, geese, hen harrier, other raptors, curlew, snipe, other waders and red grouse.

3.4.1. Breeding Priority Species Surveys

127. There were 103 hours spent searching adjacent habitats for priority species (**Table 9.1; Table 9.40**) with efforts concentrated on hen harrier, merlin, red grouse and waders during the breeding season. Survey times ranged between 05.40hrs to 23.40hrs and covered a wide range of weather conditions (**Table 9.40**).

Table 9.40 Details of breeding priority species searches (PSS), including survey effort, weather

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km / >2 km	22	4	2015	08:15	12:15	04:00	3	360	W	1	NIL	5
PSS	500 m	28	4	2015	08:15	14:45	06:30	10	600	W	3	IHS	5
PSS	500 m	28	4	2015	08:15	14:45	06:30	8	600	W	4	ILS	5
PSS	2 km	6	5	2015	07:55	09:25	01:30	10	250	NW	3	IHM	1
PSS	500 m	6	5	2015	09:30	11:00	01:30	10	400	NW	3	NIL	2
PSS	2 km	6	5	2015	07:55	09:30	01:35	10	250	NW	3	CHM	0.5
PSS	2 km / >2 km	6	5	2015	09:40	11:10	01:30	10	450	NW	3	NIL	5
PSS	2 km / >2 km	13	5	2015	08:20	09:50	01:30	6	800	E	1	NIL	5
PSS	2 km / >2 km	13	5	2015	09:50	11:50	02:00	6	800	E	1	NIL	5
PSS	2 km	13	5	2015	11:50	13:00	01:10	6	800	E	1	NIL	5
PSS	500 m	13	5	2015	13:00	14:20	01:20	6	800	E	1	NIL	5
PSS	2 km / >2 km	27	5	2015	17:20	20:20	03:00	10	350	W	3	CLR	2.5
PSS	2 km	27	5	2015	17:15	20:15	03:00	10	400	SW	4	CLR	2
SNS / RGS	500 m	27	5	2015	20:20	23:40	03:20	10	400	W	2	ILM	
PSS	500 m	27	5	2015	20:20	23:30	03:10	10	400	W	3	ILM	3
SNS / RGS	500 m	27	5	2015	20:20	23:40	03:20	10	400	W	3	ILM	3
SNS / RGS	500 m	27	5	2015	21:00	23:30	02:30	10	500	W	4	ILR	5
PSS	2 km	28	5	2015	17:15	20:25	03:10	10	350	W	3	CLR	5
PSS	500 m / 2 km / >2 km	28	5	2015	20:30	22:45	02:15	8	450	W	3	NIL	5
PSS	500 m / 2 km	4	6	2015	05:40	08:55	03:15	10	600	SE	2	ILR	3
PSS	500 m/ 2 km	15	6	2015	09:55	14:45	04:50	10	750	SW	2	NIL	3
PSS	500 m	30	6	2015	06:20	15:25	09:05	4	750	S	3	NIL	5

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	500 m / 2 km / >2 km	8	7	2015	06:20	12:20	06:00	8	600	NW	3	NIL	5
PSS	2 km	28	7	2015	08:15	09:45	01:30	10	380	NW	2	IHR	2
PSS	500 m/ 2 km	28	7	2015	09:55	11:25	01:30	10	500	NW	2	IHR	3
PSS	500 m	28	7	2015	08:00	11:00	03:00	10	220	W	2	CLR	3
PSS	500 m/ 2 km	28	7	2015	08:15	09:45	01:30	10	350	NW	2	IHR	2.5
PSS	500 m	28	7	2015	09:50	11:20	01:30	10	500	NW	2	IHR	2.5
PSS	2 km	6	8	2015	06:30	12:30	06:00	8	450	W	3	NIL	3
PSS	500 m	19	8	2015	08:25	11:25	03:00	10	320	SE	2	CHR	3
PSS	500 m	19	8	2015	08:25	11:25	03:00	10	350	SE	2	CHR	0.5
PSS	500 m	31	8	2015	13:30	15:30	02:00	10	600	NW	2	NIL	5
PSS	500 m	31	8	2015	13:30	15:30	02:00	10	600	N	2	NIL	5
PSS	2 km	31	8	2015	13:35	15:35	02:00	9	600	NW	2	NIL	5

128. There were 16 target species were recorded; namely curlew, kestrel, buzzard, raven, sparrowhawk, lesser black-backed gull, mallard, hen harrier, peregrine, snipe, red grouse, merlin, heron, long-eared owl, white-tailed eagle and common gull (**Table 9.41**). The sightings from all surveys were aggregated to identify territory locations of target species (**Table 9.1**) and in particular to identify curlew, red grouse, snipe and raptor territories within the core survey areas (**Figure 9.22; Figure 9.22 CONFIDENTIAL**) and published avoidance distances (Ruddock & Whitfield, 2007 ; Pearce-Higgins et al., 2009) (**Figure 9.23; Figure 9.23 CONFIDENTIAL**).

3.4.1.1. Raptor surveys

129. A breeding pair of long-eared owls were recorded breeding within the 500 m turbine buffers of both existing and proposed turbines, and no other raptors were recorded in the turbine zones. There were two pairs of buzzards breeding within the survey area and 500 m buffer (**Figure 9.22; Figure 9.22 CONFIDENTIAL)**.

130. Within the 2 km survey area buzzard (n = 9), sparrowhawk (n = 3), raven (n = 1), kestrel (n = 1), merlin (n = 1) and hen harrier (n = 1) were recorded. Similar to 2014 the pair of hen harrier failed again at this locality at egg / nestling stage and no young were recorded to fledge. Beyond 2 km, five additional buzzard territories were identified along with three kestrel territories, one merlin territory, three raven territories and three hen harrier territories and indirect evidence of peregrine occupancy at one site (**Figure 9.22 CONFIDENTIAL**).

131. During 2015 a white-tailed eagle was seen on a number of occasions to the south and north of the site boundary including within the 2 km survey buffer. The bird was recorded to have two white wings tags but no codes were observed. This colour sequence may therefore be a Scottish tagged bird (A. Mee, personal communication). The bird was a non-territory holding eagle and the hen harriers within the 2 km survey area were recorded mobbing the bird near the nesting area.

3.4.1.2. Red grouse surveys

132. Red grouse surveys within the survey area and 500 m buffer identified five red grouse territories (six in 2014). Three of these were within the 500 m buffer of the existing turbines and within the 500 m buffer of the proposed turbines (**Figures 9.22**) and two (29%) of the proposed turbines were outside the 500 m buffer of red grouse territories (**Figures 9.23 & 9.23**) whilst eight (80%) of the existing turbines were recorded within 500 m of the red grouse during 2015.

3.4.1.3. Wader surveys

133. There were no curlew within the survey area and 500 m buffer. No curlew territories recorded were recorded within 1km of either existing or proposed turbines (see Pearce-Higgins et al., 2009; **Figure 9.23**), however a curlew territory was recorded within 2km at Craiggore and was located circa 1.4 km away from the nearest proposed turbines and 1.5 km from the nearest existing turbine.

134. There were 12 snipe territories within the survey area and 500 m buffer in 2015 (17 in 2014), of which seven were within the 500 m existing turbine buffer and nine were within the 500 m proposed turbine buffer (**Figure 9.22**). There were two of the three territories beyond the 500 m turbine buffers which were within 500 m of the proposed access track. The 400 m buffer of snipe territory locations (see Pearce-Higgins et al., 2009) (**Figure 9.23**) shows that six of the ten existing turbines are within 400 m of snipe territories, whilst six of the seven proposed turbines are within the 400 m buffer of snipe territories (**Figure 9.23**). There was one additional snipe territory recorded just beyond the 500 m survey area. Snipe were recorded nesting immediately adjacent to an operational turbine (circa 25 m) and chicks were observed walking around turbine bases and tracks during surveys (**Table 9.41**).

Table 9.41 Details of breeding priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	2 km / >2 km	22	4	2015	BZ, SH, RN, HH	BZ circling over forest in display and calling BZ female. SH seen displaying with CH alarming. RN flying. HH female on site perched up and holding territory. SH and 2 RO. HC. BZ flying and displaying. SH flying and perched. 2 RN.
PSS	500 m	28	4	2015	BZ, RN, SN, RG	BZ flying. 2 RN flying. SN flew from ground. RG flew from ground. HH male displaying to north (second site), also separate pair seen near quarry
PSS	500 m	28	4	2015	BZ, RN, SN	BZ flying and calling. RN flying. SN flew. SN flew and calling.
PSS	2 km	6	5	2015	SN	SN flew north
PSS	500 m	6	5	2015	RN, BZ	RN calling. BZ flying
PSS	2 km	6	5	2015	RN, CU	RN calling over Craiggore, heard only in heavy mist. Curlew calling and displaying at Craiggore (pair)
PSS	2 km / >2 km	6	5	2015	RN, BZ, LB	9:55 RN mobbed by HC (1), foraging through clearfell. 9:57 BZ circling over Cam forest. 10:45 BZ circling over Cam forest (separate pair). 10:50 RN over vp flying west. 10:50 LB north-west over Keady. ML pair observed displaying over forest edge to north and seen perched on top of conifer edge
PSS	2 km / >2 km	13	5	2015	RN, RG, K., WE	8:50 RN heard calling E of Craiggore. 8:55 RG heard only, calling from Craiggore (usual place). 9:15 K. hunting / hovering over rough grassland along forest edge, flew into forest. 9:40 WE mobbed by HC (2) 2 white wing tags, landed on fence post, too far for binoculars to read tag codes. Flew towards windfarm. Lost then seen over Cam forest (north) from Temain road, soaring. Flew over ridge north.
PSS	2 km / >2 km	13	5	2015	BZ, RN, HH	No sign of WE. 10:05 BZ calling over ridge line. 10:15 2nd BZ seen SW of VP1, hunting over improved grassland. Watched CU habitat farmer drove through on quad and cattle present - no response. 2 RN flew from west site to mob BZ hunting and soaring. HH male observed defending territory persistently from HC (2) before hunting over moorland.
PSS	2 km	13	5	2015	RN, HC, BZ, ML	2 RN came of forest edge to mob BZ repeatedly. HC (4) foraging in field on Boyds Mountain. BZ and RN active on north side of forest. ML pair seen near K. site, copulating at forest edge
PSS	500 m	13	5	2015	LB, RG	LB seen circling. RG (x 3) small chicks also observed walking along heather ridge with adult

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	2 km / >2 km	27	5	2015	MA, RN	18:07 MA level, straight flight. 18:35 RN flying
PSS	2 km	27	5	2015	RN, HH	17:32 RN flying south. 17:48 HH male flying. 19:08 HH male from forest corner out over rough grassland
SNS / RGS	500 m	27	5	2015	SN, LE	4 SN, 2 in around turbines, SN chicks seen walking up windfarm track and around base of turbine. 2 SN calling towards Temain hill. LE pair calling and displaying flight along forest edge
PSS	500 m	27	5	2015	SN	21:55 SN chipping intermittently for 15 min at 3 - 4 minute intervals.
SNS / RGS	500 m	27	5	2015	SN	21:31 SN. 21:59 SN. 22:03 SN. 22:35 SN.
SNS / RGS	500 m	27	5	2015	SN	21:49 2 SN, 2 separate locations, 1 due west, 2nd due SE . 2 SN 1 NW and 1 SW
PSS	2 km	28	5	2015	HH, K.	7:27 - HH male flying west at northern site (nearest). K. pairs active in both quarries
PSS	500 m / 2 km / >2 km	28	5	2015	HH	Southern HH nest site active, and food passing; RN family party seen along forest edge also. Eggs likely at eastern HH site with female dropping into nest area in 2F
PSS	500 m / 2 km	4	6	2015	RN, RG, LB, BZ, SH, CU	6:30 RN flying. 6:40 RN. 7:05 RG Heard only. 7:25 RN flying. 8:05 LB flying. 8:15 CU heard only near previous display area. 8:28 RN flying. 8:45 BZ flying up high and in with prey. 8:50 LB flying through. SH activity in river gully near vp1
PSS	500 m/ 2 km	15	6	2015	LB, RN, BZ, H.,	3 LB near Ford. 2 RN near Ballycrum. BZ near Ballyavelin (two pairs with separate sites both active). H. near Terrydoo walker. BZ near Farm hill into forest. 2 LB and BZ near Gortnarney. 2 RN near Craiggore and K. at Donalds Hill
PSS	500 m	30	6	2015	RG, RN, SH, LB, BZ, SN, K.	2 RG, 1 RN, 1 RN, 1 SH, 2 RN calling, 3 LB, 1 SN alarming, 1 BZ, 2 RN, 3 RN, 1 RN, 1 RN, 1 RN, 1 K. Additional - HH male seen at 12:45 and female seen dropping into heather at quarry c 1.5h. BZ pairs with young flying on north side of valley and at Boyds Mountain
PSS	500 m / 2 km / >2 km	8	7	2015	RN, K., HH, BZ, SH	3 RN at Terrydoo walker, BZ 3y. 2 RN in and around turbines. BZ 1y Fort View Lodge, 1y Gortnarney, 2y Little Derry K. hunting near Coolnasillagh with juveniles out flying from nest site. 3 young HH fledged from southern site. Eastern site confirmed failed and never progressed beyond egg stage / early hatching. SH x 3 active in Cam Forest, WP kills found along track at southern one, BZ moved towards forest edge along looped track but failed, BZ The Sheds 3y and Kiltest 2y
PSS	2 km	28	7	2015	RN, HH	8:50 2 RN perched at forest edge, flew into forest in heavy rain. 9:45 HH female seen from Donalds hill towards nest site.
PSS	500 m/ 2 km	28	7	2015	BZ	9:57 BZ female circling to dry off between showers. 11:00 2 BZ circling together over Terrydoo Clyde, flew west, 1A and 1y from Ford site. Birds seen after vp at 11:30 worming on field together
PSS	500 m	28	7	2015	RN, SH, BZ	8:48 RN flying. 9:10 SH male with prey. 9:41 BZ hunting and 1y at Cam Forest and 2y at Keady, 2y Ballyavelin, 2y Boyds Mountain
PSS	500 m/ 2 km	28	7	2015	RN, HH, ML	8:45 RN flying. 9:45 HH female flying and hunting. ML pair seen at eastern edge of forest behind area of felled forest / male
						eating prey and plucking posts observed. May have moved from south west of here from initial pair seen copulating. No evidence of active nest
PSS	500 m	28	7	2015	K.	Checking K. sites. Cam quarry failed; Keady Mt pair 2 chicks; Craiggore 3 young; Donalds Hill 4y. No further evidence of breeding at either of the other three HH sites
PSS	2 km	6	8	2015	BZ, LB, RN, K., CM	6:35 BZ flew off over fields. 6:45 LB flying. 6:50 2 RN flying. 7:05 K. flying. 7:30 4 RN flying. 7:55 3 RN flying. 8:05 2 LB flying. 8:15 23 CM feed after slurry. 8:35 BZ flying. 9:05 LB. 9:20 2 BZ. 9:35 2 BZ. 10:05 2 BZ. 10:15 RN perched and calling
PSS	500 m	19	8	2015	CU, PE	One CU seen near Craiggore on bog, sitting on post. Probable juvenile, with shorter bill. No adults observed Plucking post and wide range of age of kills identified at southern peregrine site but no birds seen, probably single bird using area
PSS	500 m	19	8	2015	HH, RG, ML, SN	HH Male near southern turbines. RG in middle of turbines. ML in amongst the northern turbines on site. SN alarming.
PSS	500 m	31	8	2015	SN, RN, LB	SN - near Temain hill, flew SW. Dead sheep noted at 2 separate locations with RN and LB present in area
PSS	500 m	31	8	2015	SN	SN flew from ground. RG pellets
PSS	2 km	31	8	2015	HH, RN, BZ, LB	13:58 HH female perched on lone conifer then flew off. 14:10 RN. 14:30 BZ. 14:40 2 RN. 15:10 BZ. 15:35 LB.

3.5. Field Surveys 2016 – 2017

There were additional priority species surveys carried out between March 2016 to February 2017 which included a series of walkover, vantage point observations within 500 m – 2 km (and beyond 2 km for hen harrier and whooper swans) in particular focusing on breeding and wintering priority species particularly swans, geese, hen harrier, other raptors, curlew, snipe, other waders and red grouse.

3.5.1. Breeding Priority Species Surveys

135. There were 112 hours and 10 minutes spent searching adjacent habitats for priority species (**Table 9.1; Table 9.42**) with efforts concentrated on hen harrier, red grouse and waders during the breeding season. Survey times ranged between 05.10hrs to 23.05hrs and covered a wide range of weather conditions (**Table 9.42**).

Table 9.42 Details of breeding priority species searches (PSS), including survey effort, weather

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km	30	3	2016	08:25	11:25	03:00	3	600	SE	1	NIL	5
PSS	2 km	30	3	2016	11:35	14:35	03:00	5	600	SE	2	NIL	5
PSS	500 m	30	3	2016	14:35	15:35	01:00	6	600	SE	2	ILR	5
PSS	500 m	30	3	2016	08:20	11:20	03:00	3	600	SE	2	NIL	5
PSS	500 m / 2 km	30	3	2016	11:35	14:35	03:00	4	600	SE	2	NIL	5
PSS	500 m / 2 km	30	3	2016	14:35	15:35	01:00	5	600	SE	2	ILR	5
PSS	2 km	16	4	2016	06:05	08:05	02:00	6	500	N	2	ILR	3
PSS	2 km	16	4	2016	08:05	10:05	02:00	8	500	N	2	NIL	5

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	500 m/ 2 km	16	4	2016	10:05	12:05	02:00	5	500	N	2	NIL	5
RGS / PSS	500 m / 2 km	27	4	2016	14:05	22:35	08:30	5	1200	N	1	NIL	2
PSS	2 km	27	4	2016	14:15	19:15	05:00	5	800	NW	3	NIL	5
RGS / PSS	500 m	27	4	2016	19:30	22:30	03:00	6	800	NW	3	NIL	5
SNS / PSS	500 m / 2 km	10	5	2016	06:45	10:45	04:00	3	800	E	2	NIL	5
PSS	2 km / 500 m	10	5	2016	10:50	13:50	03:00	5	800	NE	3	NIL	5
SNS / PSS	500 m / 2 km	10	5	2016	06:45	10:45	04:00	4	1000	E	3	NIL	5
PSS	2 km	10	5	2016	10:45	13:45	03:00	4	1000	E	3	NIL	5
PSS	500 m	20	5	2016	05:10	09:20	04:10	4	500	SW	2	NIL	5
PSS	500 m / 2 km	20	5	2016	09:20	13:20	04:00	8	500	SW	2	NIL	5
SNS / PSS	500 m	20	5	2016	20:35	22:40	02:05	8	500	SW	2	NIL	2
SNS / PSS	500 m	31	5	2016	20:20	23:05	02:45	5	900	N	1	NIL	2
PSS	2 km	9	6	2016	06:30	09:30	03:00	10	300	SE	2	CHM	0.5
PSS	2 km	9	6	2016	09:35	12:35	03:00	10	300	SE	2	CHM	0.5
PSS	500 m / 2 km	29	6	2016	08:25	11:25	03:00	10	600	SE	2	CLR	5
PSS	2 km	29	6	2016	11:40	14:40	03:00	10	600	E	2	CLR	3
PSS	500 m	29	6	2016	08:30	11:45	03:15	10	600	SE	3	CLR	5
PSS	2 km	29	6	2016	11:45	14:45	03:00	10	600	SE	3	CLR	5
PSS	2 km	11	7	2016	08:35	11:35	03:00	8	500	NW	2	NIL	5
PSS	500 m/ 2 km	11	7	2016	11:35	14:35	03:00	10	400	NW	2	NIL	5
PSS	500 m/ 2 km	27	7	2016	11:30	15:30	04:00	10	800	W	3	ILR	5
PSS	500 m/ 2 km	27	7	2016	11:30	15:50	04:20	8	900	W	1	NIL	5
PSS	500 m/ 2 km	27	7	2016	11:30	15:30	04:00	10	800	W	3	ILR	5
PSS	2 km	11	8	2016	07:45	10:40	02:55	10	300	W	4	CHM	0.5
PSS	2 km	11	8	2016	07:30	10:40	03:10	10	300	W	4	CHM	1
PSS	2 km	23	8	2016	12:00	15:00	03:00	10	500	E	1	ILM	3.5
PSS	500 m	23	8	2016	12:00	15:00	03:00	10	450	E	1	ILM	4

136. There were 15 target species were recorded; namely buzzard, raven, snipe, herring gull, sparrowhawk, red grouse, hen harrier, peregrine, lesser black-backed gull, kestrel, heron, greater black-backed gull, black-headed gull, long-eared owl and merlin (**Table 9.43**). The sightings from all surveys were aggregated to identify territory locations of target species (**Table 9.1**) and in particular to identify curlew, red grouse, snipe and raptor territories within the core survey areas (**Figure 9.24; Figure 9.24 CONFIDENTIAL**) and to review published avoidance distances (Ruddock & Whitfield, 2007; Pearce-Higgins et al., 2009) (**Figure 9.25; Figure 9.25 CONFIDENTIAL**).

3.5.1.1. Raptor surveys

137. There was one raptor, long-eared owl, recorded breeding within the 500 m turbine buffers of both existing and proposed turbines along the forest edge adjacent to the east of the turbines. There were two pairs of buzzards and two pairs of sparrowhawk breeding within 500 m survey area (**Figures 9.24 & 9.24 CONFIDENTIAL**). One pair of ravens were recorded within the 2 km buffer and in the wider 2 km area buzzard (n = 10) and sparrowhawk (n = 2) along with two kestrel territories, one peregrine territory, one hen harrier territory and a merlin territory were recorded (**Figures 9.24 & 9.24 CONFIDENTIAL**).

138. Beyond 2 km, four additional buzzard territories were identified along with, two kestrel territories, two raven territories, one merlin territory and two hen harrier territories (**Figure 9.24 CONFIDENTIAL**). Neither of the hen harriers were successful. A single peregrine was recorded to utilise two separate locations to the north beyond 2 km (**Figure 9.24 CONFIDENTIAL**). Only one bird was present and this was confirmed by flight observations of the bird moving between the two locations and distinctive feather moult patterns (**Table 9.43**).

3.5.1.2. Red grouse surveys

139. Red grouse surveys within the survey area and 500 m buffer identified fewer territories during 2016 with only two red grouse territories recorded (6 in 2014; 5 in 2015). One of these was within the 500 m buffer of the existing turbines and two were within the 500 m buffer of the proposed turbines (**Figure 9.24**). An additional red grouse was recorded just beyond the 500 m survey area (**Figure 9.24)** and seven of the existing turbines were completely outside the 500 m buffer of red grouse territories (**Figures 9.25 & 9.25 CONFIDENTIAL**) whilst four of the proposed turbines were recorded within 500 m of the red grouse during 2016.

3.5.1.3. Wader surveys

140. There were no curlew within the survey area, 500 m buffer or 800 m buffer (**Figure 9.24**). There were no curlew recorded within the 2 km survey area during 2016 although a single sighting in March 2017 was recorded to the east at approximately 5 - 6 km away

141. There were 10 snipe territories within the survey area and 500 m buffer in 2016 (12 in 2014; 17 in 2015), of which nine were within the 500 m existing turbine and 10 were recorded within the 500 m proposed turbine buffer (**Figure 9.24**). The 400 m buffer of snipe territory locations (see Pearce-Higgins et al., 2009) (**Figure 9.25**) shows that the all ten existing turbines and all seven proposed turbines are within 400 m of snipe territories (**Figure 9.25**).

Table 9.43 Details of breeding priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species Detected	Notes
PSS	2 km	30	3	2016	SH, BZ	9:02 SH perched in tree at side of forest then took off into forest. 9:39 SH female being mobbed by 2 HC, then started to circle and gain height. 10:26 BZ pair of BZ circling then moved to forest and landed in tree, the pair mated, then one took off and the other followed shortly after. 10:51 BZ. HH male seen displaying over valley and quarry
PSS	2 km	30	3	2016	RN, HH	12:13 RN flying. HH pair at southern site observed separately but nearby to south-west of previous nest site. Male hunting and female perched up
PSS	500 m	30	3	2016	RN, PE	14:51 2 RN flying together, stayed in circled area for about 20 min before heading towards Giants Mill and PE seen there circling over cliff mobbed by RN
PSS	500 m	30	3	2016	CU, K., ML, BZ	CU on way to site (>5 km), K. male hunting over Temain hill - Craiggore. ML flying along western slope below turbines, flew up into windfarm and on to southern edge of

Survey Type	Search Area	Day	Month	Year	Species Detected	Notes
						forest calling and chipping. Second bird heard also but not seen. BZ female flying, perching over corner of forest, perched in same tree on southern side. New hardstanding 150 m from possible nest site.
PSS	500 m / 2 km	30	3	2016	HH	HH male and female. Male flew over forest towards nest site, female seen briefly flying in to join him from moorland. No CU, RG or SN detected. Corvid numbers seem lower than last year.
PSS	500 m / 2 km	30	3	2016	BZ, RN	BZ female flying from telegraph pole in farmers lane, circled over nest site in deciduous planting. 2 RN flying west of main site.
PSS	2 km	16	4	2016	RN	RN flew over road into forest. K. active in both quarries to the north
PSS	2 km	16	4	2016	K.	K. south of Craiggore and separate pair hovering and circling over Donald's Pot
PSS	500 m/ 2 km	16	4	2016	RN, BZ	2 RN flying between Rigged hill and Temain hill. RN flying west of Terrydoo walker. BZ between Tirmaquin and Ford.
RGS / PSS	500 m / 2 km	27	4	2016	RN, SH, SN, RG, LE, HH	1 RG and 1 SN south of turbines towards Temain hill. 2 RN and 1 SH west of turbines near Aghansillagh. 6 SN, 1 RG, 1 male HH (foraging) and 1 LE (displaying and calling) in and around turbines.
PSS	2 km	27	4	2016	SN, BZ, HH	SN alarming Rigged Hill. Male BZ no calling/ alarming. 2 BZ flying together. Female HH lost in sun, displayed at >1000m. Seen again displaying, mobbed by RN (2). Displayed from northern site along valley at Ballycrum along route of powerlines and observed heading towards same site as per 2015
RGS / PSS	500 m	27	4	2016	SN	No RG heard calling, SN calling near turbines x 3
SNS / PSS	500 m / 2 km	10	5	2016	SN, RN	8:10 SN. 9:20 RN. 10:10 SN heard only. 10:45 2 RN.
PSS	2 km / 500 m	10	5	2016	HH, RN	11:05 HH male carrying prey towards nest site. 12:01 HH female seen carrying nest material towards 2F area 12:35 RN.
SNS / PSS	500 m / 2 km	10	5	2016	SN	SN at Donald's hill calling, two separate chipping and calling birds
PSS	2 km	10	5	2016	HH, BZ	HH male hunting near Evish. BZ near Crockanboy.
PSS	500 m	20	5	2016	RN,SN,LB	8:55 RN flying. 9:05 SN flying low level. 9:20 3 LB flying.
PSS	500 m / 2 km	20	5	2016	BZ, RN, SH, LB	9:35 BZ flying. 10:15 RN flying. 11:10 SH male flying. 11:25 2 BZ flying and display at height. 11:40 SH male flying in towards previous nest area. 12:10 5 LB flying through.
SNS / PSS	500 m	20	5	2016	SN	SN x 5 chipping, drumming and bleating 21:08; 21:17; 21:19; 21:45; 22:03; 22:19. No RG heard
SNS / PSS	500 m	31	5	2016	SN	No RG heard calling, SN near turbines in distance but none on lower slopes in previous locations
PSS	2 km	9	6	2016	None	
PSS	2 km	9	6	2016	PE	Sub-adult PE seen in quarry along with 4-5 old JD kills and 1 MG
PSS	500 m / 2 km	29	6	2016	SH	8:25 SH male perched up near nest site and CD plucking post nearby. No activity at HH site
PSS	2 km	29	6	2016	RN, SN	11:55 RN flying. 12:15 3 RN flying. 13:20 SN flew from ground. 14:05 SN disturbed by sheep. 14:05 SN flying and calling. 14:35 2 RN.
PSS	500 m	29	6	2016	SN, RN, SH	RG pellets found at Temain. 3 RN in and around southern turbines. 3 SN in middle of windfarm. 2 RN towards northern turbines. Male SH in Cam forest.
PSS	2 km	29	6	2016	None	No HH activity at nest site. Appears to have failed. PE seen in quarry with broken tail feather - perched and flew north
PSS	2 km	11	7	2016	RN, K., SN	9:05 3 RN flying. 9:15 RN flying. 10:20 SN heard only on ground. 10:55 3 SN flew from ground and calling (2 birds). 11:05 K. flying and hunting. 11:10 RN flying
PSS	500 m/ 2 km	11	7	2016	RN, LB, H., BZ	11:40 RN flying. 11:50 4 LB. 12:05 H.. 12:50 RN. 13:10 3 BZ. 13:25. 2 RN.
PSS	500 m/ 2 km	27	7	2016	BZ, RN	RN west of Temain hill. RN flew into forest at Tibaran Mountain. RN flew onto forest north of Rigged hill. BZ flying around forest north of Rigged hill. RN flew out of forest north of Rigged hill. BZ flying around Terrydoo Walker. K. 2 young fledged at quarry
PSS	500 m/ 2 km	27	7	2016	BZ, LB, GB, BH, HG, RN, PE	RN (2 juveniles) north of Keady. BZ + 1 juvenile at Keady. BZ + 2 juveniles at Cam forest. 5 LB, 108 GB, 51 BH, 6 HG north of Terrydoo walker. BZ + 2 juveniles east of Terrydoo walker. RN (+19HC) south of Terrydoo walker. BZ + 2 juveniles at Little Derry. PE seen flying out of quarry in direction of eastern quarry (broken tail feather as per previous)
PSS	500 m/ 2 km	27	7	2016	LB, BZ, RN	15 LB to the south east of Ford. BZ 2 juveniles + female at Terrydoo Walker. 2 RN at Rigged hill. RN east of Temain hill.
PSS	2 km	11	8	2016	RN, SN	08:50 RN heard only. 10:05 SN heard only.
PSS	2 km	11	8	2016	None	
PSS	2 km	23	8	2016	RN	13:05 RN heard only.
PSS	500 m	23	8	2016	RN	RN calling near turbines.

3.5.2. Wintering Priority Species Surveys 2016 - 2017

142. During the winter of 2016 to 2017 (September 2016 to February 2017) there were 76 hours and 40 minutes spent searching adjacent habitats within the survey areas (**Figure 9.1**) for priority species (**Table 9.1; Table 9.44**) with efforts concentrated on hen harrier wintering sites, and whooper swan during the wintering season. Survey times ranged between 06.35hrs to 17.05hrs and covered a wide range of weather conditions (**Table 9.44**).

Table 9.44 Details of wintering priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	500 m / 2 km	2	9	2016	06:35	09:35	03:00	10	600	SW	2	ILR	5
PSS	2 km	13	9	2016	13:10	16:10	03:00	7	900	NE	2	NIL	5
PSS	500 m / 2 km	30	9	2016	11:35	14:00	02:25	7	600	W	3	NIL	5
PSS	2 km	30	9	2016	11:30	14:00	02:30	7	500	W	3	NIL	5
PSS	500 m / 2 km	30	9	2016	11:25	14:00	02:35	8	700	W	3	NIL	5
PSS	500 m / 2 km	11	10	2016	10:35	13:35	03:00	8	800	E	3	NIL	5
WRS / PSS	2 km	17	10	2016	07:05	10:55	03:50	8	800	SW	3	ILR	3
PSS	2 km	25	10	2016	08:35	11:15	02:40	2	350	SE	2	NIL	5
PSS	2 km / >2 km	25	10	2016	08:25	11:15	02:50	2	350	SE	2	NIL	5
PSS	500 m / 2 km	9	11	2016	10:35	13:35	03:00	8	500	SW	2	NIL	5
PSS	2 km / >2 km	22	11	2016	08:10	11:10	03:00	6	500	NW	4	NIL	5
PSS	500 m / 2 km	22	11	2016	08:10	11:10	03:00	6	500	NW	4	NIL	5
PSS	2 km	29	11	2016	07:15	10:05	02:50	10	800	SW	2	NIL	5
WRS / PSS	500 m / 2 km / >2 km	15	12	2016	13:40	17:05	03:25	6	600	SE	2	NIL	5
PSS	2 km	23	12	2016	08:45	11:45	03:00	10	400	SW	3	NIL	5
PSS	500 m / 2 km	23	12	2016	11:45	14:45	03:00	8	400	W	5	ILR	5
PSS	2 km	30	12	2016	08:20	10:30	02:10	10	800	SW	3	ILM	3.5
PSS	500 m	30	12	2016	10:40	12:20	01:40	10	600	SW	5	NIL	5
PSS	2 km / >2 km	4	1	2017	07:20	09:40	02:20	10	500	N	1	NIL	5
PSS	500 m / 2 km	4	1	2017	09:40	11:40	02:00	8	500	N	1	NIL	5
PSS	500 m / 2 km	17	1	2017	10:20	13:30	03:10	10	400	SW	2	ILM	2
WRS / PSS	2 km / >2 km	25	1	2017	08:10	11:15	03:05	6	500	S	4	NIL	5
PSS	500 m	25	1	2017	08:15	11:15	03:00	6	500	S	4	NIL	5
PSS	500 m / 2 km / >2 km	2	2	2017	11:15	14:15	03:00	10	400	SE	3	ILR	1.5
WRS / PSS	2 km / >2 km	17	2	2017	06:35	08:15	01:40	5	800	N	1	NIL	2
PSS	2 km	17	2	2017	08:15	11:15	03:00	5	800	N	1	NIL	5
PSS	500 m / 2 km	17	2	2017	11:15	12:45	01:30	5	800	S	2	NIL	
PSS	2 km	25	2	2017	09:25	12:25	03:00	10	500	SW	3	NIL	5

143. There were 14 target species recorded; namely raven, hen harrier, golden plover, snipe, buzzard, red grouse, sparrowhawk, heron, whooper swan, peregrine, woodcock, lesser black-backed gull, common gull and kestrel (**Table 9.45**).

144. The sightings from all surveys were aggregated to identify key wintering locations of target species (**Table 9.1**) and in particular to identify hen harrier and whooper swan locations within the survey area and 500 m buffer (**Figure 9.26; Figure 9.26 CONFIDENTIAL**).

145. Wintering priority species were recorded widely within 2 km including buzzard, sparrowhawk and kestrel in various locations (**Figure 9.26**) including near known breeding locations (**Figure 9.24**). Woodcock were recorded along forest tracks / edges at a number of localities and on moorland to the south of Cam Forest. Snipe were recorded in a wide range of grassland / moorland areas within the Site, 500 m survey area and in the 2 km survey area. Gulls were typically associated with agricultural activity (e.g. ploughing, spreading) the wider area and any aggregations and movements to / from such features were evident. Ravens were recorded roosting in Cam Forest south of Tibaran Mt and east of Freugh, and roosts have relocated since the 2014 – 2015 surveys and since various mature conifer blocks have been clear-felled.

146. There was a group of nine whooper swans recorded flying north to south to the west of the site within 5 km during October migration (**Table 9.45**; **Figures 9.26**). There were no other flights or wintering roost / foraging areas recorded, and the birds were only recorded on a single occasion, with no flights detected or recorded near, towards, or transecting the Site despite extensive survey effort and coverage within 5 km.

147. Hen harriers were again recorded roosting at previously identified localities although using a range of different locations on different evenings / mornings (**Figure 9.26 & 9.26 CONFIDENTIAL**) as well as observed passing though and nearby forest sites and near known nesting sites. A maximum of three birds was recorded in the roost areas to the south and these utilised varying spatial locations, as identified, and a maximum of a single bird (female) was recorded in the roost site to the north (**Table 9.45**).

Table 9.45 Details of wintering priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	500 m / 2 km	2	9	2016	LB, H., RN, SH, K., BZ	6:50 5 LB flying. 7:05 LB flying. 7:25 H. flying. 7:55 2 RN over disused quarry flying. 8:14 SH mobbed by 2 rooks flying. 8:17 LB flying. 8:37 K. flying hover hunting. 8:55 flying. 9:05 2 RN flying.
PSS	2 km	13	9	2016	HH, RN	HH female seen near nest area; RN (19) seen heading towards previous roost area, but now located further south since felling taken place
PSS	500 m / 2 km	30	9	2016	RN, GP, SN	RN flew from and back to forest on south side of Tibaran mountain. 15 GP flying around Temain hill towards Donald's hill. SN flushed by tractors cutting
PSS	2 km	30	9	2016	RG, GP	12:46 RG flushed it. 13:54 6 GP.
PSS	500 m / 2 km	30	9	2016	K., RN, BZ, LB	12:55 K., 13:05 RN, 13:10 RN at Temain hill. RN mobbed BZ. 5 RN, 2 landed on fence. BZ mobbed by S around Aghansillagh. 3 LB west of Fort View Lodge.
PSS	500 m / 2 km	11	10	2016	LB, H., RN, BZ	LB at Lislane bridge. H. Little Derry. 3 RN between Temain hill and Rigged hill. RN near St Loury's Well. 2 BZ north of Keady.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
WRS / PSS	2 km	17	10	2016	HH, RN	Adult male HH from southern roost site on juncus / rush area; RN (17) out from roost at Tibaran - near BZ / SH breeding sites
PSS	2 km	25	10	2016	WS	9 WS seen in flight (as below), no WS in 2 km zone, and northern part of 5 km zone
PSS	2 km / >2 km	25	10	2016	RN, PE, HH, WS	RN flying north of Keady. PE flying near Cam forest. HH male. HH male seen again half a kilometre from first sighting. WS (9) in flight @ > 150m heading south
PSS	500 m / 2 km	9	11	2016	RN, BZ, SH, LB, CM, K.	RN flying near Keady. BZ flew to Cam forest. RN flying near Boyds mountain. SH male at Terrydoo walker. 3 LB and 6 CM east of Drumgesh in field. 3 RN at Temain hill. K. at Craiggore. BZ near Wood Burn. 2 RN south of Gortnarney.
PSS	2 km / >2 km	22	11	2016	None	No WS in north and eastern parts of 5 km zone
PSS	500 m / 2 km	22	11	2016	RN, SN, RG	2 RN between Temain hill and Gortnarney. SN at Rigged hill. RN flying out from and into Cam forest. SN at Temain hiill. 2 RG east of Temain hill. SN fox kill found.
PSS	2 km	29	11	2016	H., SH, RN, WK, BZ, SN, HH	H. flying east across Ballycrum. SH female south west of Ballycrum. 2 RN south of Ballycrum. WK west of Meencraig. BZ and WK north of Tibaran mountain. HH male foraging east of Baran. 4 RN and SN south of Tibaran mountain.
WRS / PSS	500 m / 2 km / >2 km	15	12	2016	RN, BZ, SH, LB, HH	RN at Keady, BZ at Cam forest. SH female at Terrydoo walker. 6 LB south of Lislane bridge. BZ south west of Cloghan. RN at Gortnarney. 5 RN between Rigged hill and Temain hill. RN at Coolnasillagh. BZ at Coolnasillagh bridge. Adult male HH (1) and ringtal (1) at roost sites (separately) 16:34; 16:49.
PSS	2 km	23	12	2016	SN, RG, RN	3 SN, 1 RG and 5 RN between Temain hill and Donald's hill.
PSS	500 m / 2 km	23	12	2016	BZ, RN	BZ at Wood Burn. BZ at Glenkeen. 2 RN at Cam forest.
PSS	2 km	30	12	2016	BZ, SH	BZ and SH south Tibaran mountain.
PSS	500 m	30	12	2016	BZ, RG, RN, SN	BZ east of Terrydoo Walker. RN north of Tibaran mountain. 2 RG and 2 SN in and around or near turbines. 3 RN south of Rigged hill. RG to the north east of Temain hill.
PSS	2 km / >2 km	4	1	2017	None	No WS in 5 km zone. Dawn watch from Keady Mt for WS movements. None seen
PSS	500 m / 2 km	4	1	2017	None	No WS in 2 km zone
PSS	500 m / 2 km	17	1	2017	K., RN, SH, LB, H.	K. at Craiggore. 3 RN at Rigged hill (2+1). SH female just north of Terrydoo walker. H. north of St Loury's well. LB at Drumgesh.
WRS / PSS	2 km / >2 km	25	1	2017	None	07:41 HH female lifted from northern roost. No WS in 5 km zone
PSS	500 m	25	1	2017	SN, RN	2 RN flying on western side of Rigged hill. SN around northern turbines. SN south side of Rigged hill.
PSS	500 m / 2 km / >2 km	2	2	2017	RN, LB, BZ, SH,	BZ and RN around Cam forest north of site. 4 LB at Terrydoo Clyde. 2 RN at Cloghan. 3 RN at Temain hill (2+1). 2 RN and
						female SH south of Tibaran mountain. BZ and 2 RN mobbing a SH on the east side of the main Cam forest.
WRS / PSS	2 km / >2 km	17	2	2017	HH, RN	HH male (2) and female (1) lifted from southern roost sites. Males @ 07:04 & 07:07 female @ 07:37. RN 14 from roost in forest
PSS	2 km	17	2	2017	None	No WS in 5 km zone
PSS	500 m / 2 km	17	2	2017	None	No WS in 500 m / 2 km zone
PSS	2 km	25	2	2017	SN, RN, BZ, RG	Between Temain hill and Donald's hill, 9 SN flush or seen, 3 RN seen, 5 RG seen. 2 RN north of Temain hill. SN east of Temain hill. BZ at Evish.
PSS	500 m / 2 km	2	9	2016	LB, H., RN, SH, K., BZ	6:50 5 LB flying. 7:05 LB flying. 7:25 H. flying. 7:55 2 RN over disused quarry flying. 8:14 SH mobbed by 2 rooks flying. 8:17 LB flying. 8:37 K. flying hover hunting. 8:55 flying. 9:05 2 RN flying.
PSS	2 km	13	9	2016	HH, RN	HH female seen near nest area; RN (19) seen heading towards previous roost area, but now located further south since felling taken place
PSS	500 m / 2 km	30	9	2016	RN, GP, SN	RN flew from and back to forest on south side of Tibaran mountain. 15 GP flying around Temain hill towards Donalds hill. SN flushed by tractors cutting

3.6. Field Surveys 2018 – 2019

3.6.1. Breeding Bird Surveys

148. Breeding season transect surveys were carried out between during April 2018 and August 2018 (**Table 9.46**). There were 92 hours and 20 minutes undertaken in transect surveys covering both the survey area and 500 m buffer for all species and priority species (curlew) within the 800 m buffer (see also Section 9.3.6.1). All parts of the survey area were accessible (**Figure 9.7**) for walkover surveys and there were not considered to be any constraints to species detection. Survey times ranged from 04.15 hrs to 19.25 hrs (**Table 9.46**) and covered a wide range of weather conditions (**Table 9.46**).

Table 9.46 Summary of survey effort and weather during breeding bird surveys

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
04	9	2018	CS	12:40	13:45	01:05	10	500	SE3	ILR	5
04	19	2018	MR	16:20	19:25	03:05	5	700	SE2	NIL	>2
04	21	2018	MR	04:45	12:50	08:05	3	>1500	S1	NIL	>2
04	22	2018	MR	04:15	12:05	07:50	3	>1000	S1	NIL	>2
04	24	2018	DR	12:40	14:40	02:00	10	800	SW3	NIL	5
04	29	2018	DR	08:20	10:50	02:30	8	800	NE2	NIL	5
05	22	2018	DR	12:50	15:50	03:00	10	500	NE2	NIL	5
05	28	2018	DR	13:10	16:20	03:10	2	800	E1	NIL	5
05	29	2018	CS	11:00	18:00	07:00	2	700	E3	NIL	5
05	30	2018	CS	08:40	14:40	06:00	3	700	N3	NIL	5
06	27	2018	DR	07:05	09:05	02:00	4	>1000	SE1	NIL	5
06	27	2018	MR	06:55	16:00	09:05	4	>1000	SE1	NIL	5

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
06	27	2018	KM	10:00	16:15	06:15	1	2000	NIL	NIL	20
06	27	2018	DR	12:15	16:15	04:00	10	700	W2	NIL	5
07	22	2018	DR	05:35	11:00	05:25	9	700	SW2	NIL	5
07	26	2018	KM	09:30	15:30	06:00	5	2000	SE4	NIL	20
07	31	2018	KM	08:00	14:45	06:45	10	1000	S4	NIL	20
08	21	2018	DR	09:35	12:55	03:20	10	400	SW2	NIL	5
08	30	2018	KM	09:45	15:30	05:45	9	1000	SW2	NIL	30

149. There were 54 species recorded (**Table 9.47**) within the survey area and 500 m buffer (**Figure 9.1**) of which only five were red-listed species in Ireland (grey wagtail; golden plover; herring gull; meadow pipit and red grouse (Colhoun & Cummins, 2013) and 13 UK red-listed species (Eaton et al., 2014; cuckoo; grasshopper warbler; grey wagtail; herring gull; hen harrier; house sparrow; linnet; lesser redpoll; mistle thrush; skylark; starling; song thrush; and tree sparrow).

150. There were fewer species (n = 27) recorded within the existing 500 m turbine buffer (**Table 9.48**) including two red-listed species (Colhoun & Cummins, 2013; golden plover and meadow pipit) and five UK red-listed species (Eaton et al., 2014; grasshopper warbler; hen harrier; lesser redpoll, mistle thrush and skylark). There were 29 species recorded within the proposed 500 m turbine buffer (**Table 9.49**) including two red-listed species (Colhoun & Cummins, 2013; golden plover and meadow pipit) and five UK red-listed species (Eaton et al., 2014; grasshopper warbler; hen harrier; lesser redpoll, mistle thrush; skylark and song thrush).

151. Behavioural analysis for all the species within the survey area and 500 m buffer indicates that there were 43 extant species recorded and/or exhibiting breeding behaviours. There were 23 confirmed breeding species and another 22 probable and three possible breeding species respectively (**Table 9.47**; **Figures 9.27; 9.28 & 9.29**). There were fewer confirmed breeding species in the existing (n = 3) and proposed (n = 6) 500 m turbine buffers; and an additional 20 and 18 respectively probable and one and two possible breeding species respectively.

152. Meadow pipits and skylarks were widespread across parts of the survey area and 500 m buffer (**Figure 9.30**) and the habitat associations of these species were evident from the distribution with a scarcity in areas of improved pasture and / or afforested habitats and wider presence on the semi-improved / semi-natural habitats (**Figure 9.31**). Occasional pairs were recorded in longer vegetation in some parts of the improved pasture network.

153. Analyses of breeding bird transect surveys for waders indicates that there was evidence of three to six snipe territories within the survey area and 500 m buffer of which two were located within either the 500 m existing or 500 m proposed turbine buffers; one was inside the proposed turbine buffer only and the remainder were outside either turbine buffers. Additional territories were detected during other surveys (Sections 9.3.6.1) where cumulative analyses are undertaken.

154. There were no curlew territories inside the survey area and 500 m buffer and no territories were recorded within the 800 m buffer, either, during 2018 although curlew were recorded in the wider 2 km buffer. Curlew were more than 1km from any existing or proposed turbines but wider cumulative curlew (and other priority species) analyses are undertaken later (Section 9.3.6.1).

155. There was a single red grouse territory recorded during breeding bird surveys within the survey area and 500 m buffer but further priority species surveys were undertaken to identify the full distribution and abundance of these species in the survey areas (see **Section 9.3.6.1**). The one territory detected during walkover surveys was beyond 500 m of existing turbines and beyond 500 m of the proposed turbines.

156. Walkover data identified one to two pairs of sparrowhawks, two buzzard territories and three raven territories were recorded within the survey area and 500 m buffer.

Table 9.47 – Summary of numbers of territories of each species detected during breeding bird surveys inside the survey area and 500 m buffer including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
B.	3	19	5		27	GREEN	GREEN
BC		4			4	GREEN	GREEN
BT		39			39	GREEN	GREEN
BZ	2				2	GREEN	GREEN
CC		2			2	GREEN	GREEN
CD	3	1			4	GREEN	GREEN
CH	3	117	3		123	GREEN	GREEN
CK		1			1	GREEN	RED
CM				2	2	AMBER	AMBER
CT		31	1		32	GREEN	GREEN
D.		12			12	GREEN	AMBER
FP		1			1	GREEN	GREEN
GC	1	10			11	AMBER	GREEN
GH		2			2	GREEN	RED
GL			1		1	RED	RED
GO		4	1		5	GREEN	GREEN
GP				2	2	RED	GREEN
GR		9			9	AMBER	GREEN
GT		11			11	GREEN	GREEN
HC	8	8			16	GREEN	GREEN
HG				1	1	RED	RED
HH				2	2	AMBER	RED
HM	1	6			7	AMBER	AMBER
HS	5	9			14	AMBER	RED
J.			2		2	GREEN	GREEN
JD	5	17	8	4	34	GREEN	GREEN
K.				1	1	AMBER	AMBER
LB				5	5	AMBER	AMBER
LI	1	10			11	AMBER	RED
LR	2	7	3		12	GREEN	RED
LT		2			2	GREEN	GREEN
M.	3	11	5		19	AMBER	RED
MG	7	5	5	1	18	GREEN	GREEN
MP	29	274	9		312	RED	AMBER
PH		9			9	GREEN	GREEN

Species	Confirmed	Probable	Possible	Non-breeding	TOTAL	BOCCI3	BOCC4
PW	1	5	4		10	GREEN	GREEN
R.		86	8		94	AMBER	GREEN
RB	1	1			2	GREEN	AMBER
RG			1		1	RED	AMBER
RN	3				3	GREEN	GREEN
RO		15	7		22	GREEN	GREEN
S.	1	61	1		63	AMBER	RED
SC		10	4		14	AMBER	GREEN
SG	3	15	7	8	33	AMBER	RED
SH		1	1		2	AMBER	GREEN
SK		8			8	GREEN	GREEN
SL	2	10	13	11	36	AMBER	GREEN
SN		3	3		6	AMBER	AMBER
ST		9	2		11	GREEN	RED
TS		1			1	AMBER	RED
W.		1	3		4	AMBER	GREEN
WP	4	12	13	1	30	GREEN	GREEN
WR	3	84	3		90	GREEN	GREEN
WW	1	42			43	GREEN	AMBER
Total	92	985	113	38	1228		

Table 9.48 – Summary of numbers of territories of each species detected during breeding bird surveys inside the existing 500 m turbine area including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	Total	BOCCI3	BOCC4
B.		1			1	GREEN	GREEN
BC		1			1	GREEN	GREEN
BT		11			11	GREEN	GREEN
CH	1	28			29	GREEN	GREEN
CT		13			13	GREEN	GREEN
GC		3			3	AMBER	GREEN
GH		1			1	GREEN	RED
GO		1			1	GREEN	GREEN
GP				1	1	RED	GREEN
GR		1			1	AMBER	GREEN
GT		3			3	GREEN	GREEN
HC	1	1			2	GREEN	GREEN
HH				1	1	AMBER	RED
J.			1		1	GREEN	GREEN
LR		2	3		5	GREEN	RED
M.		2	1		3	AMBER	RED
MP	14	103	2		119	RED	AMBER
R.		12	1		13	AMBER	GREEN
RB		1			1	GREEN	AMBER
S.		17	1		18	AMBER	RED
SC		3			3	AMBER	GREEN
SK		3			3	GREEN	GREEN
SL				2	2	AMBER	GREEN
SN		2			2	AMBER	AMBER
WP		3	1		4	GREEN	GREEN
WR		9			9	GREEN	GREEN
WW		3			3	GREEN	AMBER
Total	16	224	10	4	254		

Table 9.49 – Summary of numbers of territories of each species detected during breeding bird surveys inside the proposed 500 m turbine area including conservation status

Species	Confirmed	Probable	Possible	Non-breeding	Total	BOCCI3	BOCC4
B.		3			3	GREEN	GREEN
BC		1			1	GREEN	GREEN
BT		14			14	GREEN	GREEN
CH	1	41			42	GREEN	GREEN
CT		17			17	GREEN	GREEN
GC		7			7	AMBER	GREEN
GH		1			1	GREEN	RED
GO		1	1		2	GREEN	GREEN
GP				1	1	RED	GREEN
GR		5			5	AMBER	GREEN
GT		4			4	GREEN	GREEN
HC	1	1			2	GREEN	GREEN
HH				1	1	AMBER	RED
J.			1		1	GREEN	GREEN
LR	1	2	3		6	GREEN	RED
M.	1	1	2		4	AMBER	RED
MP	17	140	6		163	RED	AMBER
R.		15	1		16	AMBER	GREEN
RB	1	1			2	GREEN	AMBER
S.		30	1		31	AMBER	RED
SC		3	1		4	AMBER	GREEN
SH			1		1	AMBER	GREEN

Species	Confirmed	Probable	Possible	Non-breeding	Total	BOCCI3	BOCC4
SK		5			5	GREEN	GREEN
SL				5	5	AMBER	GREEN
SN		2	1		3	AMBER	AMBER
ST		3			3	GREEN	RED
WP		4	2		6	GREEN	GREEN
WR		13			13	GREEN	GREEN
WW		3			3	GREEN	AMBER
Total	22	317	20	7	366		

3.6.1.1. Comparison of breeding bird surveys between 2014 and 2018

There was some evidence of change in detections between survey years 2014 to 2018 (**Table 9.50**) although broadly a similar suite and abundance of species were recorded between years. Some species increased between years whilst others declined. Meadow pipit were the most dominant species between years although these numbers have changed by circa 27% between years whilst skylark declined considerably between survey years.

Table 9.50 – Summary of numbers of territories of each species detected during breeding bird surveys inside the survey area and 500 m buffer including conservation status showing change between surveys 2014 - 2018

Species	2014	2018	Change 2014 - 2018	Percentage change %	BOCCI3	BOCC4
B.	42	27	15	55.6	GREEN	GREEN
BC	7	4	3	75.0	GREEN	GREEN
BF	2	0	2	-100.0	GREEN	AMBER
BT	23	39	-16	-41.0	GREEN	GREEN
BZ	15	2	13	650.0	GREEN	GREEN
CC	1	2	-1	-50.0	GREEN	GREEN
CD	6	4	2	50.0	GREEN	GREEN
CH	184	123	61	49.6	GREEN	GREEN
CK	3	1	2	200.0	GREEN	RED
CM	0	2	-2	-100.0	AMBER	AMBER
CR	1	0	1	-100.0	GREEN	GREEN
CT	36	32	4	12.5	GREEN	GREEN
D.	30	12	18	150.0	GREEN	AMBER
FP	1	1	0	0.0	GREEN	GREEN
GC	45	11	34	309.1	AMBER	GREEN
GH	4	2	2	100.0	GREEN	RED
GL	6	1	5	500.0	RED	RED
GO	12	5	7	140.0	GREEN	GREEN
GP	0	2	-2	-100.0	RED	GREEN
GR	4	9	-5	-55.6	AMBER	GREEN
GT	17	11	6	54.5	GREEN	GREEN
HC	11	16	-5	-31.3	GREEN	GREEN
HG	0	1	-1	-100.0	RED	RED
HH	1	2	-1	-50.0	AMBER	RED
HM	24	7	17	242.9	AMBER	AMBER
HS	27	14	13	92.9	AMBER	RED
J.	2	2	0	0.0	GREEN	GREEN
JD	27	34	-7	-20.6	GREEN	GREEN
K.	2	1	1	100.0	AMBER	AMBER
LB	4	5	-1	-20.0	AMBER	AMBER
LI	24	11	13	118.2	AMBER	RED
LR	3	12	-9	-75.0	GREEN	RED
LT	2	2	0	0.0	GREEN	GREEN
M.	14	19	-5	-26.3	AMBER	RED
MG	26	18	8	44.4	GREEN	GREEN
ML	1	0	1	-100.0	AMBER	RED
MP	397	312	85	27.2	RED	AMBER
PE	7	0	7	-100.0	GREEN	GREEN
PH	0	9	-9	-100.0	GREEN	GREEN
PW	23	10	13	130.0	GREEN	GREEN
R.	108	94	14	14.9	AMBER	GREEN
RB	12	2	10	500.0	GREEN	AMBER
RG	1	1	0	0.0	RED	AMBER
RN	33	3	30	1000.0	GREEN	GREEN
RO	14	22	-8	-36.4	GREEN	GREEN
S.	194	63	131	207.9	AMBER	RED
SC	5	14	-9	-64.3	AMBER	GREEN
SG	32	33	-1	-3.0	AMBER	RED
SH	0	2	-2	-100.0	AMBER	GREEN
SI	1	0	1	-100.0	AMBER	AMBER
SK	3	8	-5	-62.5	GREEN	GREEN
SL	29	36	-7	-19.4	AMBER	GREEN
SN	12	6	6	100.0	AMBER	AMBER
ST	23	11	12	109.1	GREEN	RED
SW	1	0	1	-100.0	GREEN	GREEN
TS	1	1	0	0.0	AMBER	RED
W.	3	4	-1	-25.0	AMBER	GREEN
WP	34	30	4	13.3	GREEN	GREEN
WR	139	90	49	54.4	GREEN	GREEN

Species	2014	2018	Change 2014 - 2018	Percentage change %	BOCCI3	BOCC4
WW	76	43	33	76.7	GREEN	AMBER

3.6.2. Wintering Bird Surveys

157. Wintering season transect surveys were carried out between September 2018 and March 2019 inclusive (**Table 9.51**). There were 46 hours and 10 minutes completed in wintering walkover surveys. Survey times ranged from 07.30 hrs to 16.30 hrs (**Table 9.51**) and covered a wide range of weather conditions (**Table 9.51**).

Table 9.51 Summary of survey effort and weather during wintering bird surveys

Month	Day	Year	Obs	Start	End	Dur	Cloud Cover	Cloud Height (m)	Wind - Dir & Speed	Precip	Vis (km)
09	6	2018	MR	07:30	13:30	06:00	8	900	NW2	ILS	5
09	25	2018	KM	12:30	16:30	04:00	10	500	SW4	NIL	30
10	11	2018	KM	08:00	09:30	01:30	10	500	SE2	NIL	10
10	11	2018	KM	12:30	14:00	01:30	8	1000	S3	NIL	15
10	18	2018	KM	09:10	10:10	01:00	4	1000	SSW1	NIL	30
10	18	2018	KM	13:10	15:10	02:00	8	600	SSW3	NIL	40
10	19	2018	DR	12:20	13:50	01:30	5	900	SW2	NIL	5
10	26	2018	DR	11:50	12:50	01:00	5	800	NW3	NIL	5
11	19	2018	CS	13:20	14:20	01:00	10	800	E3	NIL	5
11	30	2018	CS	12:00	16:00	04:00	10	500	W5	IHR	5
12	13	2018	KM	09:50	11:30	01:40	10	1000	SE4	ILR	10
12	13	2018	KM	14:30	15:50	01:20	10	1000	SE5	ILR	10
12	17	2018	CS	11:50	14:00	02:10	10	500	E3	NIL	5
01	10	2019	KM	09:30	10:30	01:00	10	2000	NW2	NIL	30
01	10	2019	KM	13:30	14:00	00:30	10	2000	W3	NIL	30
01	15	2019	KM	09:15	13:15	04:00	10	1000	SW2	NIL	30
01	24	2019	KM	09:30	11:00	01:30	10	350	NIL	ILR	2
01	24	2019	KM	14:00	15:30	01:30	10	350	SW2	NIL	2
02	6	2019	KM	09:15	11:15	02:00	9	2000	S3	NIL	20
02	6	2019	KM	14:15	15:15	01:00	6	1000	S5	NIL	30
02	27	2019	KM	09:15	11:15	02:00	1	2000	W2	NIL	5
02	27	2019	KM	14:15	15:15	01:00	4	2000	E2	NIL	5
03	12	2019	DR	09:00	12:00	03:00	10	1000	SSE3	NIL	10

158. There were 1,111 observation of 2,878 individuals from 50 species recorded (**Tables 9.52; Figure 9.32**) within the survey area and 500 m buffer (**Figure 9.1**) of which four were red-listed species in Ireland (grey wagtail, golden plover, herring gull, meadow pipit and red grouse; Colhoun & Cummins, 2013) and seven UK red-listed species (fieldfare, grey wagtail, herring gull, hen harrier, house sparrow, linnet, lesser redpoll, mistle thrush, redwing, skylark, starling, song thrush and tree sparrow; Eaton et al., 2014).

159. There were fewer species (276 observations of 400 individuals from 26 species) recorded within the 500 m existing turbine buffer (**Tables 9.53**) including four red-listed species (Colhoun & Cummins, 2013; golden plover, herring gull, meadow pipit and red grouse) and four UK red-listed species (Eaton et al., 2014; herring gull, hen harrier, mistle thrush and skylark).

160. Whilst within the proposed turbine 500 m buffer there were 380 detections of 554 individuals from 29 species (**Table 9.54**) including four red-listed species (Colhoun & Cummins, 2013; golden plover, herring gull, meadow pipit and red grouse) and four UK red-listed species (Eaton et al., 2014; herring gull, hen harrier, mistle thrush and skylark).

Table 9.52 Summary of numbers of each species detected during wintering bird surveys inside the survey area and 500 m buffer including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	16	16	GREEN	GREEN
BC	4	4	GREEN	GREEN
BF	2	2	GREEN	AMBER
BT	17	23	GREEN	GREEN
BZ	6	8	GREEN	GREEN
CD	4	9	GREEN	GREEN
CH	63	87	GREEN	GREEN
CM	8	104	AMBER	AMBER
CT	35	38	GREEN	GREEN
D.	5	10	GREEN	AMBER
FF	3	44	GREEN	RED
GC	9	9	AMBER	GREEN
GL	2	2	RED	RED
GO	6	70	GREEN	GREEN
GP	11	23	RED	GREEN
GT	5	6	GREEN	GREEN
H.	1	1	GREEN	GREEN
HC	61	107	GREEN	GREEN
HG	4	6	RED	RED
HH	3	4	AMBER	RED
HS	10	30	AMBER	RED
J.	13	13	GREEN	GREEN
JD	42	330	GREEN	GREEN
K.	6	9	AMBER	AMBER
LB	2	2	AMBER	AMBER
LI	4	19	AMBER	RED
LR	2	2	GREEN	RED
LT	3	10	GREEN	GREEN
M.	18	27	AMBER	RED
MG	33	50	GREEN	GREEN

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
MP	203	327	RED	AMBER
PE	1	1	GREEN	GREEN
PW	19	23	GREEN	GREEN
R.	61	65	AMBER	GREEN
RB	3	3	GREEN	AMBER
RE	4	39	GREEN	RED
RG	23	41	RED	AMBER
RN	87	202	GREEN	GREEN
RO	67	322	GREEN	GREEN
S.	20	20	AMBER	RED
SC	6	6	AMBER	GREEN
SG	34	378	AMBER	RED
SL	24	187	AMBER	GREEN
SN	57	61	AMBER	AMBER
ST	2	6	GREEN	RED
TS	2	19	AMBER	RED
W.	4	4	AMBER	GREEN
WP	20	30	GREEN	GREEN
WR	75	78	GREEN	GREEN
WW	1	1	GREEN	AMBER
Total	1111	2878		

Table 9.53 – Summary of numbers of each species detected during wintering bird surveys inside the existing 500 m turbine area including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	1	1	GREEN	GREEN
BC	1	1	GREEN	GREEN
BF	1	1	GREEN	AMBER
CH	12	12	GREEN	GREEN
CT	11	11	GREEN	GREEN
GC	1	1	AMBER	GREEN
GP	10	20	RED	GREEN
HC	11	11	GREEN	GREEN
HG	2	3	RED	RED
HH	2	3	AMBER	RED
J.	6	6	GREEN	GREEN
K.	4	5	AMBER	AMBER
M.	2	2	AMBER	RED
MG	1	2	GREEN	GREEN
MP	87	124	RED	AMBER
R.	9	9	AMBER	GREEN
RB	2	2	GREEN	AMBER
RG	16	33	RED	AMBER
RN	33	74	GREEN	GREEN
S.	7	7	AMBER	RED
SC	1	1	AMBER	GREEN
SL	3	14	AMBER	GREEN
SN	40	44	AMBER	AMBER
W.	1	1	AMBER	GREEN
WP	1	1	GREEN	GREEN
WR	11	11	GREEN	GREEN
Total	276	400		

Table 9.54 – Summary of numbers of each species detected during wintering bird surveys inside the proposed 500 m turbine area including conservation status

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
B.	1	1	GREEN	GREEN
BC	3	3	GREEN	GREEN
BF	1	1	GREEN	AMBER
BT	1	1	GREEN	GREEN
BZ	1	1	GREEN	GREEN
CH	16	16	GREEN	GREEN
CT	15	15	GREEN	GREEN
GC	3	3	AMBER	GREEN
GP	11	23	RED	GREEN
HC	12	13	GREEN	GREEN
HG	2	3	RED	RED
HH	2	3	AMBER	RED
J.	8	8	GREEN	GREEN
K.	4	5	AMBER	AMBER
M.	2	2	AMBER	RED
MG	1	2	GREEN	GREEN
MP	130	189	RED	AMBER
R.	10	10	AMBER	GREEN

Species	No. of detections	No. of individuals	BOCCI3	BOCC4
RB	3	3	GREEN	AMBER
RG	19	36	RED	AMBER
RN	45	106	GREEN	GREEN
S.	12	12	AMBER	RED
SC	1	1	AMBER	GREEN
SL	6	22	AMBER	GREEN
SN	48	52	AMBER	AMBER
W.	1	1	AMBER	GREEN
WP	1	1	GREEN	GREEN
WR	20	20	GREEN	GREEN
WW	1	1	GREEN	AMBER
Grand Total	380	554		

3.6.3. Breeding Vantage Point Surveys

161. There were 36 hours observation completed at each of the four vantage points between March 2018 and August 2018 (**Tables 9.55 & 9.56**). Cumulative observation time from all vantage points over the survey area was 144 hours during the study period (**Table 9.56**). Survey times ranged from 05.50 hrs to 22.55 hrs (**Table 9.55**) and covered a wide range of weather conditions (**Table 9.57**).

Table 9.55 – Breeding vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
BVP	3	CS	3	6	2018	07:30	10:30	03:00
BVP	1	DR	3	6	2018	07:45	10:45	03:00
BVP	2	DR	3	12	2018	10:15	13:15	03:00
BVP	4	DR	3	17	2018	08:10	11:10	03:00
BVP	2	DR	3	19	2018	06:05	09:05	03:00
BVP	4	CS	3	22	2018	11:50	14:50	03:00
BVP	3	AM	3	22	2018	11:50	14:50	03:00
BVP	1	DR	3	25	2018	06:35	09:35	03:00
BVP	2	DR	4	4	2018	11:40	14:40	03:00
BVP	4	CS	4	9	2018	13:45	16:45	03:00
BVP	1	CS	4	17	2018	14:00	17:00	03:00
BVP	3	CS	4	17	2018	17:15	20:15	03:00
BVP	2	DR	4	19	2018	15:30	18:30	03:00
BVP	1	DR	4	24	2018	06:10	09:10	03:00
BVP	3	DR	4	24	2018	09:35	12:35	03:00
BVP	4	DR	4	29	2018	11:10	14:10	03:00
BVP	2	CS	5	4	2018	14:00	17:00	03:00
BVP	3	CS	5	4	2018	18:35	21:35	03:00
BVP	1	DR	5	7	2018	05:50	08:50	03:00
BVP	4	DR	5	7	2018	09:10	12:10	03:00
BVP	2	DR	5	22	2018	06:20	09:20	03:00
BVP	3	DR	5	22	2018	09:40	12:40	03:00
BVP	4	MR	5	23	2018	19:55	22:55	03:00
BVP	1	DR	5	28	2018	10:05	13:05	03:00
BVP	2	DR	6	7	2018	06:45	09:45	03:00
BVP	3	DR	6	7	2018	10:00	13:00	03:00
BVP	4	DR	6	14	2018	06:35	09:35	03:00
BVP	1	DR	6	14	2018	09:55	12:55	03:00
BVP	3	DR	6	19	2018	07:50	10:50	03:00
BVP	2	DR	6	19	2018	13:55	16:55	03:00
BVP	4	DR	6	27	2018	09:10	12:10	03:00
BVP	1	CS	6	30	2018	19:40	22:40	03:00
BVP	2	DR	7	9	2018	10:45	13:45	03:00
BVP	3	DR	7	9	2018	14:00	17:00	03:00
BVP	1	DR	7	16	2018	07:10	10:10	03:00
BVP	2	DR	7	16	2018	10:45	13:45	03:00
BVP	4	DR	7	22	2018	11:15	14:15	03:00
BVP	3	DR	7	26	2018	06:35	09:35	03:00
BVP	1	DR	7	26	2018	11:50	14:50	03:00
BVP	4	DR	7	29	2018	10:50	13:50	03:00
BVP	1	DR	8	5	2018	06:20	09:20	03:00
BVP	3	DR	8	5	2018	09:40	12:40	03:00
BVP	2	DR	8	8	2018	06:15	09:15	03:00
BVP	4	DR	8	8	2018	09:40	12:40	03:00
BVP	2	DR	8	21	2018	06:35	09:35	03:00
BVP	1	DR	8	23	2018	07:05	10:05	03:00
BVP	3	DR	8	23	2018	10:20	13:20	03:00
BVP	4	DR	8	30	2018	07:35	10:35	03:00

Table 9.56 – Breeding vantage point survey effort by month

VP No.	Mar	Apr	May	Jun	Jul	Aug	TOTAL
1	6	6	6	6	6	6	36
2	6	6	6	6	6	6	36
3	6	6	6	6	6	6	36
4	6	6	9	6	6	6	36
TOTAL	24	24	24	24	24	24	144

Table 9.57 – Breeding vantage point weather conditions

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D	Y	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
3	3	6	2018	10	10	10	10	275	275	275	275	E2	E2	E2	E1	CLR	CLR	CLS	ILS	0.2	0.2	1	5
1	3	6	2018	10	10	10	10	300	300	300	500	E2	E2	E2	E2	CLR	CLR	CLR	CLR	2.5	2.5	2.5	3
2	3	12	2018	6	4	4	6	800	800	800	800	W2	W2	W2	NW2	NIL	NIL	NIL	NIL	5	5	5	5
4	3	17	2018	10	8	8	9	800	800	800	800	E3	E4	E4	E4	NIL	NIL	NIL	NIL	5	5	5	5
2	3	19	2018	8	8	6	6	800	800	800	800	E3	E3	E3	NE3	NIL	NIL	NIL	NIL	2.5	5	5	5
4	3	22	2018	10	10	10	10	600	600	600	600	SW4	SW3	SW3	SW3	NIL	NIL	NIL	ILR	5	5	5	5
3	3	22	2018	8	10	10	10	600	600	600	500	SW4	SW3	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
1	3	25	2018	6	6	8	8	600	600	600	600	E2	E2	NE3	NE3	NIL	NIL	NIL	NIL	5	5	5	5
2	4	4	2018	10	10	10	10	600	600	600	600	NE3	NE3	NE3	NE3	NIL	ILR	ILR	NIL	5	5	5	5
4	4	9	2018	10	10	10	10	500	500	600	600	SE3	SE3	SE3	SE3	ILR	ILR	ILR	NIL	5	5	5	5
1	4	17	2018	7	8	8	9	500	500	500	500	S4	S3	S3	S4	NIL	ILR	ILR	ILR	5	5	5	5
3	4	17	2018	9	9	9	8	500	500	500	500	S5	S5	S5	S5	NIL	ILR	IHR	NIL	5	5	5	5
2	4	19	2018	6	7	5	4	800	800	800	800	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
1	4	24	2018	8	8	10	10	800	800	800	800	SW2	SW2	SW2	SW2	ILM	NIL	NIL	NIL	5	5	5	5
3	4	24	2018	10	10	10	10	800	800	800	800	SW3	SW3	SW2	SW3	NIL	NIL	NIL	NIL	5	5	5	5
4	4	29	2018	5	2	6	6	800	800	800	800	NE2	NE2	NE2	NE3	NIL	NIL	ILR	NIL	5	5	5	5
2	5	4	2018	9	9	9	9	600	600	600	600	SW3	SW3	SW3	SW3	NIL	NIL	NIL	NIL	5	5	5	5
3	5	4	2018	7	8	6	6	600	600	600	600	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
1	5	7	2018	10	10	10	10	800	800	800	800	SE2	SE2	SE2	SE2	NIL	NIL	NIL	NIL	5	5	5	5
4	5	7	2018	10	9	9	9	800	800	800	800	SE3	SE3	SE3	SE3	NIL	NIL	NIL	NIL	5	5	5	5
2	5	22	2018	10	10	10	10	400	400	400	500	N2	N2	N2	NE2	ILM	NIL	NIL	NIL	5	5	5	5
3	5	22	2018	10	9	9	9	500	500	600	600	NE2	NE3	NE3	NE3	NIL	NIL	NIL	NIL	5	5	5	5
4	5	23	2018	2	2	2	2	1500	1500	1500	1500	E2	E2	E2	E2	NIL	NIL	NIL	NIL	5	5	5	5
1	5	28	2018	3	1	1	1	1000	1000	1000	1000	E1	E1	E1	E2	NIL	NIL	NIL	NIL	5	5	5	5
2	6	7	2018	8	6	6	6	800	800	1000	1000	NE2	NE2	NE2	NE2	NIL	NIL	NIL	NIL	5	5	5	5
3	6	7	2018	5	5	7	7	800	800	800	800	NE2	NE2	NE2	NE2	NIL	NIL	NIL	NIL	5	5	5	5
4	6	14	2018	10	10	10	10	600	600	600	600	SW4	W4	W4	W4	NIL	IHR	IHR	NIL	5	5	3	5
1	6	14	2018	10	8	8	10	600	600	800	800	W3/4	W3/4	W4	W3	NIL	NIL	ILR	ILR	5	5	5	5
3	6	19	2018	10	10	10	9	800	800	800	800	SW2	SW2	SW3	SW2	NIL	ILR	NIL	NIL	5	5	5	5
2	6	19	2018	8	8	10	10	800	800	800	800	SW2	SW2	SW2	SW3	NIL	NIL	NIL	NIL	5	5	5	5
4	6	27	2018	4	4	5	5	1000	1000	1000	1000	E1	E1	E2	E2	NIL	NIL	NIL	NIL	5	5	5	5
1	6	30	2018	1	2	2	2	1000	1000	1000	1000	SE2	SE2	SE2	SE2	NIL	NIL	NIL	NIL	5	5	5	5
2	7	9	2018	3	10	10	10	800	800	800	800	N2	N2	N2	N2	NIL	NIL	NIL	NIL	5	5	5	5
3	7	9	2018	10	10	9	10	800	800	800	800	N2	N2	N2	NW2	NIL	NIL	NIL	NIL	5	5	5	5
1	7	16	2018	4	4	6	6	800	800	800	800	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
2	7	16	2018	6	6	8	8	800	800	800	800	SW2	SW2	SW3	SW2	NIL	NIL	NIL	NIL	5	5	5	5
4	7	22	2018	9	9	10	10	700	700	700	700	SW2	SW3	W3	W3	NIL	NIL	NIL	NIL	5	5	5	5
3	7	26	2018	3	3	5	5	800	800	800	800	SE2	SE2	SE3	SE3	NIL	NIL	NIL	NIL	5	5	5	5
1	7	26	2018	5	5	3	3	800	800	800	600	SW2	SW2	SW2	S2	NIL	NIL	NIL	NIL	5	5	5	5
4	7	29	2018	8	6	8	8	600	600	600	600	SW3	W3	W3	W3	NIL	NIL	NIL	NIL	5	5	5	5
1	8	5	2018	10	10	10	10	800	800	800	800	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
3	8	5	2018	9	6	8	8	800	800	800	800	SW2	SW3	SW2	SW3	NIL	NIL	NIL	NIL	5	5	5	5
2	8	8	2018	9	10	9	10	500	400	400	400	SW2	SW2	SW2	SW2	ILR	ILR	NIL	NIL	5	5	5	5
4	8	8	2018	9	9	10	8	600	600	600	600	SW3	SW3	SW3	SW3	NIL	ILR	NIL	NIL	5	5	5	5
2	8	21	2018	10	10	10	10	350	350	350	400	S1	S2	S2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
1	8	23	2018	10	8	9	8	600	600	600	600	W2	W2	W2	W2	NIL	NIL	IHR	NIL	5	5	5	5
3	8	23	2018	10	10	9	9	600	600	600	600	W3	W3	W2	W3	ILR	ILR	NIL	NIL	5	5	5	5
4	8	30	2018	9	9	8	8	600	600	600	600	SW2	SW3	SW3	SW2	NIL	NIL	NIL	NIL	5	5	5	5

162. There were 10 target species (**Table 9.58**) recorded inside the survey area and 500 m buffer; buzzard, common gull, hen harrier, kestrel, lesser black-backed gull, peregrine, red grouse, raven, sparrowhawk and snipe (**Tables 9.58 & 9.59**). The occurrence rate of the detected species was less than 5% of total observation time for six species, and greater than 5% for five species (**Table 9.59**) buzzard, hen harrier, kestrel, lesser black-backed gull and raven. Most frequently recorded were raven and buzzard accounting for 67% of the observation duration. A comparative analysis with 2014 to 2015 results is shown in Section 9.3.6.4.1. As requested by NIEA (see **Chapter 9**) buzzard, kestrel and raven flights were additionally mapped (**Figures 9.33; 9.34 & 9.35**).

Table 9.58 – Breeding vantage point sightings records recorded within the 500 m survey boundary.

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
1	3	6	2018	2	LB	1	09:10	1	
3	3	6	2018	2	RG	1	08:35	1	Flying and calling
3	3	6	2018	2	RN	2	10:00	1	Flying together
2	3	12	2018	2	RN	2	10:45	1	
2	3	12	2018	2	RN	2	11:15	1	
2	3	12	2018	2	RN	2	11:30	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	3	12	2018	2	RN	2	12:30	1	
2	3	12	2018	2	BZ	1	13:15	1	
4	3	17	2018	2	RG	1	08:15	1	On ground
4	3	17	2018	2	RN	1	09:00	1	
4	3	17	2018	2	SH	1	10:10	1	Female
4	3	17	2018	2	RN	4	10:30	1	Undulating flight
2	3	19	2018	2	RN	2	07:45	1	
2	3	19	2018	2	RN	1	08:20	1	
3	3	22	2018	2	RN	2	12:40	1	Over forest E of vp calling
3	3	22	2018	2	RN	1	12:45	1	Flying around met mast
4	3	22	2018	2	SN	1	11:55	1	On way to vp
4	3	22	2018	2	SN	1	12:30	1	
4	3	22	2018	1	HH	1	13:10	2	Male mobbing BZ perched in tree
4	3	22	2018	2	BZ	1	13:10	2	
2	4	4	2018	2	RN	1	12:15	1	
2	4	4	2018	2	RN	2	13:00	1	
2	4	4	2018	2	K.	1	13:15	1	
2	4	4	2018	2	RN	1	13:50	1	
4	4	9	2018	2	K.	1	16:05	1	Male hunting
4	4	9	2018	2	K.	1	16:25	1	Female hunting
3	4	17	2018	2	RN	2	17:30	1	Flying together
3	4	17	2018	2	SN	1	19:30	1	Chipping
2	4	19	2018	1	HH	1	15:35	1	Male
2	4	19	2018	2	BZ	1	16:00	1	
2	4	19	2018	2	RN	2	16:00	1	RNs mobbing BZ
2	4	19	2018	2	RG	1	16:15	1	Heard calling
2	4	19	2018	2	RN	2	16:20	1	
2	4	19	2018	2	RN	1	16:30	1	
2	4	19	2018	2	RN	1	16:45	1	
2	4	19	2018	2	RN	2	17:50	1	
2	4	19	2018	2	RN	1	17:50	1	
2	4	19	2018	2	RN	1	17:50	1	
2	4	19	2018	2	RN	1	17:50	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	4	19	2018	2	RN	1	18:10	1	
1	4	24	2018	2	LB	2	08:05	1	
1	4	24	2018	2	CM	8	08:20	1	
3	4	24	2018	2	RN	2	10:35	1	
3	4	24	2018	2	RN	1	11:15	1	
4	4	29	2018	2	BZ	1	11:55	1	
4	4	29	2018	2	RN	1	12:35	1	
4	4	29	2018	2	RN	2	13:25	1	
4	4	29	2018	1	HH	1	13:55	1	Male over vp 4
2	5	4	2018	2	BZ	1	14:15	11	Circling hunting, perched on post
2	5	4	2018	2	BZ	1	16:35	1	Flying NW away from site
2	5	4	2018	2	RN	1	16:45	1	
2	5	4	2018	2	RN	1	16:45	1	
3	5	4	2018	2	BZ	1	18:50	1	Hover hunting
3	5	4	2018	2	K.	1	19:10	1	Perched on tree the flew off
3	5	4	2018	2	K.	1	19:35	1	Flew from forest then started hunting
3	5	4	2018	2	RN	1	19:45	1	Flying and calling
1	5	7	2018	2	RN	1	06:35	1	
1	5	7	2018	2	LB	3	07:00	1	
4	5	7	2018	2	RN	2	10:20	1	
4	5	7	2018	2	RG	1	10:40	1	Heard calling
4	5	7	2018	2	RN	1	11:35	1	
2	5	22	2018	2	RN	2	07:40	1	
2	5	22	2018	2	LB	5	08:50	1	
3	5	22	2018	2	RN	1	10:10	1	
3	5	22	2018	2	RG	1	10:15	1	Called twice during flight
3	5	22	2018	2	RN	1	10:55	1	
4	5	23	2018	2	SN	1	20:25	1	Chipping
1	5	28	2018	2	RN	3	10:55	1	
1	5	28	2018	2	LB	3	11:50	1	
2	6	7	2018	2	RN	1	07:10	1	
2	6	7	2018	2	RN	3	07:35	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	6	7	2018	2	RN	2	07:40	1	
2	6	7	2018	2	RN	1	07:45	1	
2	6	7	2018	2	LB	13	08:20	1	Mixed flock of LB and CM
2	6	7	2018	2	CM	21	08:45	1	Mixed flock of LB and CM
2	6	7	2018	2	BZ	1	09:25	1	
2	6	7	2018	2	RN	1	09:35	1	
3	6	7	2018	2	RN	2	10:50	1	
3	6	7	2018	2	K.	1	11:45	1	
3	6	7	2018	1	HH	1	12:35	1	Male
1	6	14	2018	2	CM	12	10:00	1	
1	6	14	2018	2	LB	3	10:20	1	
1	6	14	2018	2	RN	2	11:00	1	
1	6	14	2018	2	CM	8	11:35	1	
1	6	14	2018	2	BZ	1	11:55	1	
4	6	14	2018	2	RN	1	08:20	1	
4	6	14	2018	2	SN	1	09:25	1	
4	6	14	2018	2	SN	1	09:25	1	
2	6	19	2018	2	RN	2	14:55	1	
2	6	19	2018	2	RN	1	16:05	1	
3	6	19	2018	2	RN	1	08:35	1	
3	6	19	2018	2	RN	1	08:45	1	
3	6	19	2018	2	RN	1	10:00	1	
3	6	19	2018	2	K.	1	10:15	1	Hover hunting
4	6	27	2018	2	K.	1	09:45	1	Hovering
4	6	27	2018	2	RG	1	10:20	1	Heard calling
4	6	27	2018	2	RN	1	11:15	1	
4	6	27	2018	2	RN	1	11:15	1	
4	6	27	2018	2	RN	1	11:25	1	Heard calling
1	6	30	2018	2	LB	1	20:10	1	Flying North
2	7	9	2018	2	RN	2	11:25	1	
2	7	9	2018	2	RN	1	11:35	1	
2	7	9	2018	2	RN	5	12:10	1	
2	7	9	2018	2	BZ	2	12:35	1	
2	7	9	2018	2	RN	1	13:10	1	
3	7	9	2018	2	RN	2	14:10	1	
3	7	9	2018	2	RN	1	14:35	1	
3	7	9	2018	1	HH	1	14:55	1	Male
1	7	16	2018	2	LB	1	07:50	1	
1	7	16	2018	2	BZ	1	08:00	1	
1	7	16	2018	2	RN	2	08:20	1	
1	7	16	2018	2	RN	1	09:20	1	
2	7	16	2018	2	RN	1	11:15	1	
2	7	16	2018	2	RN	1	11:30	1	
2	7	16	2018	1	HH	1	12:25	1	Male hunting
2	7	16	2018	2	RN	1	12:35	1	
2	7	16	2018	1	HH	1	12:50	1	Male
4	7	22	2018	2	K.	1	12:45	1	Hover hunting
4	7	22	2018	2	K.	1	12:55	1	
4	7	22	2018	2	CM	5	13:00	1	
4	7	22	2018	2	LB	3	13:00	1	
4	7	22	2018	2	RN	1	13:20	1	
1	7	26	2018	2	SH	1	11:55	1	Female
1	7	26	2018	2	LB	1	12:55	1	
3	7	26	2018	2	RN	1	07:40	1	
3	7	26	2018	2	RN	1	08:10	1	
3	7	26	2018	1	PE	1	08:25	1	
3	7	26	2018	1	PE	1	09:00	1	
4	7	29	2018	2	RN	1	11:40	1	
4	7	29	2018	2	RN	2	12:05	1	
4	7	29	2018	2	LB	1	13:10	1	
1	8	5	2018	2	BZ	1	06:45	1	
1	8	5	2018	2	RN	1	06:55	1	
1	8	5	2018	2	RN	1	07:35	1	
1	8	5	2018	2	CM	50-60	08:55	1	Fragmented - 12 birds landed
1	8	5	2018	2	CM	22	09:05	1	
3	8	5	2018	2	RN	1	09:45	1	
3	8	5	2018	1	HH	1	09:55	1	Female
3	8	5	2018	1	HH	1	10:05	1	Female
3	8	5	2018	2	RN	1	10:25	1	
3	8	5	2018	2	LB	1	10:50	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
3	8	5	2018	1	HH	1	11:35	1	Male hunting
3	8	5	2018	2	RN	2	12:05	1	
2	8	8	2018	2	RN	3	07:05	1	
2	8	8	2018	2	BZ	1	07:55	1	
4	8	8	2018	2	RN	1	10:40	1	
4	8	8	2018	2	LB	5	11:05	1	
4	8	8	2018	2	RN	2	11:45	1	
2	8	21	2018	2	RN	7	06:40	1	
2	8	21	2018	2	RN	3	06:55	1	
2	8	21	2018	2	RN	1	07:00	1	
2	8	21	2018	2	RN	2	07:25	1	Landed on fence/ tree
2	8	21	2018	2	RN	1	07:25	1	Landed on fence/ tree
2	8	21	2018	2	RN	1	07:25	1	Landed on fence/ tree
2	8	21	2018	2	RN	1	07:25	1	Landed on fence/ tree
2	8	21	2018	2	BZ	1	08:05	1	
2	8	21	2018	2	RN	2	08:20	1	
2	8	21	2018	1	HH	1	08:35	1	Female
2	8	21	2018	2	RN	7	09:15	1	
1	8	23	2018	2	RN	1	07:50	1	
1	8	23	2018	2	BZ	1	08:20	1	
1	8	23	2018	2	CM	12	09:20	1	
3	8	23	2018	2	RN	1	10:45	1	
3	8	23	2018	2	RN	1	10:45	1	
3	8	23	2018	2	RN	1	10:45	1	
3	8	23	2018	2	RN	1	11:10	1	Landed on tree
3	8	23	2018	2	RN	2	11:20	1	
3	8	23	2018	2	K.	1	12:10	1	
3	8	23	2018	2	RN	1	12:40	1	
4	8	30	2018	2	LB	3	08:35	1	
4	8	30	2018	2	RN	1	08:55	1	
4	8	30	2018	2	BZ	1	09:25	1	
4	8	30	2018	2	RN	2	09:55	1	
4	8	30	2018	2	RN	1	10:05	1	

Table 9.59 – Breeding vantage point aggregated species sightings records within the 500 m survey boundary.

Species	Number of detections	%	Number of five minute intervals	%
BZ	16	9.2	27	14.5
CM	8	4.6	8	4.3
HH	11	6.3	12	6.5
K.	11	6.3	11	5.9
LB	15	8.6	15	8.1
PE	2	1.1	2	1.1
RG	6	3.4	6	3.2
RN	97	55.7	97	52.2
SH	2	1.1	2	1.1
SN	6	3.4	6	3.2
Total	174		186	

163. Two target 1 species (**Table 9.1**) were recorded (**Tables 9.58 & 9.59**); hen harrier (n = 11) and peregrine (n = 2), and had flying height(s) recorded (**Table 9.61**) and were mapped (**Figures 9.36**).

164. There were 11 hen harrier observations during the breeding season including males, females and ringtails (juveniles) an additional three hen harrier flights were observed from vantage points were outside the survey area and 500 m buffer on the 22/3/2018; 9/4/2018 and 19/4/2018. These observations were all derived from two hen harrier nests in the wider 2 km survey area. Hen harrier flights were recorded for 796 seconds and all were recorded below 25 m with 48.9% below the height of potential collision risk (<15m) and remainder, 51.1%, between 15 – 25 m.

165. Curlew were not recorded within the survey area and 500 m buffer during vantage point observations but a single observation was made of a bird to the south of the site boundary from vantage point four on the 22/5/2018; but was beyond the survey area and 500 m buffer (**Figure 9.36**) and towards the known breeding territory within the 2 km buffer.

166. Peregrine were observed on two occasions (**Tables 9.60 & 9.61; Figure 9.36**), both in late July on the same day during the breeding season and peregrine flights (53 seconds) were all recorded within the potential rotor swept area 25 m to 75 m.

167. Peregrine and hen harrier flights (**Figure 9.36**) were considered to have originated from known breeding sites nearby and hen harriers fledged 3 young from one site in 2018 whilst the second site failed (see also Section 9.3.6.6). Peregrine were not recorded breeding at the nearest known breeding sites.

Table 9.60 – Breeding vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Mar	Apr	May	Jun	Jul	Aug	TOTAL
BZ	2	2	3	2	2	5	16
CM		1		3	1	3	8
HH	1	2		1	3	4	11
K.		3	2	3	2	1	11
LB	1	1	3	3	4	3	15
PE					2		2

Species	Mar	Apr	May	Jun	Jul	Aug	TOTAL
RG	2	1	2	1			6
RN	11	17	10	16	16	27	97
SH	1				1		2
SN	2	1	1	2			6
Total	20	28	21	31	31	43	174

Table 9.61 – Breeding vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	50-100m	100-125m	125-140m	>140m	Notes
4	3	22	2018	HH	1	13:07	267		267							Male
2	4	19	2018	HH	1	15:33	43	28	15							Male
4	4	29	2018	HH	1	13:52	115	85	30							Male
3	6	7	2018	HH	1	12:33	67	52	15							Male
3	7	9	2018	HH	1	14:52	48		48							Male
2	7	16	2018	HH	1	12:23	46	46								Male
2	7	16	2018	HH	1	12:48	35	35								Male
3	7	26	2018	PE	1	08:23	35			15	20					
3	7	26	2018	PE	1	08:56	18				18					
3	8	5	2018	HH	1	09:53	27	27								Female juvenile
3	8	5	2018	HH	1	10:05	32		32							Female
3	8	5	2018	HH	1	11:32	68	68								Male
4	8	21	2018	HH	1	08:33	48	48								Female

3.6.4. Wintering Vantage Point Surveys

168. There were 39 hours observation completed at each of the four vantage points between September 2018 and March 2019 (**Tables 9.62 & 9.63**). Cumulative observation time from all vantage points over the survey area was 156 hours during the study period (**Table 9.63**). Survey times ranged from 06.35hrs to 17.15hrs (**Table 9.62**) and covered a wide range of weather conditions (**Table 9.64).**

Table 9.62 – Wintering vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
WVP	1	DR	9	16	2018	06:40	09:40	03:00
WVP	3	DR	9	16	2018	10:00	13:00	03:00
WVP	2	DR	9	19	2018	10:15	13:15	03:00
WVP	4	KM	9	25	2018	09:30	12:30	03:00
WVP	2	DR	9	27	2018	11:35	14:35	03:00
WVP	3	CS	9	29	2018	13:55	16:55	03:00
WVP	4	DR	9	30	2018	07:50	10:50	03:00
WVP	1	DR	9	30	2018	11:10	14:10	03:00
WVP	2	DR	10	3	2018	06:50	09:50	03:00
WVP	1	DR	10	3	2018	10:05	13:05	03:00
WVP	3	DR	10	7	2018	07:10	10:10	03:00
WVP	4	KM	10	11	2018	09:30	12:30	03:00
WVP	3	DR	10	19	2018	09:20	12:20	03:00
WVP	1	DR	10	23	2018	11:05	14:05	03:00
WVP	2	DR	10	23	2018	14:15	17:15	03:00
WVP	4	DR	10	29	2018	08:45	11:45	03:00
WVP	4	DR	11	4	2018	10:55	13:55	03:00
WVP	1	DR	11	6	2018	07:10	10:10	03:00
WVP	2	DR	11	6	2018	10:25	13:25	03:00
WVP	3	CS	11	19	2018	10:20	13:20	03:00
WVP	3	DR	11	26	2018	10:30	13:30	03:00
WVP	2	DR	11	26	2018	14:05	17:05	03:00
WVP	4	CS	11	27	2018	11:00	14:00	03:00
WVP	1	DR	11	28	2018	07:20	10:20	03:00
WVP	2	DR	12	4	2018	07:45	10:45	03:00
WVP	3	DR	12	4	2018	11:05	14:05	03:00
WVP	1	DR	12	9	2018	07:40	10:40	03:00
WVP	4	KM	12	13	2018	11:30	14:30	03:00
WVP	4	CS	12	17	2018	14:00	17:00	03:00
WVP	2	DR	12	19	2018	08:05	11:05	03:00
WVP	3	DR	12	23	2018	08:05	11:05	03:00
WVP	1	DR	12	23	2018	11:25	14:25	03:00
WVP	3	DR	1	4	2019	08:15	11:15	03:00
WVP	2	DR	1	4	2019	11:30	14:30	03:00
WVP	4	KM	1	10	2019	10:30	13:30	03:00
WVP	1	DR	1	13	2019	08:10	11:10	03:00
WVP	2	DR	1	17	2019	07:55	10:55	03:00
WVP	3	DR	1	17	2019	11:15	14:15	03:00
WVP	1	DR	1	22	2019	07:55	10:55	03:00
WVP	4	KM	1	24	2019	11:00	14:00	03:00
WVP	2	DR	2	3	2019	07:40	10:40	03:00

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
WVP	1	DR	2	3	2019	10:55	13:55	03:00
WVP	4	KM	2	6	2019	11:15	14:15	03:00
WVP	3	KM	2	14	2019	10:10	13:10	03:00
WVP	3	CS	2	22	2019	13:25	16:25	03:00
WVP	1	CS	2	25	2019	10:05	13:05	03:00
WVP	4	KM	2	27	2019	11:15	14:15	03:00
WVP	2	CS	2	28	2019	11:50	14:50	03:00
WVP	3	KM	3	7	2019	09:45	12:45	03:00
WVP	1	DR	3	8	2019	08:25	11:25	03:00
WVP	2	DR	3	20	2019	06:35	09:35	03:00
WVP	4	KM	3	26	2019	09:10	12:10	03:00

Table 9.63 – Wintering vantage point survey effort by month

VP No.	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
1	6	6	6	6	6	6	3	39
2	6	6	6	6	6	6	3	39
3	6	6	6	6	6	6	3	39
4	6	6	6	6	6	6	3	39
TOTAL	24	24	24	24	24	24	12	156

Table 9.64 – Wintering vantage point weather conditions

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D	Y	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
1	9	16	2018	10	10	10	10	400	350	400	350	SW3	SW2	SW2	SW2	NIL	ILR	NIL	ILR/M	3	3	5	3
3	9	16	2018	10	10	9	8	350	500	500	600	SW3	SW4	SW4	SW3	ILM/R	NIL	ILR	NIL	1.5	5	5	5
2	9	19	2018	10	10	9	9	500	500	500	500	SW4	SW5	SW5	SW4	NIL	ILR	NIL	IHR	3	3	5	5
4	9	25	2018	10	10	10	10	700	600	600	500	SW4	SW4	SW4	SW4	NIL	NIL	NIL	NIL	30	30	30	30
2	9	28	2018	6	8	8	10	600	800	800	600	NW2	NW2	NW2	NW2	NIL	NIL	NIL	NIL	5	5	5	5
3	9	29	2018	10	10	10	10	600	600	600	600	W4	W4	SW4	W4	NIL	ILR	NIL	NIL	5	5	5	5
4	9	30	2018	9	10	8	9	600	600	600	600	W3	W4	W4	W4	NIL	NIL	IHR	ILR	5	5	3	5
1	9	30	2018	7	5	10	8	600	6000	500	600	W2	W2	W3	W2	NIL	ILR	ILR	IHR	5	5	5	3
2	10	3	2018	10	10	10	10	350	300	300	400	SW2	SW3	SW3	SW3	IHM	CHM	CHM	CLM	1	1.5	3	3
1	10	3	2018	10	10	9	8	350	350	400	400	SW2	SW2	SW2	SW2	CLM	CHM	CHM	CHM	5	5	5	5
3	10	7	2018	10	10	10	10	600	600	600	600	S3	S3	S4	S3	NIL	ILR	IHR	NIL	5	3	2	5
4	10	11	2018	9	9	9	8	600	600	600	1000	SE3	SE3	SE3	S3	IHR	IHR	NIL	NIL	10	10	10	15
3	10	19	2018	10	10	10	9	450	450	500	500	SW2	SW2	W2	W2	NIL	ILM	NIL	NIL	5	5	5	5

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
1	10	23	2018	10	10	10	9	500	500	500	600	W3	W3	W3	W2	NIL	ILR	NIL	NIL	3	3	3	5
2	10	23	2018	9	8	8	10	600	600	600	600	W3	W3	W3	W3	NIL	ILR	NIL	NIL	5	5	5	5
4	10	29	2018	10	10	10	10	800	800	800	800	SE3	SE3	SE3	SE3	NIL	NIL	NIL	NIL	5	5	5	5
4	11	4	2018	5	5	5	5	1000+	1000+	1000+	1000+	S4	S3	S4	S3	NIL	NIL	NIL	NIL	5	5	5	5
1	11	6	2018	10	10	10	9	400	350	400	500	SE2	SE2	SE2	SE2	ILR	ILR	ILR	NIL	3	3	3	5
2	11	6	2018	8	10	10	10	500	500	500	600	SE3	SE3	SE3	SE2	NIL	ILR	ILR	NIL	5	5	5	5
3	11	19	2018	9	10	10	10	800	800	800	800	E3	E3	E3	E3	NIL	NIL	NIL	NIL	5	5	5	5
3	11	26	2018	8	8	6	6	600	600	800	800	E2	E3	E3	E3	ILR	NIL	NIL	NIL	5	5	5	5
2	11	26	2018	6	4	3	5	800	800	600	600	E3	SE3	SE3	SE3	NIL	NIL	NIL	NIL	5	5	5	5
4	11	27	2018	10	10	10	10	350	350	360	360	E5	E6	E5	E4	CHR	CHR	CLR	ILR	0.2	0.2	2	2
1	11	28	2018	10	10	10	10	350	350	350	400	SE3	SE3	SE3	SE3	CLR/M	CLR/M	CLR/M	CLR/M	0.5	3	3	3
2	12	4	2018	2	3	5	5	600	600	600	600	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	3	5	5	5
3	12	4	2018	7	8	8	9	600	600	600	600	SW3	SW3	SW3	SW3	NIL	NIL	NIL	NIL	5	5	5	5
1	12	9	2018	10	10	10	10	400	400	400	400	NW2	NW2	NW2	NW2	NIL	NIL	NIL	NIL	1.5	5	5	5
4	12	13	2018	10	10	9	10	2000	2000	2000	1000	SE5	SE5	SE5	SE5	NIL	NIL	ILR	ILR	20	20	20	10
4	12	17	2018	10	10	10	10	500	450	450	450	E4	SE4	SE4	SE4	NIL	ILR	NIL	NIL	5	5	5	0.005
2	12	19	2018	6	6	6	8	600	600	500	500	SE2	SE2	SE3	SE2	NIL	NIL	NIL	NIL	2	5	5	5
3	12	23	2018	10	10	10	10	350	350	400	400	N1	NW1	NW1	NW1	IHM	IHM	NIL	NIL	1.5	2.5	2.5	2.5
1	12	23	2018	10	10	10	10	350	350	350	350	NW1	NW1	NW1	NW1	CHM	CHM	IHM	IHM	1	0.5	1.5	0.5
3	1	4	2019	10	10	10	10	600	600	600	600	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	2	5	5	5
2	1	4	2019	10	8	5	5	600	600	600	600	SW2	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
4	1	10	2019	10	10	10	10	2000	2000	2000	2000	NW2	W3	W3	W3	NIL	NIL	NIL	NIL	20	30	30	30
1	1	13	2019	10	10	10	10	600	600	600	600	W3	W3	W4	W4	NIL	NIL	CLR	ILR	5	5	5	5
2	1	17	2019	5	7	7	5	600	600	600	600	NW2	NW2	NW2	NW2	NIL	NIL	NIL	NIL	3	5	5	5
3	1	17	2019	5	5	8	8	600	600	600	600	NW2	NW3	NW3	NW3	NIL	NIL	NIL	NIL	5	5	5	5
1	1	22	2019	8	6	8	10	350	375	400	350	SW2	W2	W2	W2	ILR/S	NIL	NIL	ILS	1.5	5	5	5
4	1	24	2019	10	10	10	10	350	400	350	400	SW2	SW2	SW2	SW2	NIL	NIL	ILR	NIL	2	2	2	2
2	2	3	2019	10	10	10	10	400	400	300	300	SW2	SW3	SW2	SW2	NIL	ILR	CLM	IHM	5	5	0.5	1
1	2	3	2019	10	10	10	10	350	400	400	400	SW2	SW2	SW2	SW2	CHM	CHM	CHM	CHM	1.5	3	3	3
4	2	6	2019	6	7	6	6	1000	1000	1000	1000	S4	S4	S4	S5	NIL	NIL	NIL	NIL	30	30	30	30
3	2	14	2019	10	10	10	4	1000	1000	1000	1000	S4	S4	S4	S4	NIL	NIL	NIL	NIL	20	20	20	20
3	2	22	2019	10	10	10	10	700	700	700	700	SE3	SE3	SE3	SE3	NIL	NIL	NIL	NIL	5	5	5	5
1	2	25	2019	5	5	7	8	800	800	800	800	S3	S3	S3	S3	NIL	NIL	NIL	NIL	5	5	5	5
4	2	27	2019	1	2	2	4	2000	2000	2000	2000	W1	W1	E1	E2	NIL	NIL	NIL	NIL	5	5	5	5
2	2	28	2019	10	10	10	10	330	320	350	350	W1	W1	W1	W1	NIL	NIL	NIL	NIL	3	3	3	3
3	3	7	2019	10	9	10	9	600	600	600	600	NE4	N4	N4	N4	IHR	IHR	NIL	NIL	5	10	10	10
1	3	8	2019	8	10	8	6	500	500	500	500	S2	S2	S3	S3	NIL	ILR	ILR	NIL	3	3	3	3

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
2	3	20	2019	8	8	8	8	400	400	500	500	SW2	SW2	SW2	SW2	ILM	NIL	NIL	NIL	5	5	5	5
4	3	26	2019	10	10	10	10	1000	1000	1000	1000	WSW4	WSW4	WSW4	WSW5	NIL	NIL	NIL	NIL	40	40	40	40

169. There were 14 target species (**Table 9.65**) recorded inside the survey area and 500 m buffer during the wintering period; buzzard, common gull, golden plover, heron, hen harrier, kestrel, lesser black-backed gull, mallard, peregrine, red grouse, raven, sparrowhawk, snipe and whooper swan. The occurrence rate of the detected species ranged from 0.7% - 56.2% with four species which were recorded more than 5% of total observation time namely buzzard (6%), kestrel (8.5%), red grouse (5%) and raven (63.8%) (**Tables 9.65 & 9.66**).

170. There was some variation in detection rates across the wintering period (**Table 9.67**) although only buzzard, raven and red grouse were seen throughout the wintering period (**Table 9.67**). As requested by NIEA (see **Chapter 9**) buzzard, kestrel and raven flights were additionally mapped (**Figures 9.34; 9.35 & 9.36**, see also Section 9.3.3.3).

Table 9.65 – Wintering vantage point sightings records recorded within the survey area and 500 m buffer

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
1	9	16	2018	2	CM	8	08:20	1	
1	9	16	2018	2	BZ	1	09:15	1	
3	9	16	2018	2	RN	1	10:40	1	
3	9	16	2018	2	K.	1	11:00	1	Juveniles hunting / playing in the wind
3	9	16	2018	2	K.	1	11:00	1	Juveniles hunting / playing in the wind
3	9	16	2018	1	PE	1	12:05	1	Swooped down towards flock of MP
3	9	16	2018	2	RN	2	12:30	1	
2	9	19	2018	2	K.	1	11:15	1	Soaring / hovering. Landed on fence post
4	9	25	2018	2	RN	1	10:35	1	Flying low
4	9	25	2018	2	RG	5	12:10	1	Flying low
2	9	28	2018	2	RN	1	11:50	1	
2	9	28	2018	2	RN	2	12:20	1	
2	9	28	2018	2	RN	1	13:30	1	
2	9	28	2018	2	K.	1	13:40	1	
3	9	29	2018	2	RN	2	14:15	1	Flying together
3	9	29	2018	2	K.	1	14:20	1	Female hunting
3	9	29	2018	2	RN	2	14:30	1	Flying together
3	9	29	2018	2	RN	6	14:50	26	Flying around in the same area, tumbling and chasing each other, 1 or 2 occasionally landing for a couple min then lifting again. Flying in the one area for the rest of vp
3	9	29	2018	2	BZ	1	15:40	1	Circling over forest
1	9	30	2018	2	RN	1	11:30	1	
1	9	30	2018	2	K.	2	12:25	1	Hovering / hunting
1	9	30	2018	2	CM	15+	12:40	1	Landed in field
1	9	30	2018	2	BZ	1	12:55	1	
1	10	3	2018	2	CM	7	10:20	1	
2	10	3	2018	2	RN	5	06:55	1	Perched on fence post below mist line
2	10	3	2018	2	K.	1	06:55	1	Perched on fence post below mist line
2	10	3	2018	2	RN	1	06:55	1	Perched on fence post below mist line
2	10	3	2018	2	K.	1	07:40	1	
2	10	3	2018	2	RN	2	07:45	1	
2	10	3	2018	2	RN	1	08:30	1	
2	10	3	2018	2	RN	3	09:10	1	Heard calling
3	10	7	2018	2	RG	1	07:15	1	Disturbed
3	10	7	2018	2	RN	2	08:35	1	
4	10	11	2018	2	K.	1	11:05	1	Hunting along forest edge 20m
3	10	19	2018	2	RN	2	10:10	1	
3	10	19	2018	2	RN	1	10:25	1	
3	10	19	2018	1	PE	1	10:55	1	
3	10	19	2018	2	RN	1	12:00	1	
2	10	23	2018	2	LB	2	15:00	1	
2	10	23	2018	2	BZ	1	15:05	2	
2	10	23	2018	2	CM	13	15:25	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	10	23	2018	2	RN	1	16:20	1	
2	10	23	2018	2	RN	3	17:00	1	
4	10	29	2018	2	RN	2	09:40	1	
4	10	29	2018	2	RG	1	11:20	1	
4	10	29	2018	2	RG	1	11:20	1	
4	10	29	2018	1	GP	13	11:35	1	
4	11	4	2018	2	BZ	1	11:10	1	
4	11	4	2018	2	RN	1	12:00	1	
2	11	6	2018	2	RN	2	10:30	2	Undulating Flight
2	11	6	2018	2	RN	1	10:55	1	Undulating flight
2	11	6	2018	2	RN	1	11:00	1	Undulating flight
2	11	6	2018	2	K.	1	11:45	1	Hovering / hunting
2	11	6	2018	2	RN	2	12:35	2	
1	11	7	2018	2	LB	2	07:35	1	
1	11	7	2018	2	SH	1	08:45	1	Male
1	11	7	2018	2	CM	9	10:10	1	
3	11	19	2018	2	RN	10	10:20	15	10 RN flying across site (roosting birds)
3	11	19	2018	2	RG	1	10:20	1	On ground
3	11	19	2018	2	RN	1	11:55	1	Flying near each other
3	11	19	2018	2	RN	1	11:55	1	Flying near each other
3	11	19	2018	2	RN	1	12:30	1	
2	11	26	2018	2	RN	1	14:20	1	Landed on fence post
2	11	26	2018	2	RN	2	14:45	1	
2	11	26	2018	2	RN	1	15:10	1	
2	11	26	2018	1	GP	25	15:25	1	Undulating / wheeling flight
2	11	26	2018	1	GP	15	15:25	2	Undulating / wheeling flight
2	11	26	2018	2	RN	1	16:40	1	
2	11	26	2018	1	WS	13	16:45	1	
2	11	26	2018	2	RN	1	17:00	1	
3	11	26	2018	2	RN	1	11:15	1	
3	11	26	2018	2	RN	1	12:05	1	
1	11	28	2018	2	CM	16	08:15	1	
1	11	28	2018	2	CM	5	09:30	1	

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
2	12	4	2018	2	RN	2	08:10	1	
2	12	4	2018	2	LB	3	09:35	1	
2	12	4	2018	2	RN	2	10:00	1	
3	12	4	2018	2	RN	2	11:30	1	
3	12	4	2018	2	RN	1	12:05	1	
3	12	4	2018	2	RN	1	12:30	1	
3	12	4	2018	2	RN	3	13:10	1	
3	12	4	2018	2	RN	2	13:10	1	
3	12	4	2018	2	RN	2	13:10	1	
3	12	4	2018	2	H.	1	13:55	1	
1	12	9	2018	2	CM	6	08:20	1	
1	12	9	2018	2	LB	1	09:35	1	
1	12	9	2018	2	SH	1	10:20	1	Female
2	12	19	2018	2	RN	2	08:25	1	
2	12	19	2018	2	RN	1	08:55	1	
2	12	19	2018	2	RN	1	09:35	1	
2	12	19	2018	2	RN	3	10:15	1	
2	12	19	2018	1	PE	1	10:55	1	
1	12	23	2018	2	RG	1	11:25	1	Disturbed from ground
1	12	23	2018	2	RN	1	12:20	1	Heard calling
1	12	23	2018	2	RG	1	13:45	1	Heard calling
3	12	23	2018	2	BZ	1	09:40	1	
2	1	4	2019	2	RN	1	12:10	1	
2	1	4	2019	2	RN	1	12:35	1	One bird landed on fence post
2	1	4	2019	2	RN	1	12:35	1	One bird landed on fence post
2	1	4	2019	2	RN	1	12:35	1	One bird landed on fence post
2	1	4	2019	2	RN	1	13:40	1	
3	1	4	2019	2	RG	4	08:15	2	Heard calling
3	1	4	2019	2	SN	1	08:20	1	Disturbed
3	1	4	2019	2	RN	1	08:55	1	
3	1	4	2019	2	RN	1	09:30	1	
3	1	4	2019	1	HH	1	10:10	2	Female
3	1	4	2019	2	RN	1	10:45	1	Flew together then split up
3	1	4	2019	2	RN	1	10:45	1	Flew together then split up

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
4	1	10	2019	2	RN	1	11:35	1	Flying through windfarm
4	1	10	2019	2	RN	1	12:00	1	Flying through windfarm
4	1	10	2019	2	K.	1	12:10	1	Male hunting
4	1	10	2019	2	K.	1	12:25	1	Male hunting
4	1	10	2019	2	K.	1	12:35	1	Male hunting
4	1	10	2019	2	K.	1	13:10	1	Male hunting
1	1	13	2019	2	LB	2	09:25	1	
1	1	13	2019	2	RN	1	10:50	1	
2	1	17	2019	1	PE	1	08:40	1	Female crossed site, lower slopes toward Lough Foyle
2	1	17	2019	2	RN	2	09:15	1	
2	1	17	2019	2	BZ	1	10:05	1	
3	1	17	2019	2	RN	1	11:30	1	
3	1	17	2019	2	RN	2	12:50	1	
3	1	17	2019	2	RN	1	13:30	1	
1	1	22	2019	2	BZ	1	09:00	1	
1	1	22	2019	2	RN	3	09:00	1	In and out of low cloud mist
1	1	22	2019	2	RN	1	09:15	1	
1	1	22	2019	2	K.	1	09:50	1	
4	1	24	2019	2	RN	4	12:15	1	Flying in windfarm
2	2	3	2019	2	RN	2	09:05	1	Undulating flight
2	2	3	2019	2	RN	2	09:05	1	Undulating flight
2	2	3	2019	2	RN	1	09:05	1	Undulating flight
2	2	3	2019	2	RN	1	10:25	1	
4	2	6	2019	2	RN	3	11:35	1	Flying through windfarm
3	2	14	2019	2	RN	1	10:30	1	Flying at Temain hill
3	2	14	2019	2	RG	1	12:20	1	Flying at Temain hill
3	2	14	2019	2	RN	1	12:30	1	Flying south of windfarm
3	2	14	2019	2	RN	1	12:30	1	Flying in windfarm
3	2	14	2019	1	GP	3	12:35	1	Flying towards windfarm
3	2	14	2019	2	RN	1	12:55	1	Flying in windfarm
3	2	22	2019	2	RN	2	14:15	1	
1	2	25	2019	2	BZ	2	10:55	2	Adult male and female flying together circling and calling
4	2	27	2019	2	RN	4	12:20	1	Flying west of windfarm
4	2	27	2019	2	RN	2	14:10	1	Flying in windfarm
2	2	28	2019	2	RN	1	13:15	1	
1	3	8	2019	2	BZ	1	09:45	1	
1	3	8	2019	2	LB	3	10:15	1	
2	3	20	2019	2	MA	1	07:05	1	
2	3	20	2019	2	K.	1	07:55	1	Male
2	3	20	2019	2	LB	3	08:35	1	
2	3	20	2019	2	K.	1	08:55	1	Male
4	3	26	2019	2	RN	1	09:35	1	Flying in windfarm
4	3	26	2019	2	RN	2	10:20	1	Flying in windfarm
4	3	26	2019	1	HH	1	10:45	1	Male hunting
4	3	26	2019	2	RN	3	10:45	1	Mobbing HH male

Table 9.66 – Wintering vantage point aggregated species sightings records within the survey area and 500 m buffer

Species	Number of detections	%	Number of five minute intervals	%
BZ	10	6.5	12	6.0
CM	8	5.2	8	4.0
GP	4	2.6	5	2.5
H.	1	0.7	1	0.5
HH	2	1.3	3	1.5
K.	17	11.1	17	8.5
LB	7	4.6	7	3.5
MA	1	0.7	1	0.5
PE	4	2.6	4	2.0

Species	Number of detections	%	Number of five minute intervals	%
RG	9	5.9	10	5.0
RN	86	56.2	127	63.8
SH	2	1.3	2	1.0
SN	1	0.7	1	0.5
WS	1	0.7	1	0.5
Total	153		199	

Table 9.67 – Wintering vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
BZ	3	1	1	1	2	1	1	10
CM	2	2	3	1				8
GP		1	2			1		4
H.				1				1
HH					1		1	2
K.	6	3	1		5		2	17
LB		1	1	2	1		2	7
MA							1	1
PE	1	1		1	1			4
RG	1	3	1	2	1	1		9
RN	10	12	16	13	19	13	3	86
SH			1	1				2
SN					1			1
WS			1					1
Total	23	24	27	22	31	16	10	153

171. Four target 1 species flights (**Table 9.1**) were recorded (**Table 9.67**); golden plover (n = 4), hen harrier (n = 2), peregrine (n = 4) and whooper swan (n =1) and had flying height(s) recorded (**Table 9.68**) and were mapped (**Figures 9.37**).

172. Both male and female hen harriers were recorded during the winter and there was further evidence of hen harriers roosting in the wider area within and beyond 2 km (see Section 9.3.6.7) during the winter period. All hen harrier flights were recorded below rotor swept area (<15 m). Whooper swans were recorded on a single occasion and were recorded at high elevation moving west above rotor swept area (>140 m).

173. Peregrine flights were recorded intermittently throughout the winter and there were 223 seconds of flight observed with all flights recorded within potential collision risk height although at relatively low level within the range 15 m to 100 m. Whilst golden plover were recorded in the winter season this species was recorded during migration periods and also observed to undertake specific avoidance actions when flying through the windfarm and operational turbines during 2018 (see also Section 9.3.6.4).

Table 9.68 – Wintering vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15 m	15-25 m	25-50 m	50-75 m	50-100 m	100-125 m	125-140 m	>140 m	Notes
3	9	16	2018	PE	1	12:03	75			15	30	30				
3	10	19	2018	PE	1	10:51	63		30	33						
4	10	29	2018	GP	13	11:32	68				15	53				
2	11	26	2018	GP	25	15:23	32	2	15	15						
2	11	26	2018	GP	15	15:25	65		35		15	15				
2	11	26	2018	WS	13	16:42	138								138	
2	12	19	2018	PE	1	10:53	39			39						
3	1	4	2019	HH	1	10:08	138	138								Female
2	1	17	2019	PE	1	08:37	46		30	16						Female
3	2	14	2019	GP	3	12:31	20			20						
4	3	26	2019	HH	1	10:43	45	45								Male

174. Cumulative data for all species detected during winter and summer vantage points (**Table 9.69**) over the 12-month study shows that raven (56%), kestrel (8.6%) and buzzard (8%), lesser black-backed gull (6.7%) and red grouse (4.6%) were the most frequently detected species throughout the 2018 – 2019 seasons.

175. Both raven and buzzard were recorded throughout every month of the study (**Table 9.69**), although both were recorded most frequently in August and ravens were also known to have a roost nearby. Red grouse were recorded frequently over the summer and winter with a small increase over winter in detection. Gulls (common gull and lesser black-backed gull) were recorded frequently throughout the study period and were typically passing through on the lower elevation / improved pastures and/or attracted to agricultural activity such as ploughing / slurry spreading on the improved pasture areas.

176. There were four species recorded in the winter which were not recorded during the breeding season, namely whooper swan, heron, mallard and golden plover. None of the species seen during the breeding season were exclusively seen in that season within the survey area and 500 m buffer. Although curlew were only observed in the breeding season (**Figure 9.36**) but were beyond the survey area and 500 m buffer.

Table 9.69 – Cumulative breeding and wintering vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL	% of detections
BZ	2	2	3	2	2	5	3	1	1	1	2	1	1	26	8.0
CM		1		3	1	3	2	2	3	1				16	4.9
GP								1	2			1		4	1.2
H.										1				1	0.3
HH	1	2		1	3	4					1		1	13	4.0
K.		3	2	3	2	1	6	3	1		5		2	28	8.6
LB	1	1	3	3	4	3		1	1	2	1		2	22	6.7
MA													1	1	0.3
PE					2		1	1		1	1			6	1.8

Species	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL	% of detections
RG	2	1	2	1			1	3	1	2	1	1		15	4.6
RN	11	17	10	16	16	27	10	12	16	13	19	13	3	183	56.0
SH	1				1				1	1				4	1.2
SN	2	1	1	2							1			7	2.1
WS									1					1	0.3
Total	20	28	21	31	31	43	23	24	27	22	31	16	10	327	

Comparison of breeding and wintering vantage point surveys between 2014 and 2018

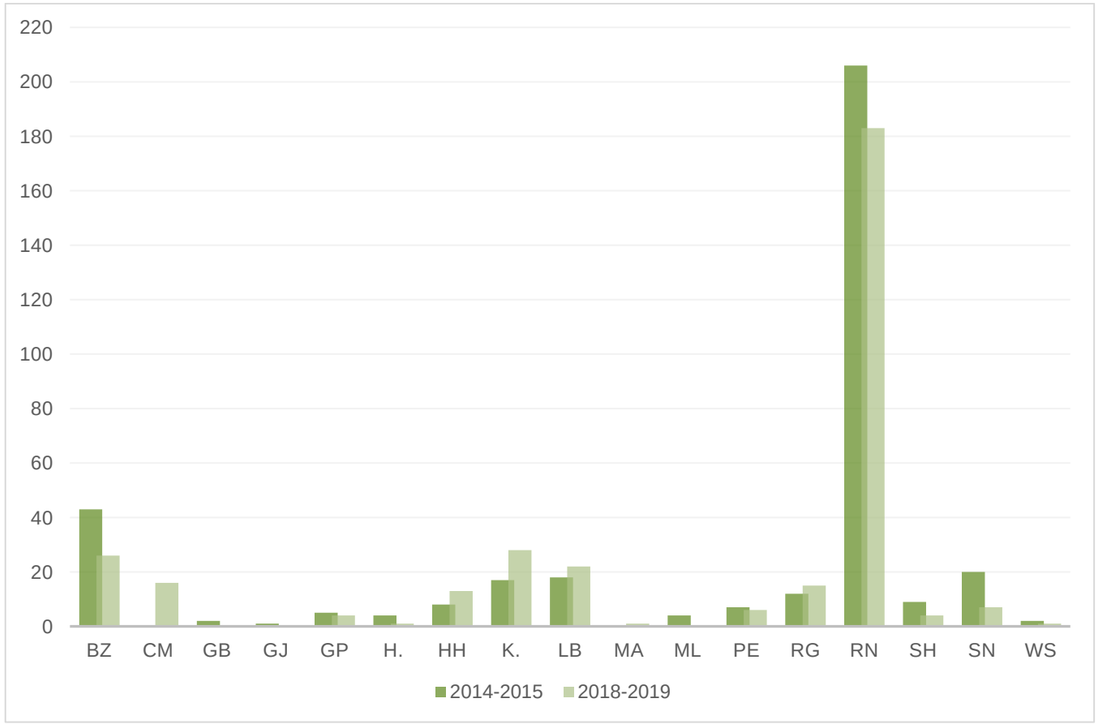
177. Between the two years of survey (2014 – 2015 and 2018 – 2019) there were some changes noted in species detection rates (**Table 9.70**). There was an increase in kestrel and hen harrier activity between years perhaps due to the presence of nesting pairs in closer proximity to the 500 m survey buffer.

178. Snipe detections on vantage points were also lower in 2018 – 2019 than in 2014 – 2015 and may be indicative of the general wader declines nationally although numbers of snipe in the windfarm and wider area appear good. Whilst slightly reduced between years, the relative activity of golden plover (and red grouse) were generally similar between the survey years.

179. Raven were the principal species recorded in both years and seasons of survey and all vantage point observations series including during breeding, wintering or migration periods. However raven declined slightly in recent years (**Table 9.70**). Raven activity declined marginally and may be that the roost site which was active in 2014 – 2015 trees had been partly felled in between surveys but nesting pairs were also recorded closer and activity remained relatively frequent between years. Raven were observed exhibiting considerable avoidance responses to operational turbines (as mapped) and also recorded flying through and around turbines readily including in one instance through the rotor swept area of turning blades (M. Ruddock, personal observation).

Table 9.70 – Cumulative breeding and wintering vantage point aggregated species sightings records within the survey area and 500 m buffer between 2014 / 2015 and 2018 / 2019. Showing species detections and proportions and direction of change between surveys in 2014-2015 and 2018-2019 (tabulated and graphed).

Species	TOTAL 2014 - 2015	% of detections	TOTAL 2018 - 2019	% of detections	Direction of change
BZ	43	12	26	8	↓
CM	0	0	16	4.9	↑
GB	2	0.6	0	0	↓
GJ	1	0.3	0	0	↓
GP	5	1.4	4	1.2	↓
H.	4	1.1	1	0.3	↓
HH	8	2.2	13	4	↑
K.	17	4.7	28	8.6	↑
LB	18	5	22	6.7	↑
MA	0	0	1	0.3	↑
ML	4	1.1	0	0	↓
PE	7	2	6	1.8	↓
RG	12	3.4	15	4.6	↑
RN	206	57.5	183	56	↓
SH	9	2.5	4	1.2	↓
SN	20	5.6	7	2.1	↓
WS	2	0.6	1	0.3	↓
TOTAL	358		327		↓



3.6.5. Migration Vantage Point Surveys

180. There were 36 hours observation completed at each vantage point in the spring (SMVP) between January 2018 and April 2018 and in the autumn (AMVP) between September 2018 and November 2018 (**Tables 9.71 & 9.72**) with a total of 72 hours completed during migration seasons. Survey times ranged from 06.40hrs to 20.10hrs (**Table 9.71**) and covered a wide range of weather conditions (**Table 9.73**).

Table 9.71 – Migration season vantage point survey effort

Type	VP No	Observer	Month	Day	Year	Start	End	Duration
SMVP	MIG	DR	1	31	2018	06:45	09:45	03:00
SMVP	MIG	DR	2	5	2018	14:20	17:20	03:00
SMVP	MIG	DR	2	12	2018	15:05	18:05	03:00
SMVP	MIG	DR	2	22	2018	10:35	13:35	03:00
SMVP	MIG	DR	2	22	2018	13:50	16:50	03:00
SMVP	MIG	MR	2	26	2018	11:30	14:30	03:00
SMVP	MIG	DR	3	12	2018	13:25	16:25	03:00
SMVP	MIG	DR	3	19	2018	09:30	12:30	03:00
SMVP	MIG	CS	3	22	2018	08:35	11:35	03:00
SMVP	MIG	DR	3	25	2018	09:55	12:55	03:00
SMVP	MIG	CS	4	9	2018	16:50	19:50	03:00
SMVP	MIG	CS	4	16	2018	12:50	15:50	03:00
AMVP	MIG	DR	9	6	2018	09:05	12:05	03:00
AMVP	MIG	DR	9	19	2018	06:40	09:40	03:00
AMVP	MIG	DR	9	27	2018	08:15	11:15	03:00
AMVP	MIG	CS	9	29	2018	17:10	20:10	03:00
AMVP	MIG	DR	10	7	2018	10:40	13:40	03:00
AMVP	MIG	KM	10	15	2018	09:45	12:45	03:00
AMVP	MIG	KM	10	18	2018	10:10	13:10	03:00
AMVP	MIG	DR	10	26	2018	08:50	11:50	03:00
AMVP	MIG	DR	11	4	2018	07:40	10:40	03:00
AMVP	MIG	CS	11	19	2018	14:20	17:20	03:00
AMVP	MIG	DR	11	21	2018	07:55	10:55	03:00
AMVP	MIG	CS	11	27	2018	14:20	17:20	03:00

Table 9.72 – Migration vantage point survey effort by month

VP No.	Jan	Feb	Mar	Apr		Sep	Oct	Nov	TOTAL
Spring Migration	3	15	12	6					36
Autumn Migration	-	-	-	-		12	12	12	36
TOTAL	3	15	12	6		12	12	12	72

Table 9.73 – Migration vantage point weather conditions

VP & DATE				Cloud Cover				Cloud Height (m)				Wind - Direction & Speed				Precipitation				Visibility (km)			
VP No.	M	D	Y	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3	0	+1	+2	+3
SMIG	1	31	2018	4	4	6	6	800	600	600	600	W3	W3	W4	W4	NIL	IHS	NIL	ILS	1.5	3	5	5
SMIG	2	5	2018	6	8	4	4	800	800	800	600	SW2	SW3	SW3	SW2	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	2	12	2018	6	8	8	10	800	800	800	800	S3	S3	S3	S3	NIL	ILR	NIL	NIL	5	5	5	5
SMIG	2	22	2018	8	10	10	10	800	800	800	800	S2	S3	S3	S3	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	2	22	2018	10	10	10	10	800	800	800	800	S3	SE3	SE2	SE2	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	2	26	2018	8	9	9	9	1100	900	900	900	SE3	E3	E3	E3	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	3	12	2018	6	8	8	8	800	800	800	800	NW3	NW3	NW2	NW2	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	3	19	2018	5	6	4	6	800	800	800	800	NE3	NE4	NE3	NE3	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	3	22	2018	9	9	10	10	600	600	600	600	SW4	SW4	SW5	SW4	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	3	25	2018	8	8	10	8	600	800	600	600	NE3	NE3	NE4	NE3	NIL	ILR	NIL	NIL	5	5	5	5
SMIG	4	9	2018	10	9	7	6	600	600	500	500	SE4	SE4	SE4	SE4	NIL	NIL	NIL	NIL	5	5	5	5
SMIG	4	16	2018	10	10	10	10	600	600	600	600	S5	SE5	SE5	SE4	NIL	NIL	ILR	NIL	5	5	5	5
AMIG	9	6	2018	9	8	9	9	600	500	400	500	NW2	NW2	NW3	NW3	NIL	IHR	NIL	NIL	5	5	5	5
AMIG	9	19	2018	10	10	8	10	500	500	500	500	SE4	S5	S5	SW4	NIL	IHR	NIL	ILR/M	1.5	5	5	5
AMIG	9	28	2018	7	8	6	6	700	600	600	600	NW1	NW2	NW3	NW3	NIL	NIL	NIL	NIL	5	5	5	5
AMIG	9	29	2018	10	9	10	10	600	600	600	600	W4	W4	W4	W4	NIL	NIL	NIL	NIL	5	5	5	5
AMIG	10	7	2018	10	10	10	10	600	600	600	600	S3	SW4	SW4	SW4	NIL	ILR	ILR	NIL	5	5	5	5
AMIG	10	15	2018	0	1	1	1	NIL	2000	2000	2000	SE1	SW2	SW2	SW2	NIL	NIL	NIL	NIL	5	5	5	5
AMIG	10	18	2018	7	9	8	8	1000	1000	600	600	SSW2	SSW2	SSW3	SSW3	NIL	NIL	NIL	NIL	5	5	5	5
AMIG	10	26	2018	9	7	7	5	600	6000	600	800	NW3	N3	N3	NW3	IHR	NIL	IHR	NIL	5	5	5	5
AMIG	11	4	2018	3	3	3	5	1000	1000	1000	1000	S4	S4	S4	S4	NIL	NIL	NIL	NIL	5	5	5	5
AMIG	11	19	2018	10	10	9	9	800	800	800	800	E3	E3	E3	E3	NIL	NIL	NIL	NIL	5	5	5	0.5
AMIG	11	21	2018	10	10	9	9	600	600	600	600	NW4	NW4	E4	E4	ILR	NIL	NIL	NIL	3	5	5	5
AMIG	11	27	2018	10	10	10	10	330	330	370	370	E4	S4	SW4	W4	ILR	NIL	NIL	NIL	0.2	0.2	5	5

181. There were nine target species (**Table 9.1**) recorded inside the survey area and 500 m buffer; buzzard, golden plover, hen harrier, kestrel, lesser black-backed gull, peregrine, red grouse, raven and sparrowhawk (**Tables 9.74 & 9.75**).

182. Raven (75%) were the most frequently detected species during the migration surveys with similar detection frequencies for buzzard (6.3%) and hen harrier next most frequently detected (4.9%) with only species all less than 4%. There was a similar level of activity of species in the autumn period (**Table 9.76**) and the spring period (**Table 9.76**).

183. There were no flocks' whooper swans or other geese recorded during migration surveys within the survey area and 500 m buffer (**Figure 9.38**). Similar to other vantage point observations both during breeding and wintering season raven were the most frequently recorded species. Raven flocks of up to 25 birds were observed in the spring.

Table 9.74 – Migration vantage point sightings records recorded within the survey area and 500 m buffer

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
SMIG	1	31	2018	2	RN	6	08:05	1	
SMIG	1	31	2018	2	RN	1	08:20	1	
SMIG	1	31	2018	2	RN	2	08:55	1	
SMIG	1	31	2018	2	BZ	1	09:20	1	
SMIG	1	31	2018	2	RN	2	09:30	1	
SMIG	1	31	2018	2	RN	1	09:40	1	
SMIG	2	5	2018	2	RN	3	14:45	1	Tumbling
SMIG	2	5	2018	2	RN	2	15:00	1	
SMIG	2	5	2018	2	RN	1	15:10	1	
SMIG	2	5	2018	2	RN	5	15:50	1	
SMIG	2	5	2018	1	HH	1	16:20	1	Female
SMIG	2	5	2018	2	RN	3	16:40	1	
SMIG	2	12	2018	2	RN	5	16:00	1	
SMIG	2	12	2018	2	RN	1	16:15	1	
SMIG	2	12	2018	2	RN	3	16:40	1	
SMIG	2	12	2018	2	RN	2	16:50	1	
SMIG	2	12	2018	2	RN	1	17:15	1	
SMIG	2	22	2018	2	RN	5	11:15	1	
SMIG	2	22	2018	2	RN	2	11:45	1	
SMIG	2	22	2018	2	RN	25	12:30	1	
SMIG	2	22	2018	2	RN	4	12:45	2	Mobbing PE
SMIG	2	22	2018	1	PE	1	12:48	1	
SMIG	2	22	2018	2	BZ	1	13:10	1	
SMIG	2	22	2018	2	RN	5	14:00	1	
SMIG	2	22	2018	2	RN	2	14:30	1	
SMIG	2	22	2018	2	RN	1	14:40	1	
SMIG	2	22	2018	2	RN	3	15:10	1	
SMIG	2	26	2018	2	RN	1	11:51	1	
SMIG	2	26	2018	1	HH	1	13:10	1	Male
SMIG	2	26	2018	2	RN	1	13:10	1	Mobbing HH
SMIG	2	26	2018	2	RN	1	13:45	1	Direct flight
SMIG	3	12	2018	2	BZ	2	13:35	1	Circling mobbed by RN
SMIG	3	12	2018	2	RN	1	13:35	1	Mobbing BZ
SMIG	3	12	2018	2	RN	2	13:45	1	
SMIG	3	12	2018	2	RN	7	14:00	1	
SMIG	3	12	2018	2	RN	1	14:25	1	
SMIG	3	12	2018	2	RN	2	14:30	1	
SMIG	3	12	2018	2	RN	5	15:10	1	
SMIG	3	12	2018	2	RG	1	15:20	1	Disturbed
SMIG	3	19	2018	2	RN	3	09:45	1	
SMIG	3	19	2018	2	RN	1	10:00	1	
SMIG	3	19	2018	2	BZ	2	10:25	1	Circling / soaring
SMIG	3	19	2018	1	HH	1	11:10	2	Male hunting flight
SMIG	3	19	2018	1	HH	1	11:10	2	Male hunting flight
SMIG	3	19	2018	2	SH	1	12:05	1	
SMIG	3	22	2018	2	RN	2	08:55	1	
SMIG	3	22	2018	2	RN	1	09:15	1	
SMIG	3	22	2018	2	RN	2	10:30	1	
SMIG	3	22	2018	2	BZ	1	10:40	1	Circling
SMIG	3	22	2018	2	RN	4	11:00	1	
SMIG	3	25	2018	2	RN	1	11:00	1	
SMIG	4	9	2018	2	RN	3	17:10	1	Flying together
SMIG	4	9	2018	2	RN	1	17:55	1	Flying, calling, tumbling / displaying
SMIG	4	16	2018	2	RN	3	13:00	1	Flying together
SMIG	4	16	2018	2	RN	1	13:45	1	Flew through wind farm
AMIG	9	6	2018	2	K.	1	09:30	1	
AMIG	9	6	2018	2	RN	2	09:40	1	
AMIG	9	6	2018	2	RN	1	10:05	1	
AMIG	9	6	2018	2	RN	3	10:20	1	
AMIG	9	6	2018	2	RN	2	10:30	1	
AMIG	9	6	2018	2	RN	3	10:35	1	
AMIG	9	6	2018	2	RN	1	10:55	1	
AMIG	9	6	2018	2	RN	2	11:30	1	
AMIG	9	6	2018	2	RN	1	11:35	1	
AMIG	9	6	2018	2	BZ	1	11:45	1	
AMIG	9	19	2018	2	RN	1	08:05	1	
AMIG	9	28	2018	2	RG	2	08:30	1	Disturbed
AMIG	9	28	2018	2	RN	2	09:10	1	
AMIG	9	28	2018	2	K.	1	10:15	1	Hunting and hovering
AMIG	9	28	2018	2	RN	1	10:30	1	
AMIG	9	29	2018	2	RN	2	17:10	11	Flying in one area. Flew north
AMIG	9	29	2018	2	RN	4	17:10	15	Flying in one area. Flew to forest

VP No	Month	Day	Year	Target	Species	Number	Time Detected	Number of 5 min intervals	Comments
AMIG	9	29	2018	2	K.	1	18:55	1	Female hunting
AMIG	10	7	2018	2	RN	1	10:50	2	Undulating flight in high wind
AMIG	10	7	2018	2	LB	2	12:00	1	
AMIG	10	7	2018	2	BZ	1	12:30	1	Hunting hovering flight into wind
AMIG	10	7	2018	2	RN	1	12:50	1	
AMIG	10	7	2018	2	RN	1	13:05	1	
AMIG	10	15	2018	2	RN	2	10:05	1	Flying at Temain hill
AMIG	10	15	2018	2	RN	1	11:25	1	Flying
AMIG	10	15	2018	2	RN	1	11:30	1	Flying
AMIG	10	15	2018	2	RN	3	11:45	2	Flying
AMIG	10	15	2018	2	RN	2	12:35	1	Flying
AMIG	10	18	2018	2	RN	1	11:05	1	Flying
AMIG	10	18	2018	2	RN	3	11:35	1	Flying
AMIG	10	18	2018	2	RN	2	11:35	1	Flying
AMIG	10	18	2018	2	BZ	1	12:00	1	Gaining height and soaring
AMIG	10	18	2018	2	RN	1	12:15	1	Takes off and flew
AMIG	10	18	2018	2	RN	1	12:25	1	Flying
AMIG	10	18	2018	2	RN	2	12:35	1	Flying
AMIG	10	18	2018	2	RN	1	12:40	1	Flying
AMIG	10	18	2018	2	RN	1	12:45	1	Flying
AMIG	10	26	2018	2	RN	1	09:00	1	
AMIG	10	26	2018	2	BZ	1	09:25	1	Soaring, circling
AMIG	10	26	2018	2	RN	1	09:25	1	
AMIG	10	26	2018	2	RN	2	09:50	1	
AMIG	10	26	2018	2	RN	1	10:20	1	
AMIG	10	26	2018	2	RN	1	11:00	1	
AMIG	10	26	2018	2	RN	1	11:30	1	
AMIG	10	26	2018	2	K.	1	11:45	1	
AMIG	11	4	2018	2	RN	3	08:20	1	
AMIG	11	4	2018	2	RN	2	09:25	1	
AMIG	11	4	2018	2	RN	2	10:15	1	
AMIG	11	19	2018	2	RN	2	15:10	1	Flying along forest
AMIG	11	19	2018	2	RN	1	15:45	1	
AMIG	11	21	2018	1	GP	150	07:55	1	
AMIG	11	21	2018	1	GP	150	09:10	3	
AMIG	11	21	2018	1	HH	1	10:40	1	Female
AMIG	11	21	2018	2	RN	3		1	
AMIG	11	27	2018	2	RG	1	16:15	1	Calling
AMIG	11	27	2018	2	RG	1	16:25	1	Calling
AMIG	11	27	2018	1	GP	1	16:30	1	Calling

Table 9.75 – Migration vantage point aggregated species sightings records within the survey area and 500 m buffer

Species	Number of detections	%	Number of five minute intervals	%
BZ	9	8.0	9	6.3
GP	3	2.7	5	3.5
HH	5	4.5	7	4.9
K.	4	3.6	4	2.8
LB	1	0.9	1	0.7
PE	1	0.9	1	0.7
RG	4	3.6	4	2.8
RN	84	75.0	111	77.6
SH	1	0.9	1	0.7
Total	112		143	

Table 9.76 – Migration vantage point aggregated species sightings records within the survey area and 500 m buffer by month

Species	Jan	Feb	Mar	Apr		Sep	Oct	Nov	TOTAL
BZ	1	1	3			1	3		9
GP								3	3
HH		2	2					1	5
K.						3	1		4
LB							1		1
PE		1							1
RG			1			1		2	4
RN	5	21	13	4		13	22	6	84
SH			1						1
Total	6	25	20	4		18	27	12	112

184. Three target 1 species flights (**Table 9.1**) were recorded (**Tables 9.74, 9.75 & 9.76**); hen harrier (n = 5), peregrine (n = 1) and golden plover (n = 3) and had flying height(s) recorded (**Table 9.77**) and were mapped (**Figures 9.38**).

185. The hen harriers were observed in late winter and spring as pairs began to re-establish breeding territories similar to other timings from previous sightings during the breeding season (see Section 9.3.3.4).

186. Golden plover movements were mostly recorded in the late autumn migration and this species is not known to over-winter on the site. Peregrines were recorded in late winter passing through and hunting.

Table 9.77 – Breeding vantage point flying height and duration of Target 1 species records inside the survey area and 500 m buffer

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	50-100m	100-125m	125-140m	>140m	Notes
SMIG	2	5	2018	HH	1	16:18	98	98								Female
SMIG	2	22	2018	PE	1	12:48	36		15	21						
SMIG	2	26	2018	HH	1	13:07	9	9								Male
SMIG	3	19	2018	HH	1	11:08	135	135								Male
AMIG	11	21	2018	GP	150	07:55	150	100	50							
AMIG	11	21	2018	GP	150	09:10	600	100	145	120	100	135				
AMIG	11	21	2018	HH	1	10:36	128	128								Female

3.6.6. Breeding Priority Species Surveys 2018

187. There were 82 hours and 40 minutes spent searching adjacent habitats for priority species between March 2018 and August 2018 (**Table 9.1; Table 9.78**) with efforts concentrated on hen harrier, merlin, red grouse and waders during the breeding season. Survey times ranged between 05.25hrs to 00.45hrs and covered a wide range of weather conditions (**Table 9.78**).

Table 9.78 Details of breeding priority species searches (PSS), including survey effort, weather

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km	22	3	2018	07:40	12:40	05:00	6	600	SW	3	NIL	5
PSS	2 km / >2 km	9	4	2018	10:30	13:30	03:00	9	500	SE	2	ILR	5
RGS / PSS	500 m / 2km	21	4	2018	20:00	23:15	03:15	3	1500	S	1	NIL	5
RGS / PSS	500 m	21	4	2018	20:00	23:15	03:15	3	1500	S	1	NIL	2
PSS	2 km	22	4	2018	12:15	16:15	04:00	3	1500	S	1	NIL	5
PSS	2 km	24	4	2018	07:15	15:00	07:45	10	800	SW	3	NIL	5
PSS	2 km	4	5	2018	17:05	18:35	01:30	8	600	SW	3	NIL	5
SNS / PSS	2 km	4	5	2018	21:35	22:35	01:00	6	600	SW	2	NIL	5
SNS / PSS	500m / 2 km / >2 km	9	5	2018	05:25	09:25	04:00	10	800	S	3	NIL	5
PSS	2 km / >2 km	9	5	2018	09:30	12:30	03:00	10	800	S	3	ILR	5
SNS / PSS	500 m	23	5	2018	22:55	00:45	01:50	3	1500	E	1	NIL	2
PSS	2 km / >2 km	28	5	2018	16:30	19:30	03:00	3	1000	NE	2	NIL	5
PSS	2 km	30	5	2018	14:40	17:40	03:00	3	700	N	3	NIL	5
PSS	2 km / >2 km	19	6	2018	10:55	13:55	03:00	10	500	SW	2	NIL	5
PSS	2 km	19	6	2018	17:15	19:00	01:45	10	500	SW	2	NIL	5
PSS	2 km	20	6	2018	15:05	19:35	04:30	5	900	NW	3	NIL	5
PSS	2 km	21	6	2018	16:05	19:45	03:40	5	90	NW	2	NIL	5
PSS	2 km	14	7	2018	17:00	22:00	05:00	5	90	SW	3	NIL	5
PSS	2 km	22	7	2018	14:30	18:20	03:50	8	700	SW	2	NIL	5
PSS	2 km	26	7	2018	09:35	11:35	02:00	5	800	S	3	NIL	5
PSS	2km	29	7	2018	07:20	10:45	03:25	5	600	SW	5	NIL	5
PSS	2 km	4	8	2018	13:45	18:35	04:50	5	900	SW	1	NIL	5
RGS / PSS	500 m / 2km	21	8	2018	13:15	17:15	04:00	10	400	SW	2	NIL	5
RGS / PSS	500 m / 2km	30	8	2018	11:05	14:10	03:05	9	1000	SW	2	NIL	5

188. There were 15 target species were recorded; namely buzzard, common gull, curlew, heron, hen harrier, kestrel, lesser black-backed gull, long-eared owl, mallard, peregrine, red grouse, raven, sparrowhawk, snipe and woodcock (**Table 9.79**). The sightings from all surveys were aggregated to identify territory locations of target species (**Table 9.1**) and in particular to identify curlew, red grouse, snipe and raptor territories within the survey area and 500 m buffer (**Figure 9.39; Figure 9.39 CONFIDENTIAL**) and to review published avoidance distances (Ruddock & Whitfield, 2007; Pearce-Higgins et al., 2009) (**Figure 9.40; Figure 9.40 CONFIDENTIAL**).

3.6.6.1. Raptor surveys

189. There was one raptor species, sparrowhawk, recorded breeding within the 500 m proposed turbine buffers and a second species just beyond the 500 m proposed turbine buffer, namely kestrel. Both species were recorded within commercial conifer forest plantation. There were two pairs of hen harrier breeding within the survey area and 500 m buffer although both were beyond 500 m from either existing or proposed turbines (**Figures 9.39 & 9.39 CONFIDENTIAL**). Two pairs of buzzards and an additional three pairs of sparrowhawk were breeding within survey area and 500 m buffer (**Figures 9.39**). Two pairs of ravens were recorded within the survey area and 500 m buffer.

190. In the wider 2 km area buzzard (n = 9) and sparrowhawk (n = 2) along with two kestrel territories and an additional raven territory (**Figures 9.39 & 9.39 CONFIDENTIAL**) were recorded. Long-eared owl were also recorded alongside the existing forest access track within 2 km and breeding (displaying) woodcock were recorded nearby the long-eared owl. A single peregrine was recorded to the south and moved between the cliff and quarries in the southern area including beyond 2 km and a separate peregrine was recorded to the north, but no breeding behaviours were recorded at either locality.

191. Beyond 2 km, three additional buzzard territories were identified along with one kestrel territory and one raven harrier territory. The hen harrier site has relocated since previous survey years further to the north (**Figure 9.39 CONFIDENTIAL**). No additional hen harrier territories were identified in the 5 km survey area during 2018, and the second pair within 500 m has almost certainly relocated from the previously recorded breeding area to the north in recent years, based on suitability of the age structure of the replanted forest at the recently selected breeding locations in close proximity to the operational Rigged Hill Windfarm.

3.6.6.2. Red grouse surveys

192. Red grouse surveys within the core survey area and 500 m buffer identified eight red grouse territories (6 in 2014; 5 in 2015; 2 in 2016). Five of these were within the 500 m buffer of both the existing turbines and the proposed turbines (**Figure 9.39**) and none of the existing and proposed turbines were completely outside the 500 m buffer of red grouse territories (**Figures 9.40 & 9.40 CONFIDENTIAL**).

3.6.6.3. Wader surveys

193. There were no curlew within the survey area, 500 m buffer or 800 m buffer. All curlew territories recorded were greater than 1km beyond both existing and proposed turbines (see Pearce-Higgins et al., 2009; **Figure 9.39**). Only one curlew territory was recorded within the 2 km survey area at Craiggore (**Table 9.79; Figure 9.39**).

194. There were 17 snipe territories within the survey area and 500 m buffer in 2018 (17 in 2014; 12 in 2015; 10 in 2016), of which eight were within the 500 m existing turbine buffer and 11 within the 500 m proposed turbine buffer (**Figure 9.39**). The 400 m buffer of snipe territory locations (see Pearce-Higgins et al., 2009) (**Figure 9.40**) shows that all of the ten existing turbines are within 400 m of snipe territories and six of the seven proposed turbines are also within the 400 m buffer of snipe territories (**Figure 9.40**).

Table 9.79 Details of breeding priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	2 km	22	3	2018	HH, BZ, SH, RN	9:05 HH female, glided from perch in forest, quartered rough grass / farmland for several minutes. 2 BZ pair diving and circling, perched on separate dead trees. Copulated. Flew together, mobbed by 2 HC. SH Circling display over forest. 2 BZ displaying in sun. 2 BZ 2nd pair along same ridge, female flew into deciduous copse at previous nest site. SH flew across fields, low along hedge. RN flying <10m from Giants Mill. 2 BZ circling, displaying together, lost behind deciduous forest.
PSS	2 km/ >2 km	9	4	2018	RN, HH	12:02 2 RN flying together calling near Boyds mountain. 12:13 RN flying and calling near Boyds mountain. HH pair displaying over valley and female dropping into land at restock north of windfarm
RGS / PSS	500 m / 2km	21	4	2018	SN, RG	5 SN in turbines (distant) and to Gortnarney, Temain Hill and Terrydoo Clyde. RG at Gortnarney and Temain Hill (x 4)
RGS / PSS	500 m	21	4	2018	RG, SN	4 SN (1+1+1+1) 2 RG (1+1) calling in windfarm. 2 SN (1+1) to the west of windfarm. RG to the south of windfarm.
PSS	2 km	22	4	2018	HH, SH, RN	HH pair to north perched up and nest building near forest edge. HH pair to east of site, dropping in and copulating in area of restock forest. Male defending against SH pair displaying and RN nest site (2 y flying at forest corner). BZ pair at Crockanboy seen displaying on departure
PSS	2 km	24	4	2018	BZ, SH, K. RN	BZ pairs and activity at Ballavelin, Grain Mill, Little Derry, Gortnarney, Terrydoo Walker and Ford (south). SH pair in river valley at Ford. RN used nest at Little Derry. RN used nest at Keady Mt, K. pair present and BZ pair further west along slope below road and also at Cam Forest
PSS	2 km	4	5	2018	BZ, HH, RG	2 BZ (1+1) and male HH foraging around Temain hill. RG flying near Donald's pot.
SNS / PSS	2 km	4	5	2018	SN, RG, CU	2 SN (1+1) and 1 RG calling near Temain hill. 4 SN (1+1+1+1) calling near Craiggore also CU pair calling at Craiggore. One bird perched on fence post
SNS / PSS	500m / 2 km / >2 km	9	5	2018	SN, SH, CM, LB, BZ, K., RN,	SN at Terrydoo Clyde and south east of Terrydoo Walker. SH pair in field edge perched up and copulating at Terrydoo Clyde. 2 RN near Boyds mountain. 3 BZ and 2 LB flying near Keady. 6 CM Flying near Ford. BZ flying near Carnet. 3 LB and 2 RN flying near Gloghan. K. flying Aghansillagh and headed south to Donalds Pot with prey.
PSS	2 km / >2 km	9	5	2018	HH, K., SN, RN, RG	HH and K. flying Craiggore both seen with prey towards nest sites. SN flying near Coolnasillagh. RG and 2 RN flying near Freugh. Kestrel pair perched up north of Tibaran Mt at edge of woodland
SNS / PSS	500 m	23	5	2018	SN, RG, LE, WK	SN chipping from different locations at 22:55 - 23:00; 23:35; 23:41; 23:45; 23:56; RG calling 23:48; 23:52. SN heard chipping earlier on vp too. LE pair perched up, calling and WK roding near track on way out of forest
PSS	2 km / >2 km	28	5	2018	RN, HH, RG	3 RN (1+1+1) flying over south side of Cam forest. RG and HH flying near Coolnasillagh. CU not seen
PSS	2 km	30	5	2018	BZ, RN	BZ flying over Fort View Lodge. BZ flying over Lislane Bridge towards Grain Mill site. RN flying towards Donalds hill.
PSS	2 km / >2 km	19	6	2018	BZ, SH, CM, RN, LB, HH, H.	2 BZ flying to the west of keady. 3 CM and a SH flying to the NW of Terrydoo Walker. 14 CM flying to the east of Carnet. 5 RN flying over Ardmore Bridge. 2 LB flying near Fort View Lodge. HH male and a RN flying around Coolnasillagh. RN flying to the south west of Mill Quarter. LB flying around Coose Quarter. 2 RN flying south of Kiltest. 2 RN and a H. flying to the N/ NE of Boyds mountain.
PSS	2 km	19	6	2018	K., HH, SH	Active kestrel nest just beyond the 500 m buffer at edge of forest. Male seen into trees with wood mouse. Male HH seen perched up at northern site. Nest may have failed. HH site active to east. SH pairs x 2 on eastern side of site
PSS	2 km	20	6	2018	HH, K	Eastern HH site active and mobbing BZ vigorously. K. site north of Tibaran Mt remained active - pair heard squealing
PSS	2 km	21	6	2018	BZ, SH	No activity at northern HH site, despite long watch. No observations of HH, appears to have failed. BZ sites and SH site both active and also BZ at Boyds Mt
PSS	2 km	14	7	2018	BZ, K.	Cam / Keady ridge 3 pairs BZ all with 1+ young flying, PE single seen over quarry. K. pair soaring / hovering over western quarry with 1+ young. SH at Terrydoo Clyde failed but young calling at Ford from river gully. BZ Little Derry 2y, Drumgesh and Ballyavelin both 1+ young
PSS	2 km	22	7	2018	HH, SH, K.	HH eastern site fledged 2+ young, adult male and female both seen. SH juveniles calling from trees; K. fledged 2+ young at Tibaran. BZ at Freugh young heard calling from trees but not seen
PSS	2 km	26	7	2018	BZ, SN, PE, RN	BZ flying around Temain hill. RN east of Craiggore. SN flying to the west of Coolnasillagh. 1 BZ flying and 1 BZ heard calling in

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
						the south side of Cam forest. 11:28 PE flying NW near Coolnasillagh then turned towards Donald's Pot
PSS	2km	29	7	2018	BZ, HH, RN, MA, PE	BZ and 2 RN (1+1) flying on north side of Cam forest near Boyds mountain. 2 MA flying to NE of Cam forest. 8:48 PE perched on dead tree in east side of Cam forest. RN calling south of Baran in Cam forest. 9:15 HH female at eastern site. Dead kestrel reported in windfarm - probable collision
PSS	2 km	4	8	2018	HH, SH	3 juvenile HH and adult female observed. SH 2 + young heard calling and flying into nest area
RGS / PSS	500 m / 2km	21	8	2018	RG	RG covey seen 4 birds
RGS / PSS	500 m / 2km	30	8	2018	RG	RG at Temain and south end; and bird called briefly near Gortnarney site

3.6.7. Wintering Priority Species Surveys 2018 - 2019

195. During the winter of 2018 to 2019 (September 2018 to February 2019), there were 44 hours and 15 minutes spent searching adjacent habitats within the survey areas (**Figure 9.1**) for priority species (**Table 9.1; Table 9.80**) with efforts concentrated on hen harrier wintering sites and whooper swan during the wintering season. Survey times ranged between 06.55hrs to 17.15hrs and covered a wide range of weather conditions (**Table 9.80**).

Table 9.80 Details of wintering priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Start time	End time	Duration	Cloud	Height	Wind dir.	Wind strength	Prec.	Vis. (km)
PSS	2 km / > 2km	6	9	2018	07:00	09:00	02:00	8	900	NW	2	ILS	5
PSS	2 km / > 2km	25	9	2018	07:00	09:00	02:00	10	500	SW	1	NIL	5
PSS	2km	29	9	2018	11:45	13:55	02:10	10	600	W	4	NIL	5
PSS	2km	29	9	2018	16:55	17:10	00:15	10	600	W	4	NIL	5
PSS	500 m/ 2 km	15	10	2018	12:45	15:45	03:00	1	2000	SW	2	NIL	60
WRS / PSS	2 km / > 2km	19	10	2018	06:55	08:45	01:50	10	450	SW	2	ILM	2
PSS	500 m / 2 km / >2 km	23	10	2018	07:45	10:45	03:00	10	500	W	4	CLM	3
PSS	2 km / > 2km	21	11	2018	11:15	15:35	04:20	9	600	E	4	NIL	5
PSS	2 km / > 2km	28	11	2018	10:35	13:45	03:10	10	350	SE	2	CLR/M	2
PSS	2 km	30	11	2018	10:45	12:00	01:15	10	500	W	4	IHR	5
WRS / PSS	2 km	30	11	2018	16:00	17:15	01:15	10	500	W	4	IHR	5
PSS	2 km / > 2km	9	12	2018	10:55	13:45	02:50	10	400	NW	2	NIL	5
PSS	2 km / > 2km	19	12	2018	11:30	13:40	02:10	6	600	SE	2	NIL	5
PSS	2 km	10	1	2019	14:00	16:00	02:00	10	2000	W	2	ILR	10
PSS	2 km	15	1	2019	13:15	16:15	03:00	10	600	W	3	ILR	20
WRS / PSS	2 km	19	1	2019	07:05	09:05	02:00	5	900	N	2	NIL	5
PSS	2 km / > 2km	19	1	2019	09:15	11:15	02:00	5	900	NW	2	NIL	5
PSS	500 m / 2km	8	2	2019	11:30	14:30	03:00	10	600	SW	6	CLR	5
PSS	2 km	14	2	2019	09:30	10:00	00:30	10	1000	S	4	NIL	20
PSS	2 km / >2 km	14	2	2019	13:20	15:50	02:30	4	1000	S	4	NIL	20

196. There were nine target species recorded; namely buzzard, herring gull, lesser black-backed gull, red grouse, raven, jack snipe, snipe, hen harrier and kestrel (**Table 9.81**).

197. The sightings from all surveys were aggregated to identify key wintering locations of target species (**Table 9.1**) and in particular to identify hen harrier and whooper swan locations within the core survey areas (**Figure 9.39; Figure 9.39 CONFIDENTIAL**).

198. Wintering priority species were recorded widely within 2 km including buzzard, and raven in various locations including near known breeding locations (**Figure 9.39**) and ravens including which were again recorded roosting within Cam forest and various aggregations throughout the winter and were again noted scavenging on carrion at a number of localities. A maximum of 27 ravens were recorded and again locations were shifted since 2014 – 2015 surveys since clear-felling of the previously utilised roost sites.

199. There were no swans or geese recorded within the 2km or 5 km zone and no winter roosting, foraging or commuting routes were identified including from the distant SPA at Lough Foyle.

200. Hen harrier winter roost areas were utilised within 2 km (**Figure 9.39 & 9.39 CONFIDENTIAL**) and included observations of ringtail (juvenile) birds roosting near the 2018 nest site on the eastern side, Other roosts were recorded to the north and to the south of the site maximum roost count was one bird (female only) to the north and a peak count of two birds (1 male and 1 female) were recorded at the southern sites (**Table 9.81**). These roost sites have been regularly and routinely occupied by hen harriers since 2014 – 2015 each winter of survey.

Table 9.81 Details of wintering priority species searches (PSS), including survey dates and species detected.

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
PSS	2 km / > 2km	6	9	2018	HH	No geese / swans in 2 km search zone. HH ringtail (juvenile) recorded at eastern nesting site perched up. Probably roosted overnight
PSS	2 km / > 2km	25	9	2018	None	No geese / swans in 5 km (south) search zone
PSS	2km	29	9	2018	BZ, HG, K., RN	BZ circling NE of Terrydoo walker. 3 HG flying over road north of Little Derry. K. female flying SE of Aghansillagh. 2 RN flying to the SW of windfarm.
PSS	2km	29	9	2018	JS, RG	JS on road at Temain hill. RG calling
PSS	500 m/ 2 km	15	10	2018	RN, SN	12:49 RN flying near Little Derry. 12:57 2 RN flying near windfarm. 13:23 RN flying over forest at Craiggore. 13:39 RN flying over forest near Freugh. 13:55 SN flushed near Craiggore. 14:00

Survey Type	Search Area	Day	Month	Year	Species detected	Notes
						SN flushed near Donald's hill. 14:32 SN flushed near Donald's hill. 14:40 RN flew over road.
WRS / PSS	2 km / > 2km	19	10	2018	HH	07:41 male HH out from roost and separately female out 08:07 from second roost site on southern side. RN (27) out from roost at southern edge of Cam Forest near BZ site
PSS	500 m / 2 km / >2 km	23	10	2018	BZ	8:47 BZ hunting / hovering into wind. 9:28 BZ flying over Cam forest. No swans or geese in 2 km zone and northern part of 5 km zone
PSS	2 km / > 2km	21	11	2018	None	No swans or geese recorded in the 5km zone
PSS	2 km / > 2km	28	11	2018	None	No swans or geese recorded in the 2 km / 5km (west / south) zones
PSS	2 km	30	11	2018	BZ	BZ flying towards Giants Mill
WRS / PSS	2 km	30	11	2018	RN	RN flying along west side of windfarm. RN flying over SE side of Cam forest in towards roost. No HH seen at southern roosts
PSS	2 km / > 2km	9	12	2018	None	No WS or other geese / swans in northern / eastern 5 km zone
PSS	2 km / > 2km	20	12	2018	BZ	BZ at Temain and over Donald's Pot. No swans or geese in 2 km zone and/or south / west of 5 km zone
PSS	2 km	10	1	2019	RN	14:46 RN flying
PSS	2 km	15	1	2019	RN	15:35 RN calling in forest at roost site
WRS / PSS	2 km	19	1	2019	HH	Female HH out from northern roost site @ 08:13 flew north over forest
PSS	2 km / > 2km	19	1	2019	None	No swans or geese in 2 km zone or northern part of 5 km zone
PSS	500 m / 2km	8	2	2019	SN	11:35 2 SN (1+1) flew from side of windfarm track near gate.
PSS	2 km	14	2	2019	BZ	9:52 BZ
PSS	2 km / >2 km	14	2	2019	LB	LB in fields. No swans or geese recorded in 2 km or 5 km zone. All suitable habitat checked

Rigged Hill Windfarm Repowering

Technical Appendix A9.2 – Ornithological Data Review

Volume 3 – Technical Appendices
July 2019

SCOTTISHPOWER RENEWABLES

A9.1 Ornithological Data Review

Table A9.1 Review of NBN data within 10km of the Rigged Hill Windfarm

Species Name	Scientific Name Authorship	Kingdom	Phylum	Class	Order	Family	Genus	Common Name
Tyto alba	(Scopoli, 1769)	Animalia	Chordata	Aves	Strigiformes	Tytonidae	Tyto	Barn owl
Turdus merula	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Turdus	Blackbird
Sylvia atricapilla	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Sylviidae	Sylvia	Blackcap
Chroicocephalus ridibundus	(Linnaeus, 1766)	Animalia	Chordata	Aves	Charadriiformes	Laridae	Chroicocephalus	Black-headed gull
Cyanocitta cristata	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Corvidae	Cyanocitta	Blue jay
Cyanistes caeruleus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Paridae	Cyanistes	Blue tit
Fringilla montifringilla	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Fringilla	Brambling
Pyrrhula pyrrhula	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Pyrrhula	Bullfinch
Fringilla coelebs	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Fringilla	Chaffinch
Phylloscopus collybita	(Vieillot, 1817)	Animalia	Chordata	Aves	Passeriformes	Phylloscopidae	Phylloscopus	Chiffchaff
Periparus ater	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Paridae	Periparus	Coal tit
Streptopelia decaocto	(Frivaldszky, 1838)	Animalia	Chordata	Aves	Columbiformes	Columbidae	Streptopelia	Collared dove
Buteo buteo	(Linnaeus, 1758)	Animalia	Chordata	Aves	Falconiformes	Accipitridae	Buteo	Common buzzard
Loxia curvirostra	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Loxia	Common crossbill
Larus canus	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Laridae	Larus	Common gull
Actitis hypoleucos	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Actitis	Common sandpiper
Phalacrocorax carbo	(Linnaeus, 1758)	Animalia	Chordata	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	Cormorant
Crex crex	(Linnaeus, 1758)	Animalia	Chordata	Aves	Gruiformes	Rallidae	Crex	Corncrake
Cuculus canorus	Linnaeus, 1758	Animalia	Chordata	Aves	Cuculiformes	Cuculidae	Cuculus	Cuckoo
Numenius arquata	(Linnaeus, 1758)	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Numenius	Curlew
Cinclus cinclus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Cinclidae	Cinclus	Dipper
Prunella modularis	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Prunellidae	Prunella	Dunnock
Columba livia	Gmelin, 1789	Animalia	Chordata	Aves	Columbiformes	Columbidae	Columba	Feral pigeon
Turdus pilaris	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Turdus	Fieldfare
Sylvia borin	(Boddaert, 1783)	Animalia	Chordata	Aves	Passeriformes	Sylviidae	Sylvia	Garden warbler
Regulus regulus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Regulidae	Regulus	Goldcrest
Pluvialis apricaria	(Linnaeus, 1758)	Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Pluvialis	Golden plover
Bucephala clangula	(Linnaeus, 1758)	Animalia	Chordata	Aves	Anseriformes	Anatidae	Bucephala	Goldeneye
Carduelis carduelis	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Carduelis	Goldfinch
Mergus merganser	Linnaeus, 1758	Animalia	Chordata	Aves	Anseriformes	Anatidae	Mergus	Goosander
Locustella naevia	(Boddaert, 1783)	Animalia	Chordata	Aves	Passeriformes	Locustellidae	Locustella	Grasshopper warbler
Larus marinus	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Laridae	Larus	Great black-backed gull
Parus major	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Paridae	Parus	Great tit
Podiceps cristatus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Podicipediformes	Podicipedidae	Podiceps	Great-crested grebe
Chloris chloris	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Chloris	Greenfinch
Ardea cinerea	Linnaeus, 1758	Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Ardea	Grey heron
Motacilla cinerea	Tunstall, 1771	Animalia	Chordata	Aves	Passeriformes	Motacillidae	Motacilla	Grey wagtail
Circus cyaneus	(Linnaeus, 1766)	Animalia	Chordata	Aves	Falconiformes	Accipitridae	Circus	Hen harrier
Larus argentatus	Pontoppidan, 1763	Animalia	Chordata	Aves	Charadriiformes	Laridae	Larus	Herring gull
Corvus cornix	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Hooded crow
Corvus corone	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Hooded crow
Delichon urbicum	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Delichon	House martin
Passer domesticus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Passeridae	Passer	House sparrow
Lymnocryptes minimus	(BrÃ¼nnich, 1764)	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Lymnocryptes	Jack snipe
Corvus monedula	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Jackdaw
Garrulus glandarius	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Corvidae	Garrulus	Jay
Falco tinnunculus	Linnaeus, 1758	Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Kestrel
Alcedo atthis	(Linnaeus, 1758)	Animalia	Chordata	Aves	Coraciiformes	Alcedinidae	Alcedo	Kingfisher
Vanellus vanellus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Vanellus	Lapwing
Larus fuscus	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Laridae	Larus	Lesser black-backed gull
Acanthis cabaret	(MÃ¼ller, 1776)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Acanthis	Lesser redpoll
Linaria cannabina	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Linaria	Linnet
Tachybaptus ruficollis	(Pallas, 1764)	Animalia	Chordata	Aves	Podicipediformes	Podicipedidae	Tachybaptus	Little grebe
Asio otus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Strigiformes	Strigidae	Asio	Long-eared owl
Aegithalos caudatus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Aegithalidae	Aegithalos	Long-tailed tit
Pica pica	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Corvidae	Pica	Magpie
Anas platyrhynchos	Linnaeus, 1758	Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Mallard
Anthus pratensis	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Motacillidae	Anthus	Meadow pipit
Falco columbarius	Linnaeus, 1758	Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Merlin
Turdus viscivorus	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Turdus	Mistle thrush
Gallinula chloropus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Gruiformes	Rallidae	Gallinula	Moorhen
Cygnus olor	(Gmelin, 1789)	Animalia	Chordata	Aves	Anseriformes	Anatidae	Cygnus	Mute swan

Species Name	Scientific Name Authorship	Kingdom	Phylum	Class	Order	Family	Genus	Common Name
Haematopus ostralegus	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Haematopus	Oystercatcher
Falco peregrinus	Tunstall, 1771	Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Peregrine
Phasianus colchicus	Linnaeus, 1758	Animalia	Chordata	Aves	Galliformes	Phasianidae	Phasianus	Pheasant
Motacilla alba	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Motacillidae	Motacilla	Pied wagtail
Anas acuta	Linnaeus, 1758	Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Pintail
Aythya ferina	(Linnaeus, 1758)	Animalia	Chordata	Aves	Anseriformes	Anatidae	Aythya	Pochard
Corvus corax	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Raven
Lagopus lagopus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Galliformes	Phasianidae	Lagopus	Red grouse
Mergus serrator	Linnaeus, 1758	Animalia	Chordata	Aves	Anseriformes	Anatidae	Mergus	Red-breasted merganser
Tringa totanus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Tringa	Redshank
Turdus iliacus	Linnaeus, 1766	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Turdus	Redwing
Emberiza schoeniclus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Emberizidae	Emberiza	Reed bunting
Erithacus rubecula	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Erithacus	Robin
Saxicola rubicola	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Saxicola	Robin
Corvus frugilegus	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Rook
Riparia riparia	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Riparia	Sand martin
Calidris alba	(Pallas, 1764)	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Calidris	Sanderling
Acrocephalus schoenobaenus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Acrocephalidae	Acrocephalus	Sedge warbler
Asio flammeus	(Pontoppidan, 1763)	Animalia	Chordata	Aves	Strigiformes	Strigidae	Asio	Short-eared owl
Spinus spinus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Spinus	Siskin
Alauda arvensis	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Alaudidae	Alauda	Skylark
Gallinago gallinago	(Linnaeus, 1758)	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Gallinago	Snipe
Plectrophenax nivalis	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Emberizidae	Plectrophenax	Snow bunting
Turdus philomelos	Brehm, 1831	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Turdus	Song thrush
Accipiter nisus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Falconiformes	Accipitridae	Accipiter	Sparrowhawk
Muscicapa striata	(Pallas, 1764)	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Muscicapa	Spotted flycatcher
Sturnus vulgaris	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Sturnidae	Sturnus	Starling
Columba oenas	Linnaeus, 1758	Animalia	Chordata	Aves	Columbiformes	Columbidae	Columba	Stock dove
Hirundo rustica	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Hirundo	Swallow
Apus apus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Apodiformes	Apodidae	Apus	Swift
Anas crecca	Linnaeus, 1758	Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Teal
Passer montanus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Passeridae	Passer	Tree sparrow
Certhia familiaris	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Certhiidae	Certhia	Treecreeper

Species Name	Scientific Name Authorship	Kingdom	Phylum	Class	Order	Family	Genus	Common Name
Aythya fuligula	(Linnaeus, 1758)	Animalia	Chordata	Aves	Anseriformes	Anatidae	Aythya	Tufted duck
Linaria flavirostris	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Fringillidae	Linaria	Twite
Bombycilla garrulus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Bombycillidae	Bombycilla	Waxwing
Oenanthe oenanthe	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Oenanthe	Wheatear
Saxicola rubetra	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Muscicapidae	Saxicola	Whinchat
Sylvia communis	Latham, 1787	Animalia	Chordata	Aves	Passeriformes	Sylviidae	Sylvia	Whitethroat
Cygnus cygnus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Anseriformes	Anatidae	Cygnus	Whooper swan
Phylloscopus trochilus	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Phylloscopidae	Phylloscopus	Willow warbler
Scolopax rusticola	Linnaeus, 1758	Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Scolopax	Woodcock
Columba palumbus	Linnaeus, 1758	Animalia	Chordata	Aves	Columbiformes	Columbidae	Columba	Woodpigeon
Troglodytes troglodytes	(Linnaeus, 1758)	Animalia	Chordata	Aves	Passeriformes	Troglodytidae	Troglodytes	Wren
Emberiza citrinella	Linnaeus, 1758	Animalia	Chordata	Aves	Passeriformes	Emberizidae	Emberiza	Yellowhammer

Table A9.2 Review of breeding and wintering BTO data for IC71 and IC72 10km squares

Spec code	CBC_ CODE	engname	BOCCI3	BOCC4	season	grid	n_ records	Max cat	status	Max countall	n_ ttvs	maxcount ttv
26	CA	Cormorant	AMBER	GREEN	B	IC72	1	3	Confirmed	1	1	1
39	H.	Grey Heron	GREEN	GREEN	B	IC71	1	1	Possible			
39	H.	Grey Heron	GREEN	GREEN	W	IC71	1	3	Present			
46	MS	Mute Swan	AMBER	AMBER	W	IC72	1	3	Present	2		
48	WS	Whooper Swan	AMBER	AMBER	B	IC72	1	2	Probable	2		
69	MA	Mallard	GREEN	AMBER	B	IC72	2	3	Confirmed	8	2	8
69	MA	Mallard	GREEN	AMBER	W	IC72	1	3	Present	13	1	13
94	RM	Red-breasted Merganser	GREEN	GREEN	W	IC72	1	3	Present	4		
95	GD	Goosander	AMBER	GREEN	W	IC72	1	3	Present	11		
105	HH	Hen Harrier	AMBER	RED	B	IC71	1	3	Confirmed			
105	HH	Hen Harrier	AMBER	RED	B	IC72	1	2	Probable			
105	HH	Hen Harrier	AMBER	RED	W	IC72	1	3	Present	1		
109	SH	Sparrowhawk	AMBER	GREEN	B	IC71	1	1	Possible			
109	SH	Sparrowhawk	AMBER	GREEN	B	IC72	3	3	Confirmed	4		
109	SH	Sparrowhawk	AMBER	GREEN	W	IC71	1	3	Present			
110	BZ	Buzzard	GREEN	GREEN	B	IC71	6	3	Confirmed	6		
110	BZ	Buzzard	GREEN	GREEN	B	IC72	14	3	Confirmed	2	5	2
110	BZ	Buzzard	GREEN	GREEN	W	IC71	1	3	Present			
110	BZ	Buzzard	GREEN	GREEN	W	IC72	4	3	Present	2	2	2
113	EA	Golden Eagle	RED	GREEN	W	ICSE	2	3	Present	1		
116	K.	Kestrel	AMBER	AMBER	B	IC71	3	3	Confirmed			
116	K.	Kestrel	AMBER	AMBER	B	IC72	6	3	Confirmed	2	2	2
116	K.	Kestrel	AMBER	AMBER	W	IC72	1	3	Present			
119	ML	Merlin	AMBER	RED	B	IC71	2	3	Confirmed			
119	ML	Merlin	AMBER	RED	B	IC72	2	3	Confirmed			
124	PE	Peregrine	GREEN	GREEN	B	IC71	3	3	Confirmed			
124	PE	Peregrine	GREEN	GREEN	B	IC72	1	1	Possible			
125	RG	Red Grouse	RED	AMBER	B	IC72	2	2	Probable			
133	PH	Pheasant	GREEN	GREEN	B	IC71	1	1	Possible			
133	PH	Pheasant	GREEN	GREEN	B	IC72	2	1	Possible	2	2	2
133	PH	Pheasant	GREEN	GREEN	W	IC71	1	3	Present			
133	PH	Pheasant	GREEN	GREEN	W	IC72	2	3	Present	3	1	3
142	MH	Moorhen	GREEN	GREEN	B	IC72	1	1	Possible	1		
142	MH	Moorhen	GREEN	GREEN	W	IC71	1	3	Present			
142	MH	Moorhen	GREEN	GREEN	W	IC72	1	3	Present	1		
167	GP	Golden Plover	RED	GREEN	B	IC72	1	1	Possible	1	1	1
191	JS	Jack Snipe	AMBER	GREEN	W	IC72	2	3	Present	1		
192	SN	Snipe	AMBER	AMBER	B	IC71	1	1	Possible			
192	SN	Snipe	AMBER	AMBER	B	IC72	3	3	Confirmed			
192	SN	Snipe	AMBER	AMBER	W	IC71	2	3	Present			
192	SN	Snipe	AMBER	AMBER	W	IC72	1	3	Present	1	1	1
203	CU	Curlew	RED	RED	B	IC71	1	1	Possible			
203	CU	Curlew	RED	RED	B	IC72	2	1	Possible			
215	CS	Common Sandpiper	AMBER	AMBER	B	IC72	1	2	Probable	2		
232	BH	Black-headed Gull	RED	AMBER	W	IC72	1	3	Present	32		
237	HG	Herring Gull	RED	RED	W	IC72	1	3	Present	12		
268	DV	Rock Dove	GREEN	GREEN	B	IC71	1	3	Confirmed			
268	DV	Rock Dove	GREEN	GREEN	B	IC72	4	1	Possible	30	4	30
268	DV	Rock Dove	GREEN	GREEN	W	IC71	1	3	Present			
270	WP	Woodpigeon	GREEN	GREEN	B	IC71	3	2	Probable			
270	WP	Woodpigeon	GREEN	GREEN	B	IC72	24	3	Confirmed	6	23	6
270	WP	Woodpigeon	GREEN	GREEN	W	IC71	1	3	Present			
270	WP	Woodpigeon	GREEN	GREEN	W	IC72	7	3	Present	81	4	81
271	CD	Collared Dove	GREEN	GREEN	B	IC72	2	1	Possible	1	2	1
271	CD	Collared Dove	GREEN	GREEN	W	IC71	2	3	Present			
271	CD	Collared Dove	GREEN	GREEN	W	IC72	4	3	Present	3	3	3
276	CK	Cuckoo	GREEN	RED	B	IC71	4	1	Possible	1		
276	CK	Cuckoo	GREEN	RED	B	IC72	8	3	Confirmed	2	4	2
286	LE	Long-eared Owl	GREEN	GREEN	B	IC71	2	3	Confirmed			
295	SI	Swift	AMBER	AMBER	B	IC71	1	1	Possible			
295	SI	Swift	AMBER	AMBER	B	IC72	1	3	Confirmed			
319	S.	Skylark	AMBER	RED	B	IC71	4	2	Probable			
319	S.	Skylark	AMBER	RED	B	IC72	5	3	Confirmed	2	3	2
321	SM	Sand Martin	AMBER	GREEN	B	IC71	3	3	Confirmed			
321	SM	Sand Martin	AMBER	GREEN	B	IC72	1	1	Possible	3	1	3
322	SL	Swallow	AMBER	GREEN	B	IC71	2	3	Confirmed			
322	SL	Swallow	AMBER	GREEN	B	IC72	15	3	Confirmed	13	14	13
325	HM	House Martin	AMBER	AMBER	B	IC71	2	3	Confirmed			
325	HM	House Martin	AMBER	AMBER	B	IC72	8	3	Confirmed	16	7	16
332	MP	Meadow Pipit	RED	AMBER	B	IC71	4	3	Confirmed	2		

Spec code	CBC_ CODE	engname	BOCCI3	BOCC4	season	grid	n_ records	Max cat	status	Max countall	n_ ttvs	maxcount ttv
332	MP	Meadow Pipit	RED	AMBER	B	IC72	15	3	Confirmed	18	13	9
332	MP	Meadow Pipit	RED	AMBER	W	IC71	1	3	Present			
332	MP	Meadow Pipit	RED	AMBER	W	IC72	2	3	Present	3	2	3
336	GL	Grey Wagtail	RED	RED	B	IC72	4	3	Confirmed	3	3	3
336	GL	Grey Wagtail	RED	RED	W	IC71	1	3	Present			
336	GL	Grey Wagtail	RED	RED	W	IC72	1	3	Present	1	1	1
337	PW	Pied/White Wagtail	GREEN	GREEN	B	IC71	2	3	Confirmed			
337	PW	Pied/White Wagtail	GREEN	GREEN	B	IC72	9	3	Confirmed	3	8	3
337	PW	Pied/White Wagtail	GREEN	GREEN	W	IC71	1	3	Present			
337	PW	Pied/White Wagtail	GREEN	GREEN	W	IC72	3	3	Present	2	1	1
338	WX	Waxwing	GREEN	GREEN	W	IC72	1	3	Present	11		
339	DI	Dipper	GREEN	AMBER	W	IC72	2	3	Present			
340	WR	Wren	GREEN	GREEN	B	IC71	2	3	Confirmed			
340	WR	Wren	GREEN	GREEN	B	IC72	27	3	Confirmed	14	25	14
340	WR	Wren	GREEN	GREEN	W	IC71	1	3	Present			
340	WR	Wren	GREEN	GREEN	W	IC72	10	3	Present	4	10	4
342	D.	Dunnock	GREEN	AMBER	B	IC71	1	2	Probable			
342	D.	Dunnock	GREEN	AMBER	B	IC72	6	3	Confirmed	4	5	4
342	D.	Dunnock	GREEN	AMBER	W	IC71	1	3	Present			
342	D.	Dunnock	GREEN	AMBER	W	IC72	5	3	Present	4	4	4
345	R.	Robin	AMBER	GREEN	B	IC71	2	2	Probable			
345	R.	Robin	AMBER	GREEN	B	IC72	22	3	Confirmed	13	22	13
345	R.	Robin	AMBER	GREEN	W	IC71	3	3	Present			
345	R.	Robin	AMBER	GREEN	W	IC72	11	3	Present	9	11	9
355	SC	Stonechat	AMBER	GREEN	B	IC71	1	2	Probable			
355	SC	Stonechat	AMBER	GREEN	B	IC72	1	3	Confirmed			
355	SC	Stonechat	AMBER	GREEN	W	IC72	1	3	Present	3	1	3
357	W.	Wheatear	AMBER	GREEN	B	IC71	3	2	Probable			
357	W.	Wheatear	AMBER	GREEN	B	IC72	3	3	Confirmed	2	2	2
371	B.	Blackbird	GREEN	GREEN	B	IC71	3	3	Confirmed			
371	B.	Blackbird	GREEN	GREEN	B	IC72	23	3	Confirmed	7	21	7
371	B.	Blackbird	GREEN	GREEN	W	IC71	3	3	Present			
371	B.	Blackbird	GREEN	GREEN	W	IC72	11	3	Present	6	8	6
375	FF	Fieldfare	GREEN	RED	W	IC71	2	3	Present			
375	FF	Fieldfare	GREEN	RED	W	IC72	5	3	Present	36	3	36
376	ST	Song Thrush	GREEN	RED	B	IC71	3	3	Confirmed			
376	ST	Song Thrush	GREEN	RED	B	IC72	10	3	Confirmed	3	9	3
376	ST	Song Thrush	GREEN	RED	W	IC71	1	3	Present			
376	ST	Song Thrush	GREEN	RED	W	IC72	1	3	Present	2	1	2
377	RE	Redwing	GREEN	RED	W	IC71	2	3	Present			
378	M.	Mistle Thrush	AMBER	RED	B	IC71	1	1	Possible			
378	M.	Mistle Thrush	AMBER	RED	B	IC72	6	3	Confirmed	3	4	2
378	M.	Mistle Thrush	AMBER	RED	W	IC71	1	3	Present			
378	M.	Mistle Thrush	AMBER	RED	W	IC72	5	3	Present	3	3	3
384	GH	Grasshopper Warbler	GREEN	RED	B	IC71	2	1	Possible	4		
384	GH	Grasshopper Warbler	GREEN	RED	B	IC72	9	3	Confirmed	2	6	2
389	SW	Sedge Warbler	GREEN	GREEN	B	IC71	1	2	Probable			
389	SW	Sedge Warbler	GREEN	GREEN	B	IC72	9	3	Confirmed	3	8	3
410	WH	Whitethroat	GREEN	GREEN	B	IC71	1	1	Possible	2		
410	WH	Whitethroat	GREEN	GREEN	B	IC72	14	3	Confirmed	4	12	4
411	GW	Garden Warbler	GREEN	GREEN	B	IC72	2	1	Possible	2	2	2
412	BC	Blackcap	GREEN	GREEN	B	IC71	3	2	Probable	3		
412	BC	Blackcap	GREEN	GREEN	B	IC72	10	3	Confirmed	8	9	8
422	CC	Chiffchaff	GREEN	GREEN	B	IC71	3	2	Probable	2		
422	CC	Chiffchaff	GREEN	GREEN	B	IC72	13	3	Confirmed	3	12	3
423	WW	Willow Warbler	GREEN	AMBER	B	IC71	4	3	Confirmed	5		
423	WW	Willow Warbler	GREEN	AMBER	B	IC72	25	3	Confirmed	40	25	40
424	GC	Goldcrest	AMBER	GREEN	B	IC71	1	1	Possible			
424	GC	Goldcrest	AMBER	GREEN	B	IC72	15	3	Confirmed	10	15	10
424	GC	Goldcrest	AMBER	GREEN	W	IC71	2	3	Present			
424	GC	Goldcrest	AMBER	GREEN	W	IC72	2	3	Present	5	2	5
426	SF	Spotted Flycatcher	AMBER	RED	B	IC71	1	3	Confirmed			
431	LT	Long-tailed Tit	GREEN	GREEN	B	IC71	1	3	Confirmed			
431	LT	Long-tailed Tit	GREEN	GREEN	B	IC72	2	1	Possible	2	2	2
431	LT	Long-tailed Tit	GREEN	GREEN	W	IC71	1	3	Present			
431	LT	Long-tailed Tit	GREEN	GREEN	W	IC72	1	3	Present	8		
435	CT	Coal Tit	GREEN	GREEN	B	IC71	2	3	Confirmed			
435	CT	Coal Tit	GREEN	GREEN	B	IC72	14	3	Confirmed	7	14	7

Spec code	CBC_ CODE	engname	BOCCI3	BOCC4	season	grid	n_ records	Max cat	status	Max countall	n_ ttvs	maxcount ttv
435	CT	Coal Tit	GREEN	GREEN	W	IC71	1	3	Present			
435	CT	Coal Tit	GREEN	GREEN	W	IC72	7	3	Present	19	5	19
436	BT	Blue Tit	GREEN	GREEN	B	IC71	2	3	Confirmed			
436	BT	Blue Tit	GREEN	GREEN	B	IC72	23	3	Confirmed	8	22	8
436	BT	Blue Tit	GREEN	GREEN	W	IC71	1	3	Present			
436	BT	Blue Tit	GREEN	GREEN	W	IC72	15	3	Present	7	13	7
437	GT	Great Tit	GREEN	GREEN	B	IC71	2	2	Probable			
437	GT	Great Tit	GREEN	GREEN	B	IC72	13	3	Confirmed	4	12	3
437	GT	Great Tit	GREEN	GREEN	W	IC71	2	3	Present			
437	GT	Great Tit	GREEN	GREEN	W	IC72	8	3	Present	5	5	5
440	TC	Treecreeper	GREEN	GREEN	B	IC72	5	1	Possible	2	5	2
440	TC	Treecreeper	GREEN	GREEN	W	IC71	1	3	Present			
449	J.	Jay	GREEN	GREEN	B	IC72	4	3	Confirmed	3	4	3
449	J.	Jay	GREEN	GREEN	W	IC72	1	3	Present			
450	MG	Magpie	GREEN	GREEN	B	IC71	2	3	Confirmed			
450	MG	Magpie	GREEN	GREEN	B	IC72	19	3	Confirmed	11	18	11
450	MG	Magpie	GREEN	GREEN	W	IC71	3	3	Present			
450	MG	Magpie	GREEN	GREEN	W	IC72	14	3	Present	10	12	10
453	JD	Jackdaw	GREEN	GREEN	B	IC71	4	3	Confirmed			
453	JD	Jackdaw	GREEN	GREEN	B	IC72	15	3	Confirmed	40	14	40
453	JD	Jackdaw	GREEN	GREEN	W	IC71	3	3	Present			
453	JD	Jackdaw	GREEN	GREEN	W	IC72	12	3	Present	68	9	68
454	RO	Rook	GREEN	GREEN	B	IC71	2	3	Confirmed			
454	RO	Rook	GREEN	GREEN	B	IC72	13	3	Confirmed	74	10	74
454	RO	Rook	GREEN	GREEN	W	IC71	1	3	Present			
454	RO	Rook	GREEN	GREEN	W	IC72	9	3	Present	102	7	102
456	RN	Raven	GREEN	GREEN	B	IC71	3	2	Probable	2		
456	RN	Raven	GREEN	GREEN	B	IC72	5	3	Confirmed	5	2	2
456	RN	Raven	GREEN	GREEN	W	IC71	2	3	Present			
456	RN	Raven	GREEN	GREEN	W	IC72	4	3	Present	3	3	3
457	SG	Starling	AMBER	RED	B	IC71	2	3	Confirmed			
457	SG	Starling	AMBER	RED	B	IC72	13	3	Confirmed	39	12	39
457	SG	Starling	AMBER	RED	W	IC71	3	3	Present			
457	SG	Starling	AMBER	RED	W	IC72	9	3	Present	121	7	16
459	HS	House Sparrow	AMBER	RED	B	IC71	2	3	Confirmed	25		
459	HS	House Sparrow	AMBER	RED	B	IC72	9	3	Confirmed	40	9	40

Spec code	CBC_ CODE	engname	BOCCI3	BOCC4	season	grid	n_ records	Max cat	status	Max countall	n_ ttvs	maxcount ttv
459	HS	House Sparrow	AMBER	RED	W	IC71	2	3	Present			
459	HS	House Sparrow	AMBER	RED	W	IC72	8	3	Present	19	6	19
461	TS	Tree Sparrow	AMBER	RED	B	IC71	1	2	Probable			
461	TS	Tree Sparrow	AMBER	RED	B	IC72	1	3	Confirmed	4		
466	CH	Chaffinch	GREEN	GREEN	B	IC71	3	3	Confirmed			
466	CH	Chaffinch	GREEN	GREEN	B	IC72	27	3	Confirmed	30	26	30
466	CH	Chaffinch	GREEN	GREEN	W	IC71	2	3	Present			
466	CH	Chaffinch	GREEN	GREEN	W	IC72	13	3	Present	47	11	47
470	GR	Greenfinch	AMBER	GREEN	B	IC71	1	1	Possible			
470	GR	Greenfinch	AMBER	GREEN	B	IC72	3	3	Confirmed	4	3	4
470	GR	Greenfinch	AMBER	GREEN	W	IC71	1	3	Present			
470	GR	Greenfinch	AMBER	GREEN	W	IC72	1	3	Present	1	1	1
471	GO	Goldfinch	GREEN	GREEN	B	IC71	3	2	Probable			
471	GO	Goldfinch	GREEN	GREEN	B	IC72	8	2	Probable	6	8	6
471	GO	Goldfinch	GREEN	GREEN	W	IC71	1	3	Present			
471	GO	Goldfinch	GREEN	GREEN	W	IC72	6	3	Present	4	5	4
472	SK	Siskin	GREEN	GREEN	B	IC71	1	1	Possible			
472	SK	Siskin	GREEN	GREEN	B	IC72	8	3	Confirmed	12	7	12
472	SK	Siskin	GREEN	GREEN	W	IC72	1	3	Present	4	1	4
473	LI	Linnet	AMBER	RED	B	IC71	2	3	Confirmed			
473	LI	Linnet	AMBER	RED	B	IC72	5	3	Confirmed	9	4	3
473	LI	Linnet	AMBER	RED	W	IC72	1	3	Present	10	1	10
474	TW	Twite	RED	RED	B	IC71	1	1	Possible			
475	FQ	Redpoll (Common / Lesser)	GREEN	GREEN	W	IC72	1	3	Present			
484	BF	Bullfinch	GREEN	AMBER	B	IC71	1	1	Possible			
484	BF	Bullfinch	GREEN	AMBER	B	IC72	1	3	Confirmed	3		
484	BF	Bullfinch	GREEN	AMBER	W	IC71	1	3	Present			
484	BF	Bullfinch	GREEN	AMBER	W	IC72	1	3	Present			
512	SB	Snow Bunting	GREEN	AMBER	W	IC71	1	3	Present			
514	Y.	Yellowhammer	RED	RED	B	IC71	1	2	Probable			
524	RB	Reed Bunting	GREEN	AMBER	B	IC71	2	2	Probable			
524	RB	Reed Bunting	GREEN	AMBER	B	IC72	7	3	Confirmed	3	3	3
524	RB	Reed Bunting	GREEN	AMBER	W	IC71	1	3	Present			
524	RB	Reed Bunting	GREEN	AMBER	W	IC72	1	3	Present			
910	HC	Hooded Crow	GREEN	GREEN	B	IC71	5	3	Confirmed	7		

Spec code	CBC_ CODE	engname	BOCCI3	BOCC4	season	grid	n_ records	Max cat	status	Max countall	n_ ttvs	maxcount ttv
910	HC	Hooded Crow	GREEN	GREEN	B	IC72	19	3	Confirmed	8	17	8
910	HC	Hooded Crow	GREEN	GREEN	W	IC71	3	3	Present			
910	HC	Hooded Crow	GREEN	GREEN	W	IC72	12	3	Present	5	11	5
1079	LR	Lesser Redpoll	GREEN	RED	B	IC71	3	3	Confirmed	2		
1079	LR	Lesser Redpoll	GREEN	RED	B	IC72	7	3	Confirmed	6	7	6
1079	LR	Lesser Redpoll	GREEN	RED	W	IC71	1	3	Present			
1079	LR	Lesser Redpoll	GREEN	RED	W	IC72	1	3	Present			
1535	XB	unidentified crossbill	GREEN	GREEN	B	IC72	4	3	Confirmed	4	2	4
1535	XB	unidentified crossbill	GREEN	GREEN	W	IC71	1	3	Present			
1535	XB	unidentified crossbill	GREEN	GREEN	W	IC72	2	3	Present	20		

Rigged Hill Windfarm Repowering

Technical Appendix A9.3– Collision Risk Modelling (CRM)

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July 2018

SCOTTISHPOWER RENEWABLES

A9.3 Collision Risk Modelling

Table A9.1 Duration of monthly hours and daylight available for collision risk modelling

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Days	31	30	31	30	31	31	30	31	30	31	31	28	31
Total hours	744	720	744	720	744	744	720	744	720	744	744	672	744
Average daylight hours	12	14	13	15	16	16.5	16	10	9	8	9	10	12
Total daylight hours	372	420	403	450	496	512	480	310	270	248	279	280	372

Table A9.2 Details of flights of Target 1 species utilised in collision risk modelling (CRM) 2014 – 2015. [1]

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	50-100m	100-125m	125-140m	>140m	Existing Flight (<500m)	Proposed Flight (<500m)
2	10	9	2014	GJ*	5	15:56	32							32		No	No
3	5	21	2014	HH	1	08:40	155	105	50							Yes	Yes
3	7	24	2014	HH	1	09:33	42	42								No	Yes
4	7	24	2014	HH	1	09:41	78	48	30							No	Yes
3	7	30	2014	HH	1	20:14	15	15								No	No
2	8	14	2014	HH	1	10:08	85	70	15							No	Yes
4	1	20	2015	HH	1	10:44	47	47								No	Yes
4	2	5	2015	HH	1	07:53	105	105								No	Yes
2	2	5	2015	HH	1	08:08	34	34								Yes	Yes
2	4	9	2014	ML**	1	12:53	12	12								No	No
3	5	28	2014	ML**	1	13:26	15	15								Yes	Yes
2	5	28	2014	ML**	1	13:27	23	23								Yes	Yes
4	10	9	2014	ML**	1	16:23	18	18								Yes	Yes
1	3	27	2014	PE	1	09:38	113	30	30	30	13	10				No	Yes
4	3	31	2014	PE	1	09:18	43			43						No	Yes
4	8	29	2014	PE	1	11:44	27	12	7	8						Yes	Yes
2	9	19	2014	PE	1	13:43	235						30	30	175	No	No
2	10	14	2014	PE	1	09:36	28				14	14				Yes	Yes
3	11	5	2014	PE	1	10:53	87	17	45	25						No	Yes
3	12	3	2014	PE	1	08:41	19	5	9	5						No	No
3	3	31	2014	WS***	17	09:40	53								53	Yes	Yes
3	3	31	2014	WS***	17	09:41	41								41	Yes	Yes

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	50-100m	100-125m	125-140m	>140m	Existing Flight (<500m)	Proposed Flight (<500m)
Existing Windfarm Potential Collision Zone								No	Yes	Yes	Yes	No	No	No	No	-	-
Proposed Windfarm Potential Collision Zone								No	Yes	Yes	Yes	Yes	Yes	Yes	No	-	-

Table A9.3 Details of flights of Target 1 species utilised in collision risk modelling (CRM) 2018 – 2019.[2]

VP No	Month	Day	Year	Species	No	Time 1st detected	Duration (secs)	<15m	15-25m	25-50m	50-75m	75-100m	100-125m	125-140m	>140m	Existing (<500m)	Proposed (<500m)
4	3	22	2018	HH	1	13:07	267		267							No	No
2	4	19	2018	HH	1	15:33	43	28	15							No	No
4	4	29	2018	HH	1	13:52	115	85	30							Yes	Yes
3	6	7	2018	HH	1	12:33	67	52	15							No	No
3	7	9	2018	HH	1	14:52	48		48							Yes	Yes
2	7	16	2018	HH	1	12:23	46	46								No	No
2	7	16	2018	HH	1	12:48	35	35								No	No
3	8	5	2018	HH	1	09:53	27	27								Yes	Yes
3	8	5	2018	HH	1	10:05	32		32							Yes	Yes
3	8	5	2018	HH	1	11:32	68	68								Yes	Yes
4	8	21	2018	HH	1	08:33	48	48								No	No
3	1	4	2019	HH	1	10:08	138	138								Yes	Yes
4	3	26	2019	HH	1	10:43	45	45								Yes	Yes
3	7	26	2018	PE	1	08:23	35			15	20					No	Yes
3	7	26	2018	PE	1	08:56	18				18					No	No
3	9	16	2018	PE	1	12:03	75			15	30	30				Yes	Yes
3	10	19	2018	PE	1	10:51	63		30	33						Yes	Yes
2	12	19	2018	PE	1	10:53	39			39						No	No
2	1	17	2019	PE	1	08:37	46		30	16						Yes	Yes
2	11	26	2018	WS*	13	16:42	138								138	No	No
Existing Windfarm Potential Collision Zone								No	Yes	Yes	Yes	No	No	No	No	-	-
Proposed Windfarm Potential Collision Zone								No	Yes	Yes	Yes	Yes	Yes	Yes	No	-	-

Table A9.4 Collision Risk Estimate (Band et al., 2007) for the operational windfarm and peregrine falcon

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	1.63	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	10		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r

[1] * GJ recorded at potential collision risk height but flight did not pass through the windfarm envelope for either existing or proposed turbines so no CRM completed ** ML recorded in flight and within the windfarm envelope for both existing and proposed turbines but were below potential collision risk height so no CRM completed *** WS recorded in flight and within the windfarm envelope for both existing and proposed turbines but were above potential collision risk height so no CRM completed

[2] * WS recorded in flight within 500 m survey area but beyond the windfarm envelope for both existing and proposed turbines and also above potential collision risk height so no CRM completed

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
BirdLength	0.42	m	0.025	0.575	9.64	15.31	1.00	0.00125	14.99	1.00	0.00125
Wingspan	1.02	m	0.075	0.575	3.21	5.21	0.56	0.00419	4.89	0.52	0.00393
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.93	3.62	0.39	0.00485	3.22	0.35	0.00432
			0.175	0.860	1.38	3.04	0.33	0.00570	2.55	0.27	0.00478
Bird speed	14	m/sec	0.225	0.994	1.07	2.69	0.29	0.00647	2.12	0.23	0.00512
RotorDiam	37	m	0.275	0.947	0.88	2.17	0.23	0.00639	1.63	0.17	0.00481
RotationPeriod	2.00	sec	0.325	0.899	0.74	1.81	0.19	0.00629	1.30	0.14	0.00451
			0.375	0.851	0.64	1.54	0.16	0.00617	1.05	0.11	0.00423
			0.425	0.804	0.57	1.33	0.14	0.00604	0.87	0.09	0.00397
			0.475	0.756	0.51	1.16	0.12	0.00590	0.73	0.08	0.00372
Bird aspect ratioo: b	0.41		0.525	0.708	0.46	1.02	0.11	0.00574	0.62	0.07	0.00348
			0.575	0.660	0.42	0.90	0.10	0.00556	0.53	0.06	0.00326
			0.625	0.613	0.39	0.97	0.10	0.00651	0.63	0.07	0.00419
			0.675	0.565	0.36	0.90	0.10	0.00654	0.58	0.06	0.00422
			0.725	0.517	0.33	0.84	0.09	0.00654	0.55	0.06	0.00427
			0.775	0.470	0.31	0.79	0.08	0.00654	0.52	0.06	0.00433
			0.825	0.422	0.29	0.74	0.08	0.00652	0.50	0.05	0.00440
			0.875	0.374	0.28	0.69	0.07	0.00648	0.48	0.05	0.00449
			0.925	0.327	0.26	0.65	0.07	0.00643	0.46	0.05	0.00460
			0.975	0.279	0.25	0.61	0.07	0.00637	0.45	0.05	0.00472
				Overall p(collision) =			Upwind	11.6%		Downwind	8.3%
								Average	10.0%		

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
			0.375	0.851	0.43	3.68	0.18	0.00675	1.60	0.08	0.00293
			0.425	0.804	0.38	3.51	0.17	0.00731	1.78	0.09	0.00370
			0.475	0.756	0.34	3.24	0.16	0.00754	1.78	0.09	0.00415
Bird aspect ratioo: b	0.41		0.525	0.708	0.31	3.00	0.15	0.00771	1.76	0.09	0.00453
			0.575	0.660	0.28	2.78	0.14	0.00781	1.72	0.08	0.00485
			0.625	0.613	0.26	2.57	0.13	0.00785	1.67	0.08	0.00510
			0.675	0.565	0.24	2.37	0.12	0.00782	1.60	0.08	0.00529
			0.725	0.517	0.22	2.18	0.11	0.00773	1.53	0.07	0.00541
			0.775	0.470	0.21	2.00	0.10	0.00758	1.44	0.07	0.00547
			0.825	0.422	0.20	1.82	0.09	0.00736	1.35	0.07	0.00547
			0.875	0.374	0.19	1.65	0.08	0.00708	1.26	0.06	0.00540
			0.925	0.327	0.18	1.49	0.07	0.00673	1.16	0.06	0.00526
			0.975	0.279	0.17	1.32	0.06	0.00631	1.06	0.05	0.00506
				Overall p(collision) =			Upwind	12.5%		Downwind	7.2%
								Average	9.9%		

Table A9.5 Collision Risk Estimate (Band et al., 2007) for the proposed windfarm and peregrine falcon

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3.953	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	44.5		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.42	m	0.025	0.575	6.51	16.37	0.80	0.00100	13.18	0.64	0.00081
Wingspan	1.02	m	0.075	0.575	2.17	6.52	0.32	0.00239	3.33	0.16	0.00122
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.30	5.36	0.26	0.00328	1.48	0.07	0.00090
			0.175	0.860	0.93	5.24	0.26	0.00449	0.73	0.04	0.00063
Bird speed	14	m/sec	0.225	0.994	0.72	5.25	0.26	0.00578	1.20	0.06	0.00132
RotorDiam	120	m	0.275	0.947	0.59	4.59	0.22	0.00617	1.43	0.07	0.00192
RotationPeriod	4.38	sec	0.325	0.899	0.50	4.08	0.20	0.00649	1.55	0.08	0.00246

Table A9.6 Collision Risk Assessment Operational Windfarm 2014 – 2015: Peregrine falcon

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m2
	Flight risk volume	84418682	m3
	Rotor swept area (single turbine)	1075.21009	m2
	Rotor swept volume (single turbine)	2204.18068	m3
	Rotor swept volume (combined)	22041.8068	m3
	Proportion of flight risk volume with turbines	0.0002611	
Bird parameters: Peregrine falcon	Months surveyed	Mar - Mar	months

Details	Month	Value	Units
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.42	m
	Wingspan of the bird	1.02	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	2	n
	Total time all birds spent in risk window	29	seconds
	Proportional time individual bird spends in risk window	1.3426E-05	
	Average time individual bird in risk window	236.446667	seconds
	Bird occupancy of flight risk window	472.893333	seconds
	Bird occupancy of rotor swept area	0.12347295	seconds
	Bird transit time through rotors	0.14642857	seconds
	Number of birds passing through rotors	0.84322988	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10	%
	Adjusted collision risk to include turbine efficiency	7.5	%
	No. of collisions with no avoidance	0.06324224	n
	Adjusted for avoidance (95%)	0.00316211	n
	Adjusted for avoidance (98%)	0.00126484	n
	Adjusted for avoidance (99%)	0.00063242	n
	Adjusted for avoidance (99.9%)	6.3242E-05	n
Frequency of mortality	No avoidance, equivalent to one bird every	15.8122163	years
	98% avoidance, equivalent to one bird every	790.610816	years

Table A9.7 Collision Risk Assessment Proposed Windfarm 2014 – 2015: Peregrine falcon

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3,288,415	m2
	Flight risk volume	394609800	m3
	Rotor swept area (single turbine)	11309.7336	m2
	Rotor swept volume (single turbine)	47421.7128	m3
	Rotor swept volume (combined)	331951.99	m3
	Proportion of flight risk volume with turbines	0.00084122	
Bird parameters: Peregrine falcon	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.42	m
	Wingspan of the bird	1.02	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	5	n
	Total time all birds spent in risk window	239	seconds
	Proportional time individual bird spends in risk window	4.4259E-05	
	Average time individual bird in risk window	779.458667	seconds
	Bird occupancy of flight risk window	3897.29333	seconds
	Bird occupancy of rotor swept area	3.27846464	seconds
	Bird transit time through rotors	0.2995	seconds
	Number of birds passing through rotors	10.9464596	n

Details	Month	Value	Units
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	9.9	%
	Adjusted collision risk to include turbine efficiency	7.425	%
	No. of collisions with no avoidance	0.81277462	n
	Adjusted for avoidance (95%)	0.04063873	n
	Adjusted for avoidance (98%)	0.01625549	n
	Adjusted for avoidance (99%)	0.00812775	n
	Adjusted for avoidance (99.9%)	0.00081277	n
Frequency of mortality	No avoidance, equivalent to one bird every	1.23035337	years
	98% avoidance, equivalent to one bird every	61.5176687	years

Table A9.8 Collision Risk Assessment Operational Windfarm 2018 – Peregrine falcon

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2204.18068	m^3
	Rotor swept volume (combined)	22041.8068	m^3
	Proportion of flight risk volume with turbines	0.0002611	
Bird parameters: Peregrine falcon	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.42	m
	Wingspan of the bird	1.02	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	3	n
	Total time all birds spent in risk window	154	seconds
	Proportional time individual bird spends in risk window	4.7531E-05	
	Average time individual bird in risk window	837.075556	seconds
	Bird occupancy of flight risk window	2511.22667	seconds
	Bird occupancy of rotor swept area	0.65568393	seconds
	Bird transit time through rotors	0.14642857	seconds
	Number of birds passing through rotors	4.47784145	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10	%
	Adjusted collision risk to include turbine efficiency	7.5	%
	No. of collisions with no avoidance	0.33583811	n
	Adjusted for avoidance (95%)	0.01679191	n
	Adjusted for avoidance (98%)	0.00671676	n
	Adjusted for avoidance (99%)	0.00335838	n
	Adjusted for avoidance (99.9%)	0.00033584	n
Frequency of mortality	No avoidance, equivalent to one bird every	2.97762515	years
	98% avoidance, equivalent to one bird every	148.881258	years

Table A9.9 Collision Risk Assessment Proposed Windfarm 2018 – Peregrine falcon

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3,288,415	m2
	Flight risk volume	394609800	m3

Details	Month	Value	Units
	Rotor swept area (single turbine)	11309.7336	m2
	Rotor swept volume (single turbine)	47421.7128	m3
	Rotor swept volume (combined)	331951.99	m3
	Proportion of flight risk volume with turbines	0.00084122	
Bird parameters: Peregrine falcon	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.42	m
	Wingspan of the bird	1.02	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	4	n
	Total time all birds spent in risk window	219	seconds
	Proportional time individual bird spends in risk window	5.0694E-05	
	Average time individual bird in risk window	892.79	seconds
	Bird occupancy of flight risk window	3571.16	seconds
	Bird occupancy of rotor swept area	3.00411613	seconds
	Bird transit time through rotors	0.2995	seconds
	Number of birds passing through rotors	10.0304378	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	9.9	%
	Adjusted collision risk to include turbine efficiency	7.425	%
	No. of collisions with no avoidance	0.74476001	n
	Adjusted for avoidance (95%)	0.037238	n
	Adjusted for avoidance (98%)	0.0148952	n
	Adjusted for avoidance (99%)	0.00744760	n
	Adjusted for avoidance (99.9%)	0.00074476	n
Frequency of mortality	No avoidance, equivalent to one bird every	1.34271441	years
	98% avoidance, equivalent to one bird every	67.1357207	years

Table A9.10 Collision Risk Estimate (Band et al., 2007) for the operational windfarm and hen harrier.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	1.63	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	10		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.48	m	0.025	0.575	8.26	13.57	1.00	0.00125	13.24	1.00	0.00125
Wingspan	1.1	m	0.075	0.575	2.75	4.63	0.58	0.00434	4.31	0.54	0.00404
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.65	3.22	0.40	0.00502	2.82	0.35	0.00440
			0.175	0.860	1.18	2.70	0.34	0.00590	2.21	0.28	0.00484
Bird speed	12	m/sec	0.225	0.994	0.92	2.39	0.30	0.00672	1.83	0.23	0.00514
RotorDiam	37	m	0.275	0.947	0.75	1.93	0.24	0.00665	1.40	0.17	0.00481
RotationPeriod	2.00	sec	0.325	0.899	0.64	1.62	0.20	0.00657	1.11	0.14	0.00450
			0.375	0.851	0.55	1.38	0.17	0.00646	0.90	0.11	0.00420
			0.425	0.804	0.49	1.19	0.15	0.00634	0.74	0.09	0.00393
			0.475	0.756	0.43	1.22	0.15	0.00725	0.79	0.10	0.00471
Bird aspect ratioo: b	0.44		0.525	0.708	0.39	1.13	0.14	0.00740	0.73	0.09	0.00477
			0.575	0.660	0.36	1.05	0.13	0.00753	0.67	0.08	0.00484
			0.625	0.613	0.33	0.98	0.12	0.00764	0.63	0.08	0.00493
			0.675	0.565	0.31	0.92	0.11	0.00774	0.60	0.07	0.00504
			0.725	0.517	0.28	0.86	0.11	0.00782	0.57	0.07	0.00517
			0.775	0.470	0.27	0.81	0.10	0.00788	0.55	0.07	0.00531
			0.825	0.422	0.25	0.77	0.10	0.00793	0.53	0.07	0.00547
			0.875	0.374	0.24	0.73	0.09	0.00796	0.52	0.06	0.00564
			0.925	0.327	0.22	0.69	0.09	0.00797	0.50	0.06	0.00583
			0.975	0.279	0.21	0.65	0.08	0.00797	0.50	0.06	0.00604
				Overall p(collision) =			**Upwind**	**13.4%**		**Downwind**	**9.5%**
								Average	**11.5%**		

Table A9.11 Collision Risk Estimate (Band et al., 2007) for the proposed windfarm and hen harrier.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3.953	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	44.5		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.48	m	0.025	0.575	5.58	14.54	0.83	0.00104	11.35	0.65	0.00081
Wingspan	1.1	m	0.075	0.575	1.86	5.91	0.34	0.00253	2.72	0.16	0.00117
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.12	4.93	0.28	0.00352	1.04	0.06	0.00074
			0.175	0.860	0.80	4.87	0.28	0.00487	1.01	0.06	0.00101
Bird speed	12	m/sec	0.225	0.994	0.62	4.93	0.28	0.00633	1.45	0.08	0.00186
RotorDiam	120	m	0.275	0.947	0.51	4.33	0.25	0.00680	1.62	0.09	0.00255
RotationPeriod	4.38	sec	0.325	0.899	0.43	4.06	0.23	0.00753	1.88	0.11	0.00349
			0.375	0.851	0.37	3.73	0.21	0.00799	1.95	0.11	0.00417
			0.425	0.804	0.33	3.45	0.20	0.00837	1.96	0.11	0.00476

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
			0.475	0.756	0.29	3.20	0.18	0.00868	1.95	0.11	0.00528
Bird aspect ratioo: b	0.44		0.525	0.708	0.27	2.97	0.17	0.00891	1.91	0.11	0.00573
			0.575	0.660	0.24	2.76	0.16	0.00906	1.86	0.11	0.00610
			0.625	0.613	0.22	2.56	0.15	0.00914	1.79	0.10	0.00639
			0.675	0.565	0.21	2.37	0.14	0.00915	1.72	0.10	0.00661
			0.725	0.517	0.19	2.19	0.13	0.00908	1.63	0.09	0.00676
			0.775	0.470	0.18	2.02	0.12	0.00893	1.54	0.09	0.00683
			0.825	0.422	0.17	1.85	0.11	0.00871	1.45	0.08	0.00682
			0.875	0.374	0.16	1.69	0.10	0.00842	1.35	0.08	0.00674
			0.925	0.327	0.15	1.52	0.09	0.00804	1.25	0.07	0.00658
			0.975	0.279	0.14	1.37	0.08	0.00760	1.14	0.07	0.00635
				Overall p(collision) =			Upwind	14.5%		Downwind	9.1%
								Average	11.8%		

Table A9.12 Collision Risk Assessment Operational Windfarm 2014 – 2015: hen harrier

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2268.69328	m^3
	Rotor swept volume (combined)	22686.9328	m^3
	Proportion of flight risk volume with turbines	0.00026874	
Bird parameters: Hen Harrier	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.48	m
	Wingspan of the bird	1.1	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	2	n
	Total time all birds spent in risk window	50	seconds
	Proportional time individual bird spends in risk window	2.3148E-05	
	Average time individual bird in risk window	407.66667	seconds
	Bird occupancy of flight risk window	815.33333	seconds
	Bird occupancy of rotor swept area	0.21912	seconds
	Bird transit time through rotors	0.17583	seconds
	Number of birds passing through rotors (Mar-Feb)	1.24615	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.5	%
	Adjusted collision risk to include turbine efficiency	8.625	%
	No. of collisions with no avoidance	0.10748	n
	Adjusted for avoidance (95%)	0.00537	n
	Adjusted for avoidance (98%)	0.00215	n
	Adjusted for avoidance (99%)	0.00107	n
	Adjusted for avoidance (99.9%)	0.00011	n
Frequency of mortality	No avoidance, equivalent to one bird every	9.30400	years
	99% avoidance, equivalent to one bird every	930.39998	years

Table A9.13 Collision Risk Assessment Proposed Windfarm 2014 – 2015: hen harrier

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	48100.2968	m^3
	Rotor swept volume (combined)	336702.078	m^3
	Proportion of flight risk volume with turbines	0.00085325	

Details	Month	Value	Units
Bird parameters: Hen Harrier	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.48	m
	Wingspan of the bird	1.1	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	7	n
	Total time all birds spent in risk window	95	seconds
	Proportional time individual bird spends in risk window	1.2566E-05	
	Average time individual bird in risk window	221.30476	seconds
	Bird occupancy of flight risk window	1549.13333	seconds
	Bird occupancy of rotor swept area	1.32180	seconds
	Bird transit time through rotors	0.35442	seconds
	Number of birds passing through rotors	3.72952	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.8	%
	Adjusted collision risk to include turbine efficiency	8.85	%
	No. of collisions with no avoidance	0.33006	n
	Adjusted for avoidance (95%)	0.01650	n
	Adjusted for avoidance (98%)	0.00660	n
	Adjusted for avoidance (99%)	0.00330	n
	Adjusted for avoidance (99.9%)	0.00033	n
Frequency of mortality	No avoidance, equivalent to one bird every	3.02973	years
	99% avoidance, equivalent to one bird every	302.97315	years

Table A9.14 Collision Risk Assessment Operational Windfarm 2018 – 2019: hen harrier

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2268.69328	m^3
	Rotor swept volume (combined)	22686.9328	m^3
	Proportion of flight risk volume with turbines	0.00026874	
Bird parameters: Hen Harrier	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.48	m
	Wingspan of the bird	1.1	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	7	n
	Total time all birds spent in risk window	110	seconds
	Proportional time individual bird spends in risk window	1.455E-05	
	Average time individual bird in risk window	256.24762	seconds
	Bird occupancy of flight risk window	1793.73333	seconds
	Bird occupancy of rotor swept area	0.48205	seconds
	Bird transit time through rotors	0.17583	seconds
	Number of birds passing through rotors	2.74154	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.5	%
	Adjusted collision risk to include turbine efficiency	8.625	%
	No. of collisions with no avoidance	0.23646	n
	Adjusted for avoidance (95%)	0.01182	n
	Adjusted for avoidance (98%)	0.00473	n
	Adjusted for avoidance (99%)	0.00236	n
	Adjusted for avoidance (99.9%)	0.00024	n
Frequency of mortality	No avoidance, equivalent to one bird every	4.22909	years
	99% avoidance, equivalent to one bird every	422.90908	years

Table A9.15 Collision Risk Assessment Proposed Windfarm 2018 – 2019: hen harrier

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	48100.2968	m^3
	Rotor swept volume (combined)	336702.078	m^3
	Proportion of flight risk volume with turbines	0.00085325	
Bird parameters: Hen Harrier	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.48	m
	Wingspan of the bird	1.1	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	7	n
	Total time all birds spent in risk window	110	seconds
	Proportional time individual bird spends in risk window	1.455E-05	
	Average time individual bird in risk window	256.24762	seconds
	Bird occupancy of flight risk window	1793.73333	seconds
	Bird occupancy of rotor swept area	1.53051	seconds
	Bird transit time through rotors	0.35442	seconds
	Number of birds passing through rotors	4.31839	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.8	%
	Adjusted collision risk to include turbine efficiency	8.85	%
	No. of collisions with no avoidance	0.38218	n
	Adjusted for avoidance (95%)	0.01911	n
	Adjusted for avoidance (98%)	0.00764	n
	Adjusted for avoidance (99%)	0.00382	n
	Adjusted for avoidance (99.9%)	0.00038	n
Frequency of mortality	No avoidance, equivalent to one bird every	2.61659	years
	99% avoidance, equivalent to one bird every	261.65863	years

Table A9.16 Details of flights of buzzard, kestrel and raven utilised in collision risk modelling (CRM) 2014 – 2015.

Species	No of sightings (2014-2015)	No of 5 minute intervals (2014-2015)	% of flights at PCH (existing) (2014-2015)	% of flights at PCH (proposed) (2014-2015)	Total no of minutes flight	Total no of seconds	Total no of seconds at PCH (existing)	Total no of seconds at PCH (proposed)
BZ	43	46	48.8	76.7	46	2760	1347.9	2118.1
K.	17	17	94.1	94.1	17	1020	960.0	960.0
RN	206	216	68.4	79.1	216	12960	8870.7	10254.8

Table A9.17 Details of flights of buzzard, kestrel and raven utilised in collision risk modelling (CRM) 2018 – 2019.

Species	No of sightings (2018-2019)	No of 5 minute intervals (2018-2019)	% of flights at PCH (existing) (2018-2019)	% of flights at PCH (proposed) (2018-2019)	Total no of minutes flight	Total no of seconds	Total no of seconds at PCH (existing)	Total no of seconds at PCH (proposed)
BZ	26	39	46.2	92.3	39	2340	1080.0	2160.0
K.	28	28	64.3	64.3	28	1680	1080.0	1080.0
RN	183	224	39.9	41.5	224	13440	5361.3	5581.6

Table A9.18 Collision Risk Estimate (Band et al., 2007) for the operational windfarm and buzzard.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	1.63	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	10		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.54	m	0.025	0.575	8.95	15.26	1.00	0.00125	14.93	1.00	0.00125
Wingspan	1.2	m	0.075	0.575	2.98	5.19	0.60	0.00449	4.87	0.56	0.00421
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.79	3.58	0.41	0.00516	3.18	0.37	0.00459
			0.175	0.860	1.28	2.98	0.34	0.00603	2.50	0.29	0.00504
Bird speed	13	m/sec	0.225	0.994	0.99	2.63	0.30	0.00682	2.06	0.24	0.00536
RotorDiam	37	m	0.275	0.947	0.81	2.13	0.25	0.00674	1.59	0.18	0.00504
RotationPeriod	2.00	sec	0.325	0.899	0.69	1.77	0.20	0.00665	1.26	0.15	0.00474
			0.375	0.851	0.60	1.51	0.17	0.00654	1.03	0.12	0.00446
			0.425	0.804	0.53	1.31	0.15	0.00642	0.85	0.10	0.00419
			0.475	0.756	0.47	1.15	0.13	0.00628	0.72	0.08	0.00393

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
Bird aspect ratioo: b	0.45		0.525	0.708	0.43	1.22	0.14	0.00742	0.82	0.10	0.00499
			0.575	0.660	0.39	1.14	0.13	0.00756	0.77	0.09	0.00508
			0.625	0.613	0.36	1.07	0.12	0.00768	0.72	0.08	0.00518
			0.675	0.565	0.33	1.00	0.12	0.00779	0.68	0.08	0.00530
			0.725	0.517	0.31	0.94	0.11	0.00789	0.65	0.07	0.00544
			0.775	0.470	0.29	0.89	0.10	0.00796	0.62	0.07	0.00559
			0.825	0.422	0.27	0.84	0.10	0.00803	0.60	0.07	0.00575
			0.875	0.374	0.26	0.80	0.09	0.00807	0.59	0.07	0.00593
			0.925	0.327	0.24	0.76	0.09	0.00810	0.57	0.07	0.00613
			0.975	0.279	0.23	0.72	0.08	0.00812	0.56	0.07	0.00634
				Overall p(collision) =			**Upwind**	**13.5%**		**Downwind**	**9.9%**
								Average	**11.7%**		

Table A9.19 Collision Risk Estimate (Band et al., 2007) for the proposed windfarm and buzzard.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3.953	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	44.5		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.54	m	0.025	0.575	6.04	16.00	0.84	0.00105	12.82	0.68	0.00084
Wingspan	1.2	m	0.075	0.575	2.01	6.40	0.34	0.00253	3.21	0.17	0.00127
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.21	5.26	0.28	0.00346	1.37	0.07	0.00090
			0.175	0.860	0.86	5.14	0.27	0.00473	0.95	0.05	0.00088
Bird speed	13	m/sec	0.225	0.994	0.67	5.15	0.27	0.00610	1.39	0.07	0.00164
RotorDiam	120	m	0.275	0.947	0.55	4.51	0.24	0.00653	1.58	0.08	0.00228
RotationPeriod	4.38	sec	0.325	0.899	0.46	4.02	0.21	0.00689	1.67	0.09	0.00286
			0.375	0.851	0.40	3.87	0.20	0.00764	1.93	0.10	0.00382
			0.425	0.804	0.36	3.57	0.19	0.00800	1.96	0.10	0.00439
			0.475	0.756	0.32	3.31	0.17	0.00829	1.96	0.10	0.00490
Bird aspect ratioo: b	0.45		0.525	0.708	0.29	3.08	0.16	0.00851	1.93	0.10	0.00533
			0.575	0.660	0.26	2.86	0.15	0.00866	1.88	0.10	0.00570
			0.625	0.613	0.24	2.66	0.14	0.00874	1.82	0.10	0.00599
			0.675	0.565	0.22	2.46	0.13	0.00876	1.75	0.09	0.00622
			0.725	0.517	0.21	2.28	0.12	0.00870	1.67	0.09	0.00638
			0.775	0.470	0.19	2.10	0.11	0.00857	1.58	0.08	0.00646
			0.825	0.422	0.18	1.93	0.10	0.00838	1.49	0.08	0.00648
			0.875	0.374	0.17	1.76	0.09	0.00811	1.39	0.07	0.00643
			0.925	0.327	0.16	1.60	0.08	0.00777	1.29	0.07	0.00631

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
			0.975	0.279	0.15	1.43	0.08	0.00737	1.19	0.06	0.00612
				Overall p(collision) =			**Upwind**	**13.9%**		**Downwind**	**8.5%**
								Average	**11.2%**		

Table A9.20 Collision Risk Assessment Operational Windfarm 2014 – 2015: buzzard

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2333.20589	m^3
	Rotor swept volume (combined)	23332.0589	m^3
	Proportion of flight risk volume with turbines	0.00027639	
Bird parameters: Buzzard	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	13	m/s
	Length of the bird	0.54	m
	Wingspan of the bird	1.2	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	43	n
	Total time all birds spent in risk window	1347	seconds
	Proportional time individual bird spends in risk window	2.9005E-05	
	Average time individual bird in risk window	510.815814	seconds
	Bird occupancy of flight risk window	21965.08	seconds
	Bird occupancy of rotor swept area	6.07081901	seconds
	Bird transit time through rotors	0.16692308	seconds

Details	Month	Value	Units
	Number of birds passing through rotors	36.3689618	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.7	%
	Adjusted collision risk to include turbine efficiency	8.775	%
	No. of collisions with no avoidance	3.1913764	n
	Adjusted for avoidance (95%)	0.15956882	n
	Adjusted for avoidance (98%)	0.06382753	n
	Adjusted for avoidance (99%)	0.03191376	n
	Adjusted for avoidance (99.9%)	0.00319138	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.31334442	years
	98% avoidance, equivalent to one bird every	15.6672212	years

Table A9.21 Collision Risk Assessment Proposed Windfarm 2014 – 2015: buzzard

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	48778.8808	m^3
	Rotor swept volume (combined)	341452.166	m^3
	Proportion of flight risk volume with turbines	0.00086529	
Bird parameters: Buzzard	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	13	m/s
	Length of the bird	0.54	m
	Wingspan of the bird	1.2	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds

Details	Month	Value	Units
	Number of birds observed	43	n
	Total time all birds spent in risk window	2118	seconds
	Proportional time individual bird spends in risk window	4.5607E-05	
	Average time individual bird in risk window	803.19814	seconds
	Bird occupancy of flight risk window	34537.52	seconds
	Bird occupancy of rotor swept area	29.8849927	seconds
	Bird transit time through rotors	0.33176923	seconds
	Number of birds passing through rotors	90.0776502	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.2	%
	Adjusted collision risk to include turbine efficiency	8.4	%
	No. of collisions with no avoidance	7.56652262	n
	Adjusted for avoidance (95%)	0.37832613	n
	Adjusted for avoidance (98%)	0.15133045	n
	Adjusted for avoidance (99%)	0.07566523	n
	Adjusted for avoidance (99.9%)	0.00756652	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.13216111	years
	98% avoidance, equivalent to one bird every	6.60805531	years

Table A9.22 Collision Risk Assessment Operational Windfarm 2018 – 2019: buzzard

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2333.20589	m^3
	Rotor swept volume (combined)	23332.0589	m^3
	Proportion of flight risk volume with turbines	0.00027639	
Bird parameters: Buzzard	Months surveyed	Mar - Mar	months

Details	Month	Value	Units
	Speed of the bird through the rotor	13	m/s
	Length of the bird	0.54	m
	Wingspan of the bird	1.2	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	26	n
	Total time all birds spent in risk window	1080	seconds
	Proportional time individual bird spends in risk window	3.8462E-05	
	Average time individual bird in risk window	677.353846	seconds
	Bird occupancy of flight risk window	17611.2	seconds
	Bird occupancy of rotor swept area	4.86747181	seconds
	Bird transit time through rotors	0.16692308	seconds
	Number of birds passing through rotors	29.1599694	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.7	%
	Adjusted collision risk to include turbine efficiency	8.775	%
	No. of collisions with no avoidance	2.55878731	n
	Adjusted for avoidance (95%)	0.12793937	n
	Adjusted for avoidance (98%)	0.05117575	n
	Adjusted for avoidance (99%)	0.02558787	n
	Adjusted for avoidance (99.9%)	0.00255879	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.39081013	years
	98% avoidance, equivalent to one bird every	19.5405065	years

Table A9.23 Collision Risk Assessment Proposed Windfarm 2018 – 2019: buzzard

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m

Details	Month	Value	Units
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	48778.8808	m^3
	Rotor swept volume (combined)	341452.166	m^3
	Proportion of flight risk volume with turbines	0.00086529	
Bird parameters: Peregrine falcon	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	13	m/s
	Length of the bird	0.54	m
	Wingspan of the bird	1.2	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	26	n
	Total time all birds spent in risk window	2160	seconds
	Proportional time individual bird spends in risk window	7.6923E-05	
	Average time individual bird in risk window	1354.70769	seconds
	Bird occupancy of flight risk window	35222.4	seconds
	Bird occupancy of rotor swept area	30.477613	seconds
	Bird transit time through rotors	0.33176923	seconds
	Number of birds passing through rotors	91.8638926	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	11.2	%
	Adjusted collision risk to include turbine efficiency	8.4	%
	No. of collisions with no avoidance	7.71656698	n
	Adjusted for avoidance (95%)	0.38582835	n
	Adjusted for avoidance (98%)	0.15433134	n
	Adjusted for avoidance (99%)	0.07716567	n
	Adjusted for avoidance (99.9%)	0.00771657	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.12959131	years
	98% avoidance, equivalent to one bird every	6.47956535	years

Table A9.24 Collision Risk Estimate (Band et al., 2007) for the operational windfarm and kestrel.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	1.63	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	10		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.34	m	0.025	0.575	8.26	11.78	1.00	0.00125	11.46	1.00	0.00125
Wingspan	0.76	m	0.075	0.575	2.75	4.04	0.50	0.00378	3.71	0.46	0.00348
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.65	2.86	0.36	0.00447	2.46	0.31	0.00384
			0.175	0.860	1.18	2.44	0.31	0.00534	1.96	0.24	0.00428
Bird speed	12	m/sec	0.225	0.994	0.92	2.19	0.27	0.00616	1.63	0.20	0.00458
RotorDiam	37	m	0.275	0.947	0.75	1.77	0.22	0.00609	1.24	0.15	0.00425
RotationPeriod	2.00	sec	0.325	0.899	0.64	1.48	0.18	0.00601	0.97	0.12	0.00394
			0.375	0.851	0.55	1.26	0.16	0.00590	0.78	0.10	0.00365
			0.425	0.804	0.49	1.09	0.14	0.00579	0.63	0.08	0.00337
			0.475	0.756	0.43	1.08	0.14	0.00642	0.65	0.08	0.00388
Bird aspect ratioo: b	0.45		0.525	0.708	0.39	0.99	0.12	0.00648	0.59	0.07	0.00385
			0.575	0.660	0.36	0.91	0.11	0.00652	0.53	0.07	0.00384
			0.625	0.613	0.33	0.84	0.10	0.00655	0.49	0.06	0.00384
			0.675	0.565	0.31	0.78	0.10	0.00656	0.46	0.06	0.00386
			0.725	0.517	0.28	0.72	0.09	0.00655	0.43	0.05	0.00390
			0.775	0.470	0.27	0.67	0.08	0.00653	0.41	0.05	0.00395
			0.825	0.422	0.25	0.63	0.08	0.00649	0.39	0.05	0.00402
			0.875	0.374	0.24	0.59	0.07	0.00643	0.38	0.05	0.00411
			0.925	0.327	0.22	0.55	0.07	0.00635	0.36	0.05	0.00422
			0.975	0.279	0.21	0.51	0.06	0.00626	0.36	0.04	0.00434
				Overall p(collision) =			Upwind	11.6%		Downwind	7.6%
								Average	9.6%		

Table A9.25 Collision Risk Estimate (Band et al., 2007) for the proposed windfarm and kestrel.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3.953	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	44.5		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.34	m	0.025	0.575	5.58	13.33	0.76	0.00095	10.15	0.58	0.00072
Wingspan	0.76	m	0.075	0.575	1.86	5.51	0.31	0.00236	2.32	0.13	0.00099

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.12	4.69	0.27	0.00335	0.80	0.05	0.00057
			0.175	0.860	0.80	4.70	0.27	0.00470	0.84	0.05	0.00084
Bird speed	12	m/sec	0.225	0.994	0.62	4.79	0.27	0.00615	1.32	0.08	0.00169
RotorDiam	120	m	0.275	0.947	0.51	4.22	0.24	0.00663	1.52	0.09	0.00238
RotationPeriod	4.38	sec	0.325	0.899	0.43	3.92	0.22	0.00727	1.74	0.10	0.00323
			0.375	0.851	0.37	3.59	0.20	0.00769	1.81	0.10	0.00387
			0.425	0.804	0.33	3.31	0.19	0.00803	1.82	0.10	0.00442
			0.475	0.756	0.29	3.06	0.17	0.00830	1.81	0.10	0.00490
Bird aspect ratioo: b	0.45		0.525	0.708	0.27	2.83	0.16	0.00849	1.77	0.10	0.00531
			0.575	0.660	0.24	2.62	0.15	0.00860	1.72	0.10	0.00564
			0.625	0.613	0.22	2.42	0.14	0.00864	1.65	0.09	0.00589
			0.675	0.565	0.21	2.23	0.13	0.00861	1.58	0.09	0.00607
			0.725	0.517	0.19	2.05	0.12	0.00850	1.49	0.09	0.00618
			0.775	0.470	0.18	1.88	0.11	0.00831	1.40	0.08	0.00621
			0.825	0.422	0.17	1.71	0.10	0.00805	1.31	0.07	0.00616
			0.875	0.374	0.16	1.55	0.09	0.00772	1.21	0.07	0.00604
			0.925	0.327	0.15	1.38	0.08	0.00730	1.11	0.06	0.00584
			0.975	0.279	0.14	1.23	0.07	0.00682	1.00	0.06	0.00557
				Overall p(collision) =			**Upwind**	**13.6%**		**Downwind**	**8.3%**
								Average	**10.9%**		

Table A9.26 Collision Risk Assessment Operational Windfarm 2014 – 2015: kestrel

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2118.16387	m^3
	Rotor swept volume (combined)	21181.6387	m^3

Details	Month	Value	Units
	Proportion of flight risk volume with turbines	0.00025091	
Bird parameters: Kestrel	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.34	m
	Wingspan of the bird	0.76	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	17	n
	Total time all birds spent in risk window	960	seconds
	Proportional time individual bird spends in risk window	5.2288E-05	
	Average time individual bird in risk window	920.847059	seconds
	Bird occupancy of flight risk window	15654.4	seconds
	Bird occupancy of rotor swept area	3.9278728	seconds
	Bird transit time through rotors	0.16416667	seconds
	Number of birds passing through rotors	23.9261287	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	9.6	%
	Adjusted collision risk to include turbine efficiency	7.2	%
	No. of collisions with no avoidance	1.72268127	n
	Adjusted for avoidance (95%)	0.08613406	n
	Adjusted for avoidance (98%)	0.03445363	n
	Adjusted for avoidance (99%)	0.01722681	n
	Adjusted for avoidance (99.9%)	0.00172268	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.58049044	years
	95% avoidance, equivalent to one bird every	11.6098087	years

Table A9.27 Collision Risk Assessment Proposed Windfarm 2014 – 2015: kestrel

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m

Details	Month	Value	Units
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	46516.9341	m^3
	Rotor swept volume (combined)	325618.539	m^3
	Proportion of flight risk volume with turbines	0.00082517	
Bird parameters: Kestrel	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.34	m
	Wingspan of the bird	0.76	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	17	n
	Total time all birds spent in risk window	960	seconds
	Proportional time individual bird spends in risk window	5.2288E-05	
	Average time individual bird in risk window	920.847059	seconds
	Bird occupancy of flight risk window	15654.4	seconds
	Bird occupancy of rotor swept area	12.9174766	seconds
	Bird transit time through rotors	0.34275	seconds
	Number of birds passing through rotors	37.6877508	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10.9	%
	Adjusted collision risk to include turbine efficiency	8.175	%
	No. of collisions with no avoidance	3.08097363	n
	Adjusted for avoidance (95%)	0.15404868	n
	Adjusted for avoidance (98%)	0.06161947	n
	Adjusted for avoidance (99%)	0.03080974	n
	Adjusted for avoidance (99.9%)	0.00308097	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.32457272	years
	95% avoidance, equivalent to one bird every	6.49145446	years

Table A9.28 Collision Risk Assessment Operational Windfarm 2018 – 2019: kestrel

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2118.16387	m^3
	Rotor swept volume (combined)	21181.6387	m^3
	Proportion of flight risk volume with turbines	0.00025091	
Bird parameters: Kestrel	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.34	m
	Wingspan of the bird	0.76	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	28	n
	Total time all birds spent in risk window	1080	seconds
	Proportional time individual bird spends in risk window	3.5714E-05	
	Average time individual bird in risk window	628.971429	seconds
	Bird occupancy of flight risk window	17611.2	seconds
	Bird occupancy of rotor swept area	4.4188569	seconds
	Bird transit time through rotors	0.16416667	seconds
	Number of birds passing through rotors	26.9168948	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	9.6	%
	Adjusted collision risk to include turbine efficiency	7.2	%
	No. of collisions with no avoidance	1.93801643	n
	Adjusted for avoidance (95%)	0.09690082	n
	Adjusted for avoidance (98%)	0.03876033	n
	Adjusted for avoidance (99%)	0.01938016	n
	Adjusted for avoidance (99.9%)	0.00193802	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.5159915	years
	95% avoidance, equivalent to one bird every	10.31983	years

Table A9.29 Collision Risk Assessment Proposed Windfarm 2018 – 2019: kestrel

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	46516.9341	m^3
	Rotor swept volume (combined)	325618.539	m^3
	Proportion of flight risk volume with turbines	0.00082517	
Bird parameters: Kestrel	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	12	m/s
	Length of the bird	0.34	m
	Wingspan of the bird	0.76	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	28	n
	Total time all birds spent in risk window	1080	seconds
	Proportional time individual bird spends in risk window	3.5714E-05	
	Average time individual bird in risk window	628.971429	seconds
	Bird occupancy of flight risk window	17611.2	seconds
	Bird occupancy of rotor swept area	14.5321612	seconds
	Bird transit time through rotors	0.34275	seconds

Details	Month	Value	Units
	Number of birds passing through rotors	42.3987197	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10.9	%
	Adjusted collision risk to include turbine efficiency	8.175	%
	No. of collisions with no avoidance	3.46609533	n
	Adjusted for avoidance (95%)	0.17330477	n
	Adjusted for avoidance (98%)	0.06932191	n
	Adjusted for avoidance (99%)	0.03466095	n
	Adjusted for avoidance (99.9%)	0.0034661	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.28850909	years
	95% avoidance, equivalent to one bird every	5.77018174	years

Table A9.30 Collision Risk Estimate (Band et al., 2007) for the operational windfarm and raven.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	1.63	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	10		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.64	m	0.025	0.575	9.64	17.34	1.00	0.00125	17.01	1.00	0.00125
Wingspan	1.35	m	0.075	0.575	3.21	5.89	0.63	0.00473	5.56	0.60	0.00447
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.93	4.02	0.43	0.00539	3.63	0.39	0.00486
			0.175	0.860	1.38	3.33	0.36	0.00624	2.84	0.30	0.00532
Bird speed	14	m/sec	0.225	0.994	1.07	2.91	0.31	0.00702	2.35	0.25	0.00566
RotorDiam	37	m	0.275	0.947	0.88	2.35	0.25	0.00693	1.82	0.19	0.00535
RotationPeriod	2.00	sec	0.325	0.899	0.74	1.96	0.21	0.00683	1.45	0.16	0.00506
			0.375	0.851	0.64	1.67	0.18	0.00671	1.19	0.13	0.00478
			0.425	0.804	0.57	1.45	0.15	0.00658	0.99	0.11	0.00451
			0.475	0.756	0.51	1.27	0.14	0.00644	0.84	0.09	0.00426
Bird aspect ratioo: b	0.47		0.525	0.708	0.46	1.36	0.15	0.00766	0.96	0.10	0.00541
			0.575	0.660	0.42	1.27	0.14	0.00783	0.90	0.10	0.00553
			0.625	0.613	0.39	1.19	0.13	0.00799	0.85	0.09	0.00566
			0.675	0.565	0.36	1.12	0.12	0.00813	0.80	0.09	0.00581
			0.725	0.517	0.33	1.06	0.11	0.00825	0.77	0.08	0.00598
			0.775	0.470	0.31	1.01	0.11	0.00836	0.74	0.08	0.00616
			0.825	0.422	0.29	0.96	0.10	0.00846	0.72	0.08	0.00635
			0.875	0.374	0.28	0.91	0.10	0.00854	0.70	0.07	0.00656
			0.925	0.327	0.26	0.87	0.09	0.00861	0.68	0.07	0.00678
			0.975	0.279	0.25	0.83	0.09	0.00867	0.67	0.07	0.00702

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
				Overall p(collision) =			Upwind	14.1%		Downwind	10.7%
								Average	12.4%		

Table A9.31 Collision Risk Estimate (Band et al., 2007) for the proposed windfarm and raven.

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3.953	m	r/R	c/C	a	collide		contribution	collide		contribution
Pitch (degrees)	44.5		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.64	m	0.025	0.575	6.51	17.73	0.87	0.00108	14.55	0.71	0.00089
Wingspan	1.35	m	0.075	0.575	2.17	6.97	0.34	0.00256	3.79	0.19	0.00139
F: Flapping (0) or gliding (+1)	1		0.125	0.702	1.30	5.64	0.28	0.00345	1.75	0.09	0.00107
			0.175	0.860	0.93	5.44	0.27	0.00465	0.93	0.05	0.00079
Bird speed	14	m/sec	0.225	0.994	0.72	5.40	0.26	0.00595	1.35	0.07	0.00149
RotorDiam	120	m	0.275	0.947	0.59	4.71	0.23	0.00634	1.55	0.08	0.00209
RotationPeriod	4.38	sec	0.325	0.899	0.50	4.19	0.20	0.00666	1.65	0.08	0.00263
			0.375	0.851	0.43	4.04	0.20	0.00741	1.96	0.10	0.00359
			0.425	0.804	0.38	3.73	0.18	0.00776	2.00	0.10	0.00416
			0.475	0.756	0.34	3.46	0.17	0.00805	2.00	0.10	0.00466
Bird aspect ratioo: b	0.47		0.525	0.708	0.31	3.22	0.16	0.00827	1.98	0.10	0.00509
			0.575	0.660	0.28	3.00	0.15	0.00843	1.94	0.10	0.00547
			0.625	0.613	0.26	2.79	0.14	0.00852	1.89	0.09	0.00577
			0.675	0.565	0.24	2.59	0.13	0.00855	1.82	0.09	0.00602
			0.725	0.517	0.22	2.40	0.12	0.00852	1.75	0.09	0.00619
			0.775	0.470	0.21	2.22	0.11	0.00841	1.66	0.08	0.00631
			0.825	0.422	0.20	2.04	0.10	0.00825	1.57	0.08	0.00636
			0.875	0.374	0.19	1.87	0.09	0.00802	1.48	0.07	0.00634
			0.925	0.327	0.18	1.71	0.08	0.00772	1.38	0.07	0.00626
			0.975	0.279	0.17	1.54	0.08	0.00736	1.28	0.06	0.00611
				Overall p(collision) =			Upwind	13.6%		Downwind	8.3%
								Average	10.9%		

Table A9.32 Collision Risk Assessment Operational Windfarm 2014 – 2015: raven

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2440.72689	m^3
	Rotor swept volume (combined)	24407.2689	m^3
	Proportion of flight risk volume with turbines	0.00028912	
Bird parameters: Raven	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.64	m
	Wingspan of the bird	1.35	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	206	n
	Total time all birds spent in risk window	8870	seconds
	Proportional time individual bird spends in risk window	3.9869E-05	
	Average time individual bird in risk window	702.13657	seconds
	Bird occupancy of flight risk window	144640.133	seconds
	Bird occupancy of rotor swept area	41.8185945	seconds
	Bird transit time through rotors	0.16214286	seconds
	Number of birds passing through rotors	257.912037	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	12.4	%
	Adjusted collision risk to include turbine efficiency	9.3	%
	No. of collisions with no avoidance	23.9858194	n
	Adjusted for avoidance (95%)	1.19929097	n
	Adjusted for avoidance (98%)	0.47971639	n
	Adjusted for avoidance (99%)	0.23985819	n
	Adjusted for avoidance (99.9%)	0.02398582	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.0416913	years
	98% avoidance, equivalent to one bird every	2.08456501	years

Table A9.33 Collision Risk Assessment Proposed Windfarm 2014 – 2015: raven

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	49909.8542	m^3
	Rotor swept volume (combined)	349368.979	m^3
	Proportion of flight risk volume with turbines	0.00088535	
Bird parameters: Raven	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.64	m
	Wingspan of the bird	1.35	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	206	n
	Total time all birds spent in risk window	10254	seconds
	Proportional time individual bird spends in risk window	4.609E-05	
	Average time individual bird in risk window	811.692039	seconds
	Bird occupancy of flight risk window	167208.56	seconds
	Bird occupancy of rotor swept area	148.038604	seconds
	Bird transit time through rotors	0.31521429	seconds

Details	Month	Value	Units
	Number of birds passing through rotors	469.644336	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10.9	%
	Adjusted collision risk to include turbine efficiency	8.175	%
	No. of collisions with no avoidance	38.3934245	n
	Adjusted for avoidance (95%)	1.91967122	n
	Adjusted for avoidance (98%)	0.76786849	n
	Adjusted for avoidance (99%)	0.38393424	n
	Adjusted for avoidance (99.9%)	0.03839342	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.02604613	years
	98% avoidance, equivalent to one bird every	1.30230634	years

Table A9.34 Collision Risk Assessment Operational Windfarm 2018 – 2019: raven

Details	Month	Value	Units
Turbine parameters	Number of turbines	10	n
	Hub height	39	m
	Rotor diameter	37	m
	Rotor radius	18.5	m
	Blade maximum chord	1.63	m
	Blade pitch	10	°
	Rotor rotation period	2	sec
	Blade depth	1.63	m
	Risk window ceiling height	57.5	m
	Risk window floor height	20.5	m
	Windfarm area	2281586	m^2
	Flight risk volume	84418682	m^3
	Rotor swept area (single turbine)	1075.21009	m^2
	Rotor swept volume (single turbine)	2440.72689	m^3
	Rotor swept volume (combined)	24407.2689	m^3
	Proportion of flight risk volume with turbines	0.00028912	
Bird parameters: Raven	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.64	m
	Wingspan of the bird	1.35	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds

Details	Month	Value	Units
	Number of birds observed	183	n
	Total time all birds spent in risk window	5361	seconds
	Proportional time individual bird spends in risk window	2.7125E-05	
	Average time individual bird in risk window	477.705137	seconds
	Bird occupancy of flight risk window	87420.04	seconds
	Bird occupancy of rotor swept area	25.2750265	seconds
	Bird transit time through rotors	0.16214286	seconds
	Number of birds passing through rotors	155.881221	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	12.4	%
	Adjusted collision risk to include turbine efficiency	9.3	%
	No. of collisions with no avoidance	14.4969535	n
	Adjusted for avoidance (95%)	0.72484768	n
	Adjusted for avoidance (98%)	0.28993907	n
	Adjusted for avoidance (99%)	0.14496954	n
	Adjusted for avoidance (99.9%)	0.01449695	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.06898001	years
	98% avoidance, equivalent to one bird every	3.4490005	years

Table A9.35 Collision Risk Assessment Proposed Windfarm 2018 – 2019: raven

Details	Month	Value	Units
Turbine parameters	Number of turbines	7	n
	Hub height	75	m
	Rotor diameter	120	m
	Rotor radius	60	m
	Blade maximum chord	3.953	m
	Blade pitch	44.5	°
	Rotor rotation period	4.38	sec
	Blade depth	3.773	m
	Risk window ceiling height	135	m
	Risk window floor height	15	m
	Windfarm area	3288415	m^2
	Flight risk volume	394609800	m^3
	Rotor swept area (single turbine)	11309.7336	m^2
	Rotor swept volume (single turbine)	49909.8542	m^3
	Rotor swept volume (combined)	349368.979	m^3
	Proportion of flight risk volume with turbines	0.00088535	

Details	Month	Value	Units
Bird parameters: Raven	Months surveyed	Mar - Mar	months
	Speed of the bird through the rotor	14	m/s
	Length of the bird	0.64	m
	Wingspan of the bird	1.35	m
	Vantage point hours completed	300	hours
	Vantage point seconds completed	1080000	seconds
	Time available for flight activity per year	4892	hours
	Flight seconds per year	17611200	seconds
	Number of birds observed	183	n
	Total time all birds spent in risk window	5581	seconds
	Proportional time individual bird spends in risk window	2.8238E-05	
	Average time individual bird in risk window	497.30878	seconds
	Bird occupancy of flight risk window	91007.5067	seconds
	Bird occupancy of rotor swept area	80.5737711	seconds
	Bird transit time through rotors	0.31521429	seconds
	Number of birds passing through rotors	255.615861	n
Collision Assessment	Estimated turbine efficiency (Band et al., 2007)	75	%
	Average collision risk (Band et al., 2007)	10.9	%
	Adjusted collision risk to include turbine efficiency	8.175	%
	No. of collisions with no avoidance	20.8965967	n
	Adjusted for avoidance (95%)	1.04482983	n
	Adjusted for avoidance (98%)	0.41793193	n
	Adjusted for avoidance (99%)	0.20896597	n
	Adjusted for avoidance (99.9%)	0.0208966	n
Frequency of mortality	No avoidance, equivalent to one bird every	0.04785468	years
	98% avoidance, equivalent to one bird every	2.39273413	years

Rigged Hill Windfarm Repowering

Technical Appendix A9.4: Operational Phase Bird Monitoring Plan

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1 Operational Phase Bird Monitoring Plan

Given the low abundance of breeding activity on the site, and the difficulties with estimating abundance and inferring causal links described above, it is considered searching for bird fatalities using the method described below would provide the most useful surveillance of bird impacts on the site during the operational phase.

SPR have an established system for detecting and recording carcasses found under turbines across every windfarm in their portfolio. The system integrates the programme of weekly external turbine inspections to include a visual check of the hardstanding and adjacent access track for dead or injured animals. While not covering the entire area where carcasses could potentially fall, this method provides a systematic sample which can be used to generate estimates of collisions.

The system was reviewed under Scottish Windfarm Bird Steering Group (SWBSG) research contract 1605[1], and can be effective at providing useful estimates provided the following conditions are met:

1. The threshold number of fatalities to detect is relatively high or the duration of the study is long (e.g. 20 years +)
2. Observer efficiency is high
3. Scavenger removal rates are likely to be high
4. There is no requirement for high precision of estimates

The collision rate for bird species at the site is currently unknown. However, if fatalities occur either frequently over a short period of time, or less frequently over a long period of time, it is probable that at least some carcasses will fall on the hardstanding areas and be detected.

1.1 Methodology

SPR will undertake external checks for carcasses at weekly intervals for the entire duration of the operational period.

External turbine checks are part of the routine maintenance programme undertaken by SPR operations, and involve a survey by the site attendant who will run through a checklist at each turbine location. Part of this checklist prompts the site attendant to visually scan the hardstanding areas around the turbine for any dead or injured animal. If any animal is found, it will trigger a detailed recording protocol which will gather the following information which is logged in the ISO140001 Environmental System and in parallel reported to the internal ecology team (4 members of staff) who will review and advise any further actions:

1. Turbine number, distance and direction from the tower
2. Photo of carcass with turbine, close-up photo(s) of the carcass with common object for scale
3. Date and notes of any injuries

Training by way of a "toolbox talk" is provided by a member of the ecology team to the site attendant to ensure familiarity with the detection, recording and reporting procedures.

1.1.1 Observer efficiency and carcass removal

Previous testing of the methodology at Whitelee windfarm 2014 – 2016 involving placing decoy carcasses randomly below turbines on hardstandings in order to test observer efficiency generated an estimate of 93% of carcasses in n=105 trials were detected and reported by operational personnel. This figure compares well to other studies in the reported literature, and is likely to be due to the easy visibility of the hardstanding areas.

Scavenger removal rates at the site are currently unknown. Studies of carcass removal rates have reported significant differences depending on species, location and time of year meaning it is difficult to rely on estimates from other studies for a specific project. However, the availability of sufficient numbers of fresh golden plover carcasses to undertake such a site-specific study is practically unachievable. For the purposes of methodological scenario testing, an exponential daily carcass persistence probability value of 0.93 has been assumed (i.e. there is a 93% probability a carcass will persist between days). This value was calculated experimentally at Clachan Flats windfarm using quail, and also at Braes of Doune windfarm using pheasant carcasses, and was also determined to be the best available estimate from a literature review carried out for the SWBSG[1]. For raptors, the persistence rate is predicted to be higher from studies which have attempted to compare removal rates between raptors and game species.

1.1.2 Example Scenario

A realistic minimum objective of this type of study would be to conclude that there is a >80% probability that the total number of bird fatalities of a particular species was <6 over an illustrative 25 years. This calculation is explained below using a worked example based on the following parameters:

Carcass persistence: 0.93 (Clachan and Braes estimated this value, was also used in SWBSG)

Observer efficiency: 0.933 (Whitelee trials)

Proportion of area searched: 0.3

Probability of detection PR(det)[2]: 0.229

Scenarios after an illustrative 25 years[3]:

No. carcasses found	Mean estimate of fatalities	80% Credible Interval
0	2	0 – 6
1	6	2 – 15
2	11	5 – 21
3	15	8 – 27

From the scenarios in Table 1, if 0 carcasses are detected using the SPR methodology during the windfarm operation it there is a >80% probability that the true fatality rate is <6.

1.1.3 Reporting

Annual reports of all habitat monitoring and carcass search results will be provided to NIEA and RSPB.

[1] Caryl, F., Vallejo, G., Tidhar, D. and Robinson, C. (2016) Precision and bias of bird fatality estimates from two contrasting carcass detection strategies. SWBSG Commissioned report number 1605.
[2] Using the perickson function in R package "carcass", reported by SWBSG project 1605 to provide the least biased results
[3] Using the posteriorN function in R package "carcass"