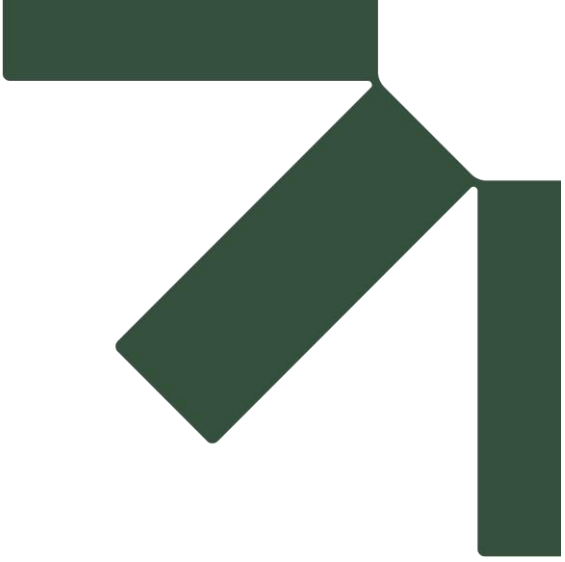




Appendix E Baseline Bird Survey Reports

**Appropriate Assessment Screening Report and Natura
Impact Statement**

Cush Wind Farm Phase II

Cush Wind Limited

SLR Project No.: 501.065723.00001

23 October 2026

BIRD SURVEY REPORT

BREEDING 2022

Cush Wind Farm

Prepared for: Galetch Energy Developments

SLR Ref: 501.V00494.00012
Version No: Issue01
August 2026



Document Control	
Document Properties	
Organisation	SLR Consulting Ireland
Project Name	Cush Wind Farm Phase 2
Report Title	Bird Survey Report Breeding 2022
Author(s)	Alice Magee
Draft version/final	Issue
Document reference	501.V00494.00012

DATE	Revision No	Prepared by	Reviewed by	Approved by	Status	Comments
21/08/26	1	Alice Magee	Dr Jonathon Dunn	Dr Jonathon Dunn		Updated to focus on extension area only (phase 2)

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1.0 Introduction

Bird surveys have been previously undertaken at the proposed wind farm development site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR Consulting Ireland (SLR) for the breeding 2020, non-breeding 2020/21, breeding 2021, and non-breeding 2021/22 seasons. The Project Site also includes a linear area that was previously surveyed for a proposed overhead line¹. Flight activity surveys were carried out at two vantage point locations along the proposed overhead line route corridor during the breeding season in 2018.

SLR was commissioned by Galetech Energy Developments to carry out a bird survey programme for the proposed wind farm at Cush, Co. Offaly (hereafter 'the Project') during the breeding season in 2022.

1.1 Background to the Commission

The Project Site includes a phase 1 (eight turbines) and an extension area (three turbines). Phase 1 was granted planning permission in November 2024. As the bird survey programme for the breeding season 2022 covered both phases, and the data are within date according to NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance², the results are considered to be relevant to the proposed extension area (Phase 2). This report focuses on the methodology and results that are relevant to the extension area. The methodology and results of the entire bird survey programme can be found in the previously issued baseline breeding bird survey report³.

1.2 Site Description

The Project Site located in the townland of Cush approximately 4 km north of Birr, Co. Offaly. The extension area predominantly consists of cutaway bog, with small areas of agricultural grassland and mixed and coniferous forest (refer to Appendix 01 Figure 1).

1.3 Scope of Work

The scope of survey work was based on existing knowledge of the area and took into account current NS Guidance², with details provided in Table 1-1. Further details are provided in Sections 2.2 to 2.5.

Table 1-1
Scope of Ornithological Survey Work May to August 2022

Survey Type	Summary Methodology (see Section 2 for further details)
Vantage Point (VP) surveys	12 hours of survey per month were carried out from a single VP between May and June 2022. Six hours of survey per month were carried out from the VP between July and August 2022.
Breeding wader surveys	Three breeding wader surveys were carried out from May to June 2022 to search for lowland waders breeding within the Project Site.

¹ SLR (2018) *Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018*. Prepared for Galetech Energy Services Ltd

² Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

³ SLR (2022) *Cush Wind Farm Breeding Bird Survey Report 2022*.

Survey Type	Summary Methodology (see Section 2 for further details)
Breeding raptor surveys	Five breeding raptor surveys were carried out from May to July to search for any raptors breeding within 2 km of the Project Site. An additional survey was undertaken at Loughnane Quarry in August to search for breeding peregrine falcon <i>Falco peregrinus</i> .

1.4 Target Species

Target species for the surveys were defined by legal and/or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS guidance.

1.4.1 Primary Target Species

Primary target species was limited to species upon which effects are most likely to be potentially significant in EIA and Appropriate Assessment (AA) terms e.g., species forming qualifying features for nearby Special Protection Areas (SPAs) or species listed on Annex 1 of the Birds Directive⁴. This enabled recording to focus on the species of greatest importance without the distraction of having to record detailed flight data for a larger number of more common species.

Primary target species included the following bird species:

- All Annex 1 raptor/owl species;
- Qualifying interest species for nearby SPAs⁵; and
- Other raptors, waders or wildfowl red-listed on the latest Birds of Conservation Concern in Ireland (BoCCI)⁶ scheme.

1.4.2 Secondary Species

Local circumstances may indicate that survey information should also be acquired on other species, especially those of regional conservation concern. Such species are termed secondary species. Recording of secondary species is subsidiary to recording of primary target species.

Secondary target species included:

- Any other wildfowl and wader species;
- Common buzzard *Buteo buteo*;
- Eurasian sparrowhawk *Accipiter nisus*;
- Northern raven *Corvus corax*;
- Grey heron *Ardea cinerea*;
- Great cormorant *Phalacrocorax carbo*; and

⁴ Annex 1 of the Birds Directive (Directive 2009/147/EC)

⁵ The relevant SPAs are listed in Section 3.1.

⁶ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22

- Gulls *Larus* sp.

NS guidance states that “it is generally considered the passerine species are not significantly impacted by wind farms”. It goes on to state that “survey of woodland passerines, especially in commercial conifer forest is generally not required”. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that passerines red-listed under the latest Birds of Conservation Concern in Ireland (BoCCI) scheme⁷ should be considered as equivalent. No such species were returned during the desk-based review or data request. NS guidance also states that “surveys of farmland passerines especially on more intensive arable habitat are generally not required”. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

1.5 Terminology

For this report, “flight line” refers to the line drawn to record avian movement during a VP survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as “a flight”. Note that the “cumulative number of flights” reflects the occupancy of the study area by a particular species. It is not equivalent to the total number of unique individuals and should not be used to infer abundance.

1.6 Purpose of this Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The assessment of impacts resulting from the proposed development and the development of mitigation measures, if required, are beyond the scope of this report and will be covered in a separate Environmental Impact Assessment (EIA) Report in due course.

⁷ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22

2.0 Methods

2.1 Desk-Based Review

The desk review collated any available information to date on the breeding and non-breeding bird populations and movements around the Project site.

The following reports resulting from previous breeding and non-breeding bird surveys were reviewed for any relevant information that could be used to inform the current bird surveys:

- SLR (2020) Cush Wind Farm Breeding Bird Survey Report 2020.
- SLR (2022) Cush Wind Farm Winter Bird Survey Report 2020-2021.
- SLR (2022) Cush Wind Farm Breeding and Winter Bird Survey Report 2021-2022.
- SLR (2018) Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018

The websites of the National Parks and Wildlife Service (NPWS)⁸, the UK and Ireland Bird Atlas 2007-2011⁹ and the National Biodiversity Data Centre (NBDC)¹⁰ were accessed for information on sites designated for nature conservation and notable bird species in the vicinity of the Project Site.

2.2 Field Survey Dates and Personnel

Surveys were undertaken by Jonathon Dunn (JD) PhD, Aisling Kinsella (AK) BSc (Hons) MSc, Darragh Nagle (DN) BSc (Hons), and Maeve Maher-McWilliams BSc (Hons) MSc.

Details of survey dates and times are provided in Appendix 02 and a record of weather conditions during surveys is provided in Appendix 03.

2.3 Flight Activity Surveys

Three VP locations were selected that covered both phases of the Project Site. The viewsheds from VP1 and VP2 cover phase 1 of the Project, and the viewshed from VP3 covers the extension area. As VP3 was deemed to adequately cover the extension area without adding additional VPs, this report will focus on surveys conducted from VP3.

VP locations, 2 km viewing arcs and viewsheds are shown in Appendix 01 Figure 1.

A total of 36 hours of flight activity surveys were conducted from VP3 during the 2022 breeding season, as summarised in Table 2-1.

In order to avoid possible complications during any subsequent collision risk modelling, VP watches were timed such that surveys were not undertaken simultaneously from both VPs. This avoids double-counting birds and ensures that no disturbance is made to birds within viewsheds from presence of the observer.

VP watches aimed to quantify the flight activity of primary and secondary target species (as defined in Section 1.4) within the study area.

The main purpose of VP watches is to collect data on primary target species that will enable estimates to be made of:

⁸ www.npws.ie Accessed 16/12/2024 21/08/26

⁹ <https://app.bto.org/mapstore/StoreServlet> Accessed 16/12/2024 21/08/26

¹⁰ <http://maps.biodiversityireland.ie/#/Map> Accessed 16/12/2024

- The time spent flying over the Project Site;
- The relative use by birds of different parts of the Project Site;
- The proportion of flying time spent within the provisional upper and lower risk height limits as determined by the potential rotor diameter and rotor hub height; and
- Ultimately, the analysis of the potential risk of collision of birds with rotating turbines.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying bout;
- Species, age and sex (where determinable);
- Number of birds observed;
- Time spent within each height band; and
- Notes on observation.

In the absence of detailed information regarding turbine specifications at the time of commencing surveys, a precautionary approach was taken in relation to recording height bands. For the 2022 breeding season, height bands were determined allowing for the maximum rotor tip height of 200 m and a lowest rotor swept height of 28 m. The relation of the height bands to the latest turbine specification is shown below.

Flight heights were attributed to four distinct height bands for the breeding season as follows:

- 1 = <25 m (below the likely rotor swept area);
- 2 = 25 m to 160 m (potentially within the likely rotor swept area, at least in part);
- 3 = 160 m to 200 m (within the likely rotor swept area); and
- 4 = >200 m (potentially within the likely rotor swept area, at least in part).

In addition, a summary of observations of secondary target species was recorded at the end of each five-minute period during each VP watch to provide an index of flight activity for secondary target species within and around the Project Site, in accordance with current NS guidance.

Table 2-1
 Summary of VP Surveys Undertaken during the Breeding Season 2022

Month	VP3 (hours)
May	12:00
June	12:00
July	6:00
August	6:00
Total hrs	36:00
VP locations ITM (Figure 1)	607798 E 711305 N

2.4 Breeding Wader Surveys

Breeding wader surveys followed the methodology described in O'Brien and Smith (1992)¹¹. The survey involved a walked transect which covered all habitat potentially suitable for breeding waders within the Project Site.

There are large plantations of mature conifer forestry in the central, western, and southern areas of the Project Site. These habitats are not suitable for breeding waders¹² and so were excluded from the survey. There are some areas of recolonising cutover bog which were as considered suitable habitats for breeding waders. As such, transects were undertaken where habitats which are more suited to breeding waders. These transects are located in the western, eastern and northern sections of the Project Site where semi-natural and wet grassland fields are present and also, passing near to areas of recolonising cutover bog.

The transect route was repeated three times across the 2022 breeding season on 9th May, 17th May and 8th June.

The location, movement and behaviour of all wader species were recorded onto field maps using standard BTO species codes. The following criteria was recorded for each species:

- Northern lapwing *Vanellus vanellus* – the total numbers of birds seen from the transect;
- Common snipe *Gallinago gallinago* – the number of drumming plus chipping birds heard or seen from the transect; and
- Other species – the number of pairs (where 'pairs' = (paired individuals/2), displaying birds, nests or broods and other single birds not in flocks).

For birds to be considered as “confirmed breeding”, one or more of the following criteria needed to be met:

- They were observed displaying or singing on more than one visit;
- Nests, eggs, or young were located;
- Adults repeatedly alarm called;
- Distraction displays were seen; and/ or
- Territorial disputes were observed.

Birds were considered to be probably or possibly (i.e. unconfirmed) breeding if:

- They were observed displaying or singing on one visit (i.e. possibly breeding) or more than one visit (i.e. probably breeding) (with the exception of obvious passage migrants in spring); or
- A pair of birds was observed in suitable habitat for nesting.

Other records were considered to be of non-breeding birds, failed breeders, birds loafing, feeding or on passage to other areas.

Please see Appendix 01 Figure 3 for an outline of the walked transect and Appendices 02 and 03 for metadata relating to these surveys.

¹¹ O'Brien, M. and Smith, K. W. (1992) Changes in the status of waders breeding on wet lowland grasslands in England and Wales between 1982 and 1989, Bird Study, 39:3, 165-176

¹² Apart from potentially for woodcock, which were not the target of surveys here.

2.5 Breeding Raptor Surveys

The survey methodology for breeding raptors used was a driven transect with regular stops, to carry out watches of suitable habitat from appropriate viewpoints to identify potential nesting territories in suitable breeding habitat¹³. The locations of these viewpoints are presented in Appendix 01 Figure 4 together with the outline of the driven survey route and the results of the surveys.

A driven survey was used due to limitations to access to third party land within the 2 km buffer zone and the availability of a good road network in the vicinity of the Project Site. Visibility from the survey route was sufficient to cover the vast majority of potentially suitable breeding habitat within the survey area.

Survey timings followed NS guidelines. This survey was repeated along the same routes on once on 9th May, 17th May and 7th June, and twice on 14th July (dawn and dusk). An additional survey was undertaken on 2nd August at Loughnane Quarry (located 1 km south of the Project Site) to search for evidence of breeding peregrine falcon. Details of survey dates, times and observers are provided in Appendix 02 and a record of weather conditions during surveys is provided in Appendix 03.

The location, movement and behaviour of all raptor species observed were recorded onto the field maps using standard BTO species codes.

2.6 Survey Limitations

No surveys were completed in April 2022. However, the survey effort was doubled up in May and June, which ensured that the required number of surveys was completed before the end of the breeding season.

Vantage point surveys at VP3 were undertaken in optimal weather conditions. Visibility was recorded as “good” (i.e. >3 km) during all 36 hours of surveys. There were no recorded hours of “moderate” (i.e. 1-3 km) or “poor” (i.e. <1 km) visibility. Further details regarding weather conditions during surveys are provided in Appendix 02.

No other limitations were encountered during surveys.

¹³ Hardey, J., Crick, H.Q.P., Wernham, C., Riley, H., Etheridge, B., Thompson, D. (2013). Raptors: A field guide for surveys and monitoring (3rd Edition). The Stationery Office Edinburgh.

3.0 Results

3.1 Desk Based Results

3.1.1 Natura 2000 sites

The Project Site is not within or immediately adjacent to any SPA. However, there are a total of eight SPAs within a 20 km¹⁴ radius with details shown in Table 3-1.

The closest SPAs to the Project Site are Dovegrove Callows SPA (Site Code: 004137), All Saints Bog SPA (Site Code: 004103) and River Little Brosna Callows SPA (Site Code: 004086) at distances of 3.6 km, 5.1 km and 5.8 km, respectively. Dovegrove Callows SPA and All Saints Bog SPA are designated for the protection of wintering Greenland white-fronted geese *Anser albifrons flavirostris*, whereas the River Little Brosna Callows SPA is designated for several wintering gull, wader and wildfowl species.

Table 3-1
SPAs within 20 km of the Project Site and their Qualifying Interests (Species Present During the Breeding Season)

Site Name	Site Code	Distance/Direction from Extension Area Boundary	Species of Special Conservation Interest Relevant to the Breeding Season
Dovegrove Callows SPA	004137	3.6 km southwest	• N/A
All Saints Bog SPA	004103	5.1 km west	• N/A
River Little Brosna Callows SPA	004086	5.8 km west	• N/A
Middle Shannon Callows SPA	004096	7.2 km northwest	• Corncrake <i>Crex crex</i> • Northern lapwing
Slieve Bloom Mountains SPA	004160	11.8 km southeast	• Hen harrier <i>Circus cyaneus</i>
River Suck Callows SPA	004097	17.3 km northwest	• N/A
Lough Derg (Shannon) SPA	004058	17.5 km southwest	• Great cormorant <i>Phalacrocorax carbo</i> • Tufted duck <i>Aythya fuligula</i> • Common tern <i>Sterna hirundo</i>
Mongan Bog SPA	004017	19.0 km northwest	• N/A

¹⁴ A 20 km search radius was used as this represents the maximum core foraging distance used by Qualifying Interest species of SPAs in the UK and Ireland

3.1.2 Other Nature Conservation Sites

There are three NHAs located within 20 km of the Project Site with site synopses that mention birds. Two NHAs (River Little Brosna Callows NHA and Suck River Callows NHA) are also SPAs, and the bird species for which they are designated are detailed above in Table 3-1. Details of the remaining NHA are presented in Table 3-2.

There are three pNHAs within 20 km of the Project Site with site synopses that mention birds. Details of these pNHAs are presented in Table 3-2.

The Project Site is not within or immediately adjacent to any Ramsar site. The Slieve Bloom Mountains Ramsar site is located 11.8 km east of the Project Site and is contained within the boundaries of the Slieve Bloom Mountains SPA.

Table 3-2

NHAs and pNHAs within 20 km of the Project Site and their Qualifying Interests (Species Present During the Breeding Season)

Site Name	Site Code	Distance/Direction from Extension Area Boundary	Species of Special Conservation Interest Relevant to the Breeding Season
Woodville Woods pNHA	000927	2.0 km southwest	<ul style="list-style-type: none"> Common snipe
Arragh More Bog NHA	004137	12.5 km southwest	<ul style="list-style-type: none"> Hen harrier
Lough Nahinch (Tipperary) pNHA	000936	17.1 km southwest	<ul style="list-style-type: none"> Common redshank <i>Tringa totanus</i> Common snipe Water rail <i>Rallus arquaticus</i>
Pallas Lough pNHA	000916	18.3 km northeast	<ul style="list-style-type: none"> Mallard <i>Anas platyrhynchos</i> Eurasian teal <i>Anas crecca</i> Eurasian wigeon Western marsh harrier <i>Circus aeruginosus</i>

3.1.3 Species Records

The NBDC database was searched for records of relevant bird species (those listed as primary/secondary target species and rare/protected species) from the 2 km grid squares N01Q and N01V within which phase 2 is located. The results are listed below in.

Table 3-3: Relevant Bird Species Recorded from the 2 km Grid Squares Within Which Phase 2 is Located

Grid Square	Species	Date of Last Record & Dataset	Designation
N01Q, N01V	Common buzzard <i>Buteo buteo</i>	2021, Birds of Ireland	BoCCI4 Green
N01V	Northern lapwing	2022, Birds of Ireland	BoCCI4 Red
N01V	Yellowhammer <i>Emberiza citrinella</i>	2021, Birds of Ireland	BoCCI4 Red

3.2 Breeding Season Flight Activity Surveys

Flight activity recorded from VP3 combined by primary target species is summarised in Table 3-4. Primary target species flights from VP3 are shown in Appendix 01 Figures 2.1 to 2.5. Flight activity data are provided in more detail in Appendix 04 with full data retained in GIS and excel format for subsequent collision risk modelling.

3.2.1 Primary Target Species

A total of 236 flight lines by five primary target species were recorded between May and August 2022.

Table 3-4
Number of Primary Target Species Flights from VP3, May to August 2022

Species	Number of flight lines by month				Total number of flight lines	Time at risk height* (s)	Cumulative number of flights
	May	June	July	August			
Black-headed gull	54	14	0	0	68	840	230
Common kestrel <i>Falco tinnunculus</i>	9	20	2	0	31	3,180	31
Northern lapwing	43	32	19	1	95	750	154
Peregrine falcon	1	2	1	0	4	240	4
Common snipe	1	19	7	0	27	1,110	29
* precautionary risk height assumed to be between 28 – 200 m							

A summary description of flight activity by each species is presented below.

Black-Headed Gull

Sixty-eight black-headed gull flight lines were recorded from May to June 2022, with a cumulative total of 230 flights. Most flight lines were within the extension area and a total of 24 flight lines (35%) were recorded within potential collision risk heights. Most flight lines consisted of a small number of birds, but there were a few

larger flocks recorded (up to 34 flights per flight line). Flight durations varied with a maximum duration of 480 seconds.

Common Kestrel

Thirty-one common kestrel flight lines were recorded during the flight activity surveys, with all observations consisting of a single bird. Most flight lines were within the extension area and total of 21 flight lines (68%) were recorded within potential collision risk heights. Flight durations varied with a maximum duration of 446 seconds.

Northern Lapwing

Ninety-five northern lapwing flight lines were recorded during the flight activity surveys, with a cumulative total of 154 flights. The highest number of flight lines was recorded in May, with numbers declining in later months. Most flight lines consisted of a single bird, but a few small flocks were recorded (up to 11 flights). Most flight lines were within the 500 m survey buffer and total of 14 flight lines (15%) were recorded within potential collision risk heights. Activity was located mostly immediately in front of VP3 outside the developable area.

Peregrine Falcon

Four peregrine falcon flight lines were recorded from May to July 2022, with all observations consisting of a single bird. Three flight lines were within the 500 m buffer and all flight lines were within potential collision risk heights.

Common Snipe

Twenty-seven common snipe flight lines were recorded from May to July 2022, with a cumulative total of 29 flights. The highest number of flight lines was recorded in June. All flight lines were within the 500 m survey buffer and total of 11 flight lines (42%) were recorded within potential collision risk heights. Flight durations varied with a maximum duration of 814 seconds.

3.2.2 Secondary Target Species

Secondary species activity at the Project Site is summarised in Table 3-5. There were ten secondary species recorded throughout the season. Common buzzard was the most frequently recorded secondary species (in 56 five-minute periods out of a possible 432). The highest number of birds recorded in one observation was 19 mallards.

Table 3-5
Secondary Species Activity Summary for VP3 – May to August 2022

Species	Number of 5 min periods recorded	Peak count of birds recorded in any 5 min period	Comments
Common buzzard	56	4	Activity in all months, within the Project Site, survey buffer and beyond.
Common gull <i>Larus canus</i>	1	1	Activity in May only, within the Project Site.
Common ringed plover <i>Charadrius hiaticula</i>	12	3	Activity in June and July only, within the Project Site.
Great black-backed gull <i>Larus marinus</i>	3	2	Activity in August only, within the Project Site and survey buffer.
Grey heron	5	2	Activity in all months except August, within the Project Site.
Herring gull <i>Larus argentatus</i>	4	8	Activity in May and June, within the Project Site and survey buffer.
Lesser black-backed gull <i>Larus fuscus</i>	10	4	Activity in all months, within the Project Site and survey buffer.
Mallard	6	19	Activity in all months except July, within the Project Site, survey buffer and beyond.
Northern raven	14	4	Activity in May and August, within the Project Site, survey buffer and beyond.
Eurasian sparrowhawk	6	1	Activity in all months, within the Project Site and survey buffer.

3.3 Breeding Wader Surveys

A total of three wader species were recorded during the breeding wader surveys. All wader observations were recorded during the two surveys in May.

Eurasian Curlew

Two observations of Eurasian curlew were made during the survey on 9th May. Two birds were recorded from the northern transect within 100 m of the extension area, and one bird was recorded from the western transect in an agricultural field adjacent to the extension area but separated by the N62 road. No evidence of breeding was recorded for this species.

Common Snipe

A single common snipe was recorded flying briefly over the survey area north-west of the extension area on 17th May. No evidence of breeding was recorded for this species. No drumming behaviour was recorded during flight activity surveys.

Northern Lapwing

A probable northern lapwing territory was identified within the extension area c. 300 m from the nearest turbine, as evidenced by frequent flight activity and aggressive behaviour. A single bird was also observed flying further south. This territory was within the south of the developable area.

Incidental Records of Other Species

No incidental records of non-target surveys were recorded during the breeding wader surveys.

3.4 Breeding Raptor Surveys

A total of four species of raptor were recorded during the targeted breeding raptor surveys.

Common Buzzard

There were 17 common buzzard observations made between May-July 2022, but no confirmed evidence of breeding was recorded during these months. Two possible territories were identified within 1 km of the extension area in May. Three birds were observed circling over suitable nest habitat in July, but no nests or young birds were recorded.

Common Kestrel

Common kestrel was observed hunting during May-July 2022 on six occasions, but there was no evidence of breeding by this species within 2 km of the Project Site.

Peregrine Falcon

A single peregrine falcon was observed flying towards Loughnane Quarry in July 2022, which is c.2 km from the nearest turbine. During the survey at the quarry in August, one bird was recorded perched on a ledge and flew off to the north. A possible nest site and several used roosts were also recorded.

Eurasian Sparrowhawk

A single Eurasian sparrowhawk was observed circling over woodland within 2 km of the Project Site, but there was no evidence of breeding by this species within 2 km of the Project Site.

Incidental Records of Other Species

Incidental records were made of sandwich tern *Sterna sandvicensis* (heard flying very high over the site, >200 m), northern lapwing and little egret during the surveys in May. A barn owl *Tyto alba* was recorded hunting on 18th May during a bat activity transect undertaken after a breeding raptor survey. The owl was located c. 1 km west of the Project Site, separated by the N62.

4.0 Summary and Conclusions

Flight activity surveys (VPs), breeding wader and breeding raptor surveys were carried out at the Project Site during the breeding season in 2022.

The following primary target species were recorded during the breeding season flight activity surveys:

- Black-headed gull;
- Common kestrel;
- Northern lapwing;
- Peregrine falcon; and
- Common snipe.

Northern lapwing was the most frequently recorded species (95 flight lines), followed by black-headed gull (68 flight lines), common kestrel (31 flight lines) and common snipe (27 flight lines).

Then secondary target species were recorded during the breeding season: common buzzard, common gull, common ringed plover, great black-backed gull, grey heron, herring gull, lesser black-backed gull, mallard, northern raven and Eurasian sparrowhawk.

Northern lapwing was probably breeding (as evidenced by a territory and aggressive behaviour) within the extension area in the same location where a nest and chicks were recorded previously, c.300 m from the nearest turbine. Common buzzards were suspected to breed (i.e. territories were present) within 2 km of the Project Site, and peregrine falcon were suspected to breed (one possible nest) in Loughnane Quarry located c.2 km south of the nearest turbine.

Incidental records made of species of conservation concern during taxon-specific surveys included sandwich tern, little egret, northern lapwing and barn owl.

4.1 Legal and Conservation Status of Target Species Recorded

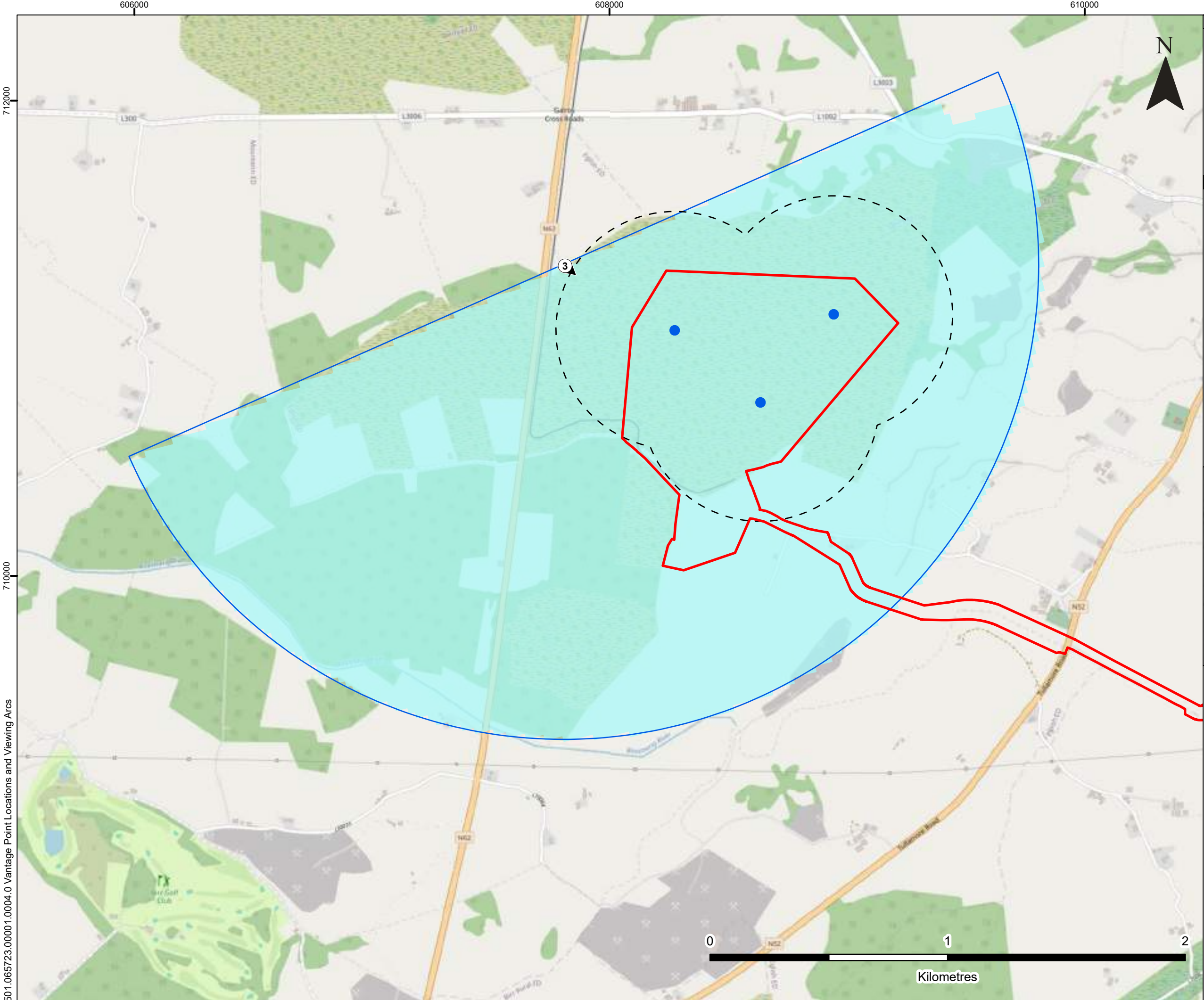
Table 4-1 summarises the legal and conservation status of the primary and secondary target species recorded during the range of ornithological surveys mentioned above. Note that all bird species in Ireland are afforded general protection by the Wildlife Acts 2000 (as amended).

Table 4-1
Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO code)	Legal and Conservation status in Ireland
Primary	Black-headed gull (BH)	BoCCI4 Amber
	Common kestrel (K.)	BoCCI4 Red
	Northern lapwing (L.)	BoCCI4 Red
	Peregrine falcon (PE)	Annex 1, BoCCI4 Green
	Common ringed plover (RP)	BoCCI4 Amber
	Common snipe (SN)	BoCCI4 Red
Secondary	Common buzzard (BZ)	BoCCI4 Green
	Common gull (CM)	BoCCI4 Amber
	Great black-backed gull (GB)	BoCCI4 Green
	Grey heron (H.)	BoCCI4 Green
	Herring gull (HG)	BoCCI4 Amber
	Lesser black-backed gull (LB)	BoCCI4 Amber
	Mallard (MA)	BoCCI4 Amber
	Northern raven (RN)	BoCCI4 Green
	Eurasian sparrowhawk (SH)	BoCCI4 Green
Incidentals	Sandwich tern (TE)	Annex 1, BoCCI4 Amber
	Barn owl (BO)	BoCCI4 Red
Key		Annex 1 – the species is listed in Annex 1 of the EC Birds Directive; and BoCCI4 status (green, amber or red) – indicates the current Birds of Conservation Concern in Ireland ⁶ status category.

APPENDIX 01

Figures



NOTES

The ZTV is calculated with a surface offset 28m & from a viewing height of 1.8m above ground level. The terrain model is derived from EU Copernicus 25 m data with a vertical accuracy of $\pm 7m$. The ZTV was calculated using ArcMAP 10.5.1 software

The analysis does not take into account the screening effects of vegetation, buildings or other screening features.

LEGEND

- Site Boundary
- Turbine Location
- Turbine Location 500 m Buffer
- Vantage Point (VP)
- VP 2 km Viewing Arc
- Theoretical Visibility from VP 3



SLR

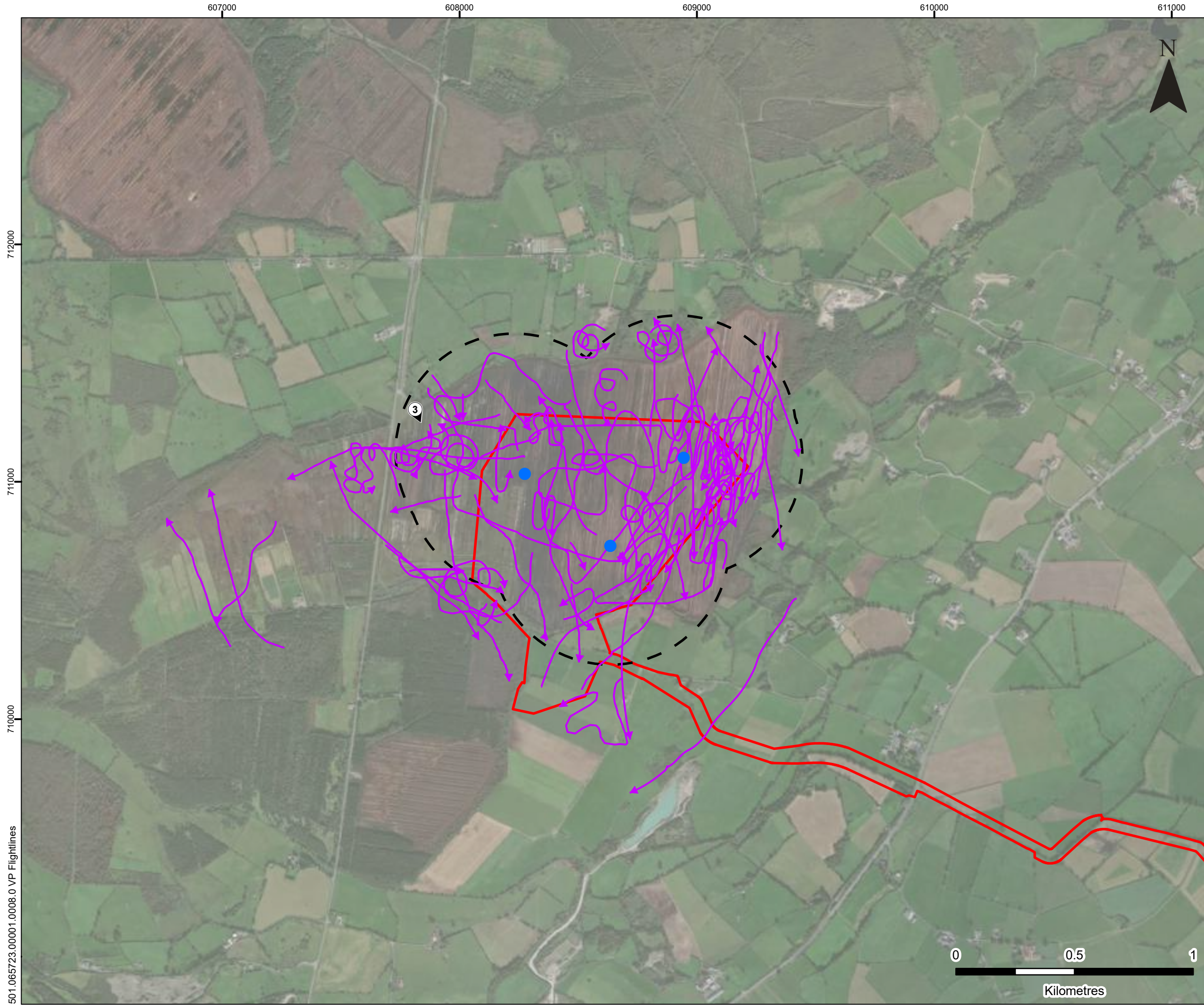
7 DUNDUM BUSINESS PARK
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**CUSH WIND FARM ORNITHOLOGY
BREEDING BIRD SURVEYS 2022**

**VANTAGE POINT LOCATIONS AND
VIEWING ARCS**

FIGURE 1

Scale 1:15,000 @ A3 Date AUGUST 2026



712000

711000

710000

501.065723.00001.0008.0 VP Flightlines

LEGEND

- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Species Flightline**
- Black-headed Gull

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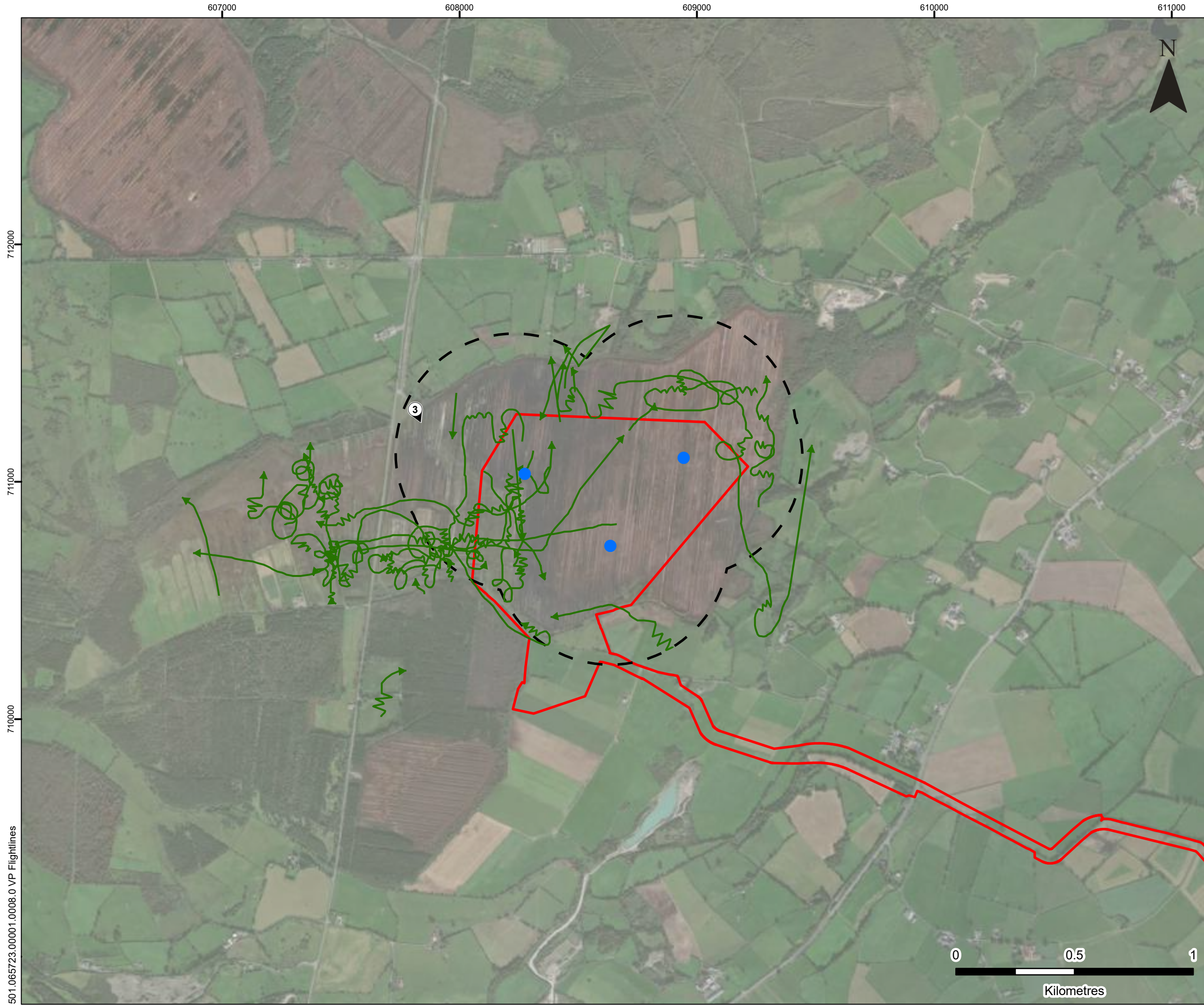
CUSH WIND FARM ORNITHOLOGY
BREEDING BIRD SURVEYS 2022

BLACK-HEADED GULL FLIGHTLINES

FIGURE 2.1

Scale 1:15,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Species Flightline
- Kestrel

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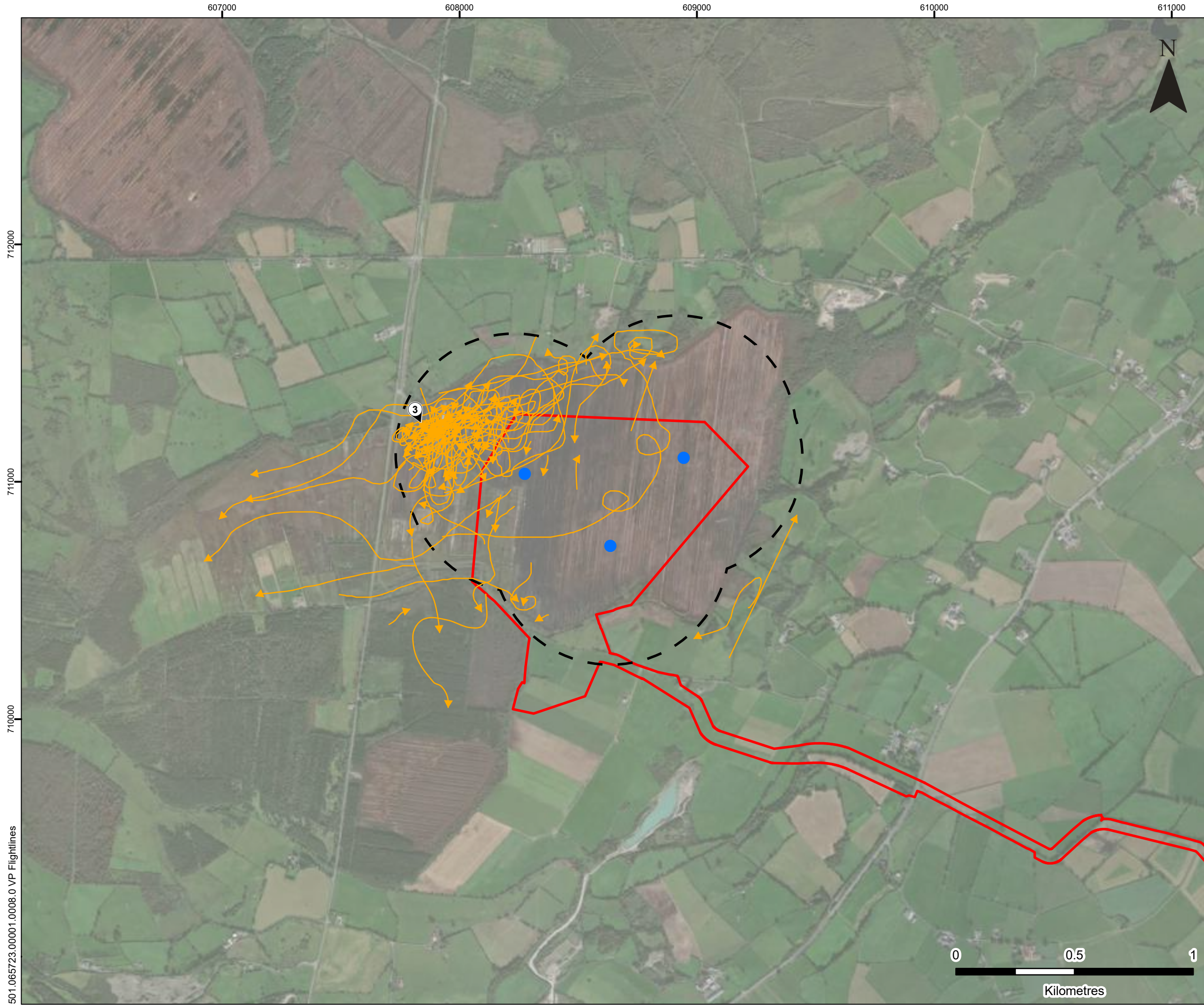
KESTREL FLIGHTLINES

FIGURE 2.2

Scale 1:15,000 @ A3

Date AUGUST 2026

501.065723.00001.0008.0 VP Flightlines



LEGEND

- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Species Flightline
 - Lapwing

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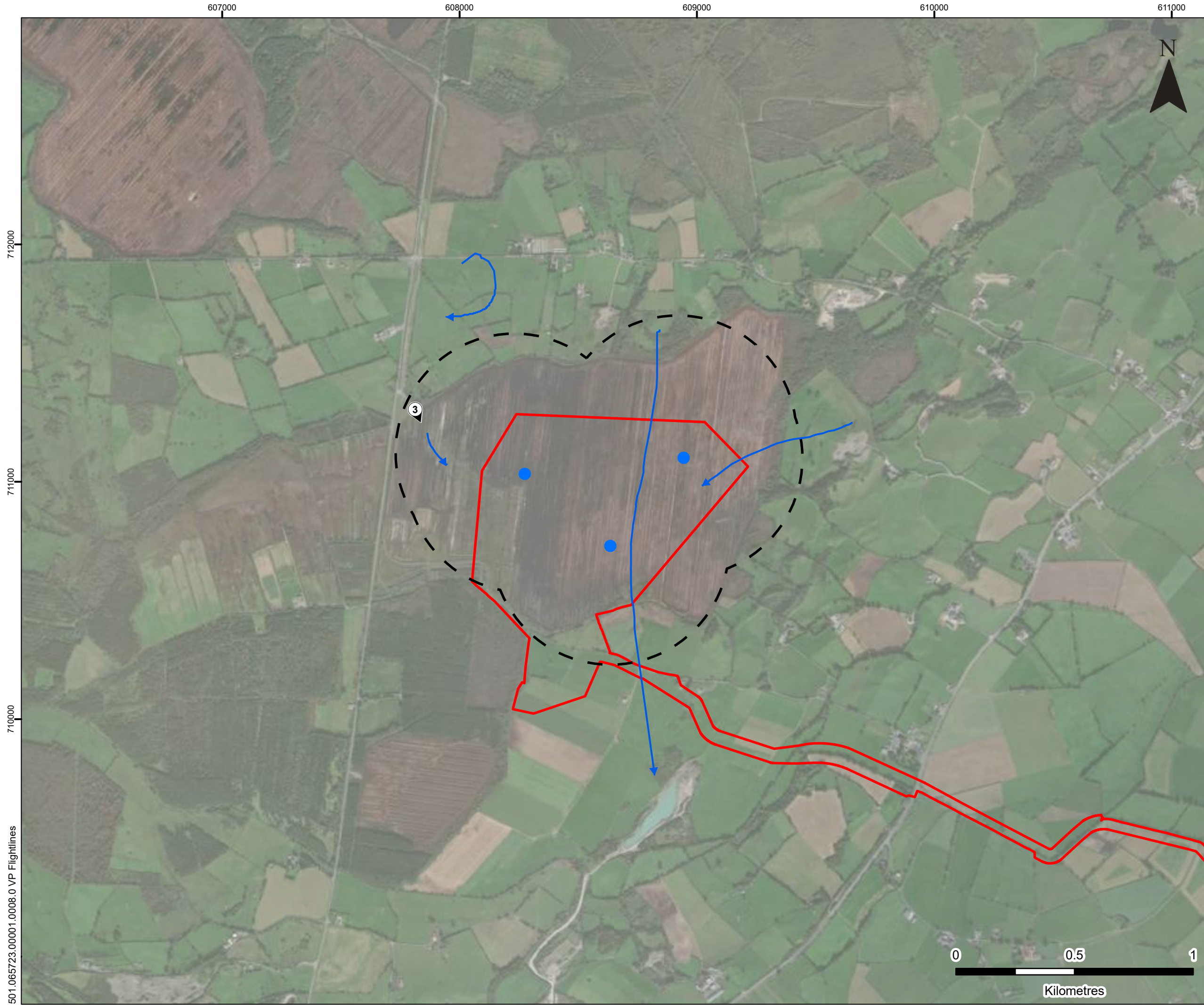
CUSH WIND FARM ORNITHOLOGY
BREEDING BIRD SURVEYS 2022

LAPWING FLIGHTLINES

FIGURE 2.3

Scale 1:15,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Species Flightline**
- Peregrine

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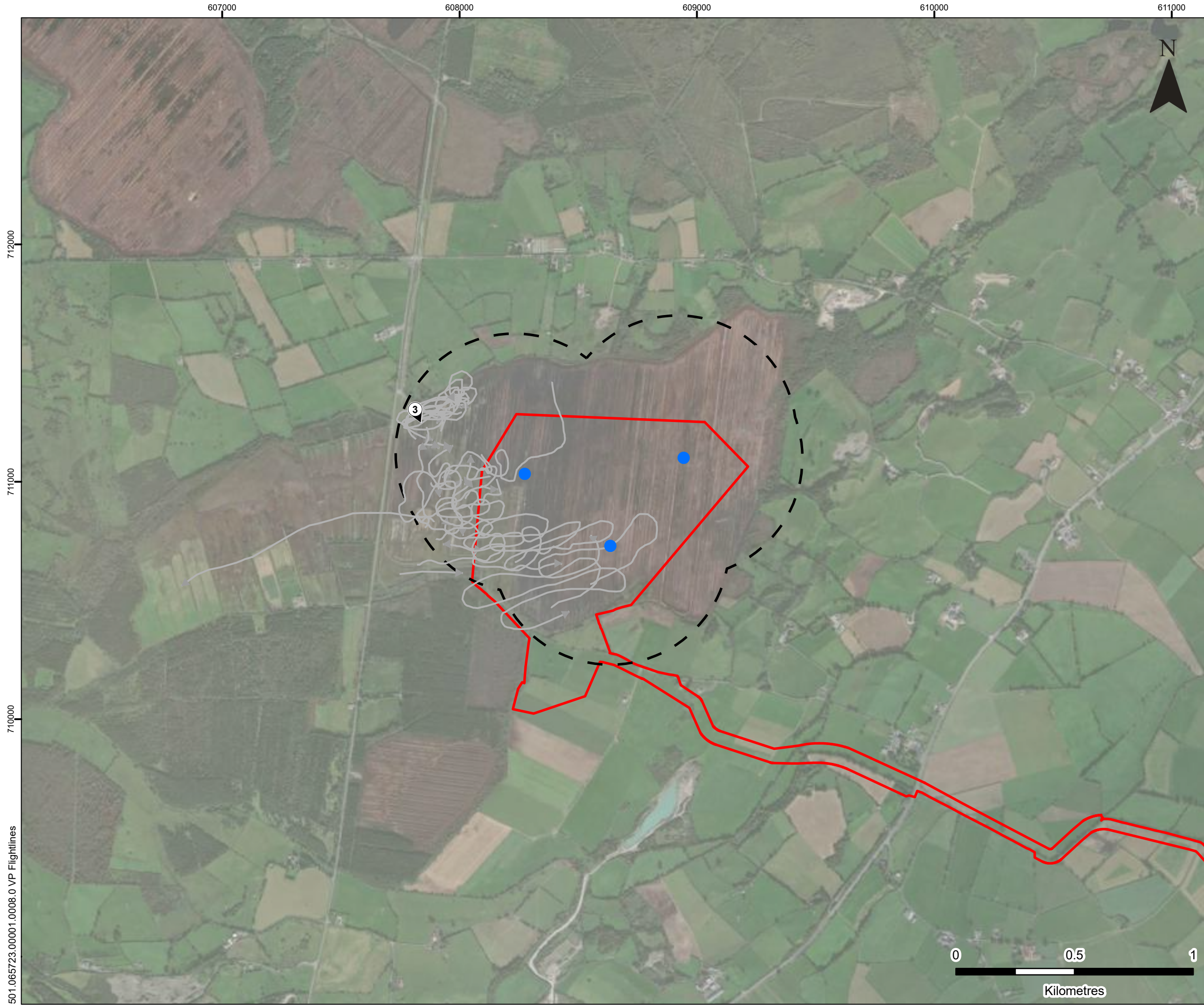
BREEDING BIRD SURVEYS 2022

PEREGRINE FLIGHTLINES

FIGURE 2.4

Scale 1:15,000 @ A3 Date AUGUST 2026

501.065723.00001.0008.0 VP Flightlines



LEGEND

- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Species Flightline
- Snipe

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BREEDING BIRD SURVEYS 2022

SNIE FLIGHTLINES

FIGURE 2.5

Scale 1:15,000 @ A3

Date AUGUST 2026

607000 608000 609000 610000 611000

712000 711000 710000

501.065723.00001.0008.0 VP Flightlines

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LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey
500 m Buffer
- Turbine Location
- Walked Transect Route
- Lapwing Territory
- Wader Point**
 - Curlew
- Wader Flight Line**
 - Lapwing
 - Snipe

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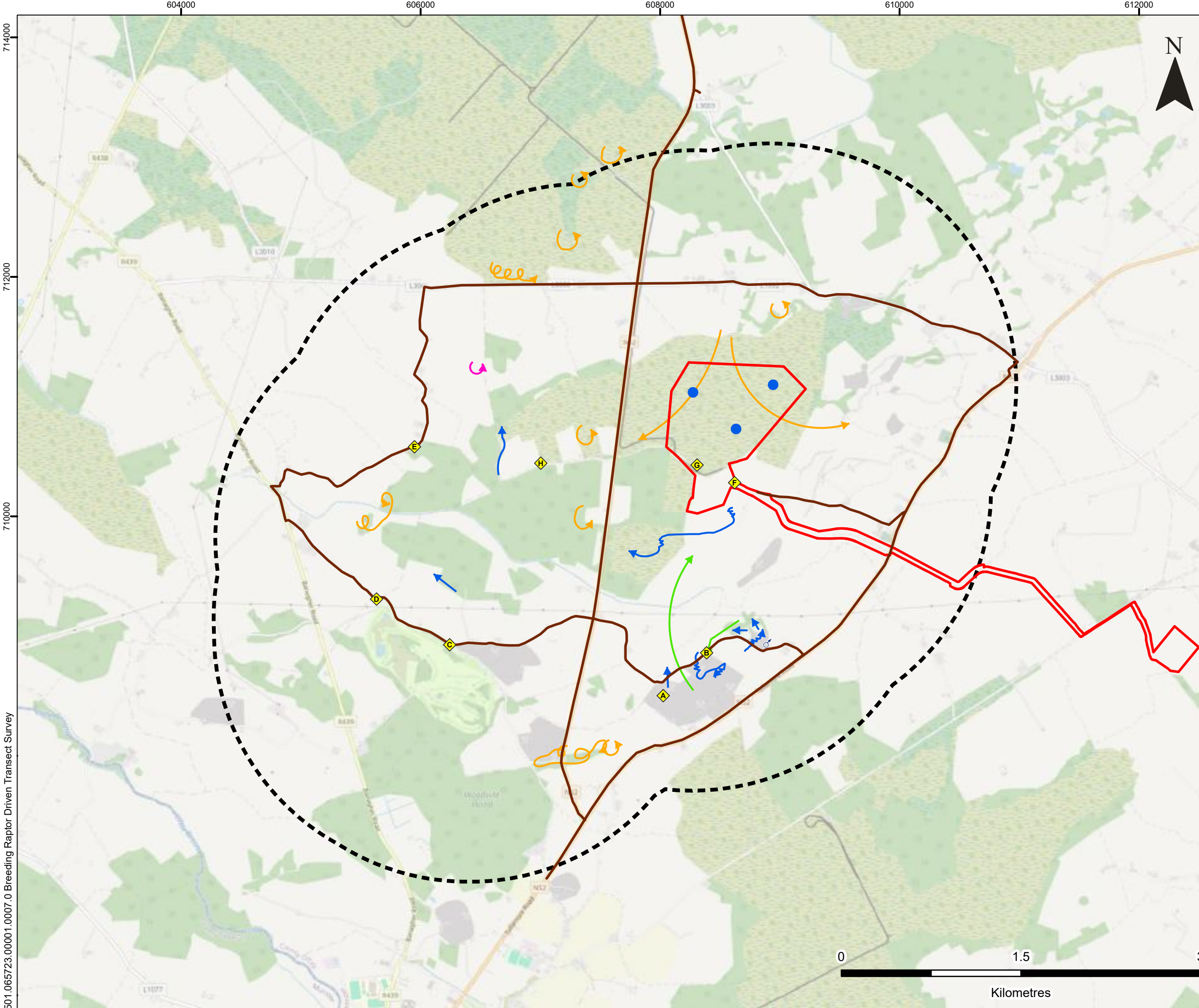
BREEDING BIRD SURVEYS

BREEDING WADER WALKED
TRANSECT SURVEY

FIGURE 3

Scale 1:15,000 @ A3 Date AUGUST 2026

501.065723.00001.0006.0 Breeding Wader Walked Transect Survey



LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey
2 km Buffer
- Turbine Location
- Raptor Vantage Point (VP)
- Driven Transect Route

Species Code

- Buzzard
- Kestrel
- Peregrine
- Sparrowhawk

BTO Activity Code

- Male

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BREEDING BIRD SURVEYS

**BREEDING RAPTOR DRIVEN
TRANSECT SURVEY**

FIGURE 4

Scale 1:30,000 @ A3

Date AUGUST 2026

501.065723.00001.0007.0 Breeding Raptor Driven Transect Survey

APPENDIX 02

Survey dates times and observers¹⁵

¹⁵ Surveyor initials are given in Section 2.2

Table A2-1
Details of VP Surveys Undertaken from VP3

Date	Surveyor	Start time	End time	No. Hours
18/05/2022	JD	09:00	12:00	03:00
20/05/2022	JD	16:00	19:00	03:00
24/05/2022	MMW	10:15	13:15	03:00
26/05/2022	MMW	12:50	15:50	03:00
13/06/2022	MMW	15:30	18:30	03:00
14/06/2022	MMW	19:00	22:00	03:00
28/06/2022	MMW	06:10	09:10	03:00
29/06/2022	MMW	09:45	12:45	03:00
11/07/2022	MMW	16:00	19:00	03:00
12/07/2022	MMW	09:20	12:20	03:00
01/08/2022	MMW	11:30	14:30	03:00
03/08/2022	MMW	06:40	09:40	03:00
Total hours				36

Table A2-2
Details of Breeding Wader Surveys

Date	Surveyor	Start time	End time	No. Hours
09/05/2022	DN	18:00	21:00	03:00
17/05/2022	JD	18:30	21:30	03:00
08/06/2022	MMW	05:30	07:35	02:05
08/06/2022	MMW	20:00	20:55	00:55
08/06/2022	MMW	21:15	22:05	00:50
Total hours				09:50

Table A2-3
Details of Breeding Raptor Surveys

Date	Surveyor	Start time	End time	No. Hours
09/05/2022	DN	12:20	16:00	03:40
17/05/2022	JD	14:30	18:30	04:00
07/06/2022	MMW	10:15	14:30	04:15
14/07/2022	MMW	07:00	10:00	03:00
14/07/2022	MMW	17:00	22:00	05:00
02/08/2022	MMW	10:00	12:30	02:30
Total hours				22:25

APPENDIX 03

Weather data

Table A3-1
Weather Data Collected During Flight Activity Surveys Undertaken from VP3

Date	Survey Start	Survey End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
18/05/2022	09:00	12:00	1	4	S	0	4	2	2	0	0	12
18/05/2022	09:00	12:00	2	4	S	0	5	1	2	0	0	14
18/05/2022	09:00	12:00	3	4	S	0	7	1	2	0	0	15
20/05/2022	16:00	19:00	1	3	E	0	7	1	2	0	0	15
20/05/2022	16:00	19:00	2	3	NE	0	8	1	2	0	0	14
20/05/2022	16:00	19:00	3	3	NE	0	8	1	2	0	0	13
24/05/2022	10:15	13:15	1	2	NW	0	7	1	2	0	0	13
24/05/2022	10:15	13:15	2	3	NW	0	5	2	2	0	0	15
24/05/2022	10:15	13:15	3	3	NW	0	6	2	2	0	0	15
26/05/2022	12:50	15:50	1	4	SW	0	8	1	2	0	0	15
26/05/2022	12:50	15:50	2	4	SW	0	6	1	2	0	0	16
26/05/2022	12:50	15:50	3	4	SW	0	3	2	2	0	0	16
13/06/2022	15:30	18:30	1	2	SW	0	8	1	2	0	0	15

¹⁶ Key: None = 0; Drizzle = 1; Light showers/snow = 2; Heavy showers/snow = 3; Heavy rain/snow = 4.

¹⁷ Expressed in oktas (n/8)

¹⁸ Key: Height of cloud above average height of viewshed. <150m = 0; 150-500m = 1; >500m = 2.

¹⁹ Key: Poor (<1km) = 0; Moderate (1-3km) = 1; Good (>3km) = 2.

²⁰ Key: Lying snow. None = 0; On site = 1; On higher ground = 2.

²¹ Key: None = 0; Ground = 1; All day = 2.

Date	Survey Start	Survey End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
13/06/2022	15:30	18:30	2	2	SW	0	8	1	2	0	0	15
13/06/2022	15:30	18:30	3	3	SW	0	8	1	2	0	0	14
14/06/2022	19:00	22:00	1	1	SW	0	7	1	2	0	0	18
14/06/2022	19:00	22:00	2	1	SW	0	8	1	2	0	0	17
14/06/2022	19:00	22:00	3	1	SW	0	7	1	2	0	0	16
28/06/2022	06:10	09:10	1	4	S	2	8	1	2	0	0	13
28/06/2022	06:10	09:10	2	4	S	2	8	1	2	0	0	14
28/06/2022	06:10	09:10	3	4	S	3	7	1	2	0	0	14
29/06/2022	09:45	12:45	1	2	SW	0	8	1	2	0	0	14
29/06/2022	09:45	12:45	2	2	SW	3	8	1	2	0	0	17
29/06/2022	09:45	12:45	3	2	SW	0	8	1	2	0	0	18
11/07/2022	16:00	19:00	1	3	S	0	6	2	2	0	0	24
11/07/2022	16:00	19:00	2	4	S	0	7	2	2	0	0	23
11/07/2022	16:00	19:00	3	3	S	0	8	2	2	0	0	22
12/07/2022	09:20	12:20	1	2	S	0	6	2	2	0	0	18
12/07/2022	09:20	12:20	2	2	S	0	7	2	2	0	0	19
12/07/2022	09:20	12:20	3	3	SW	0	8	2	2	0	0	20
01/08/2022	11:30	14:30	1	3	SW	0	8	1	2	0	0	19
01/08/2022	11:30	14:30	2	4	SW	0	5	2	2	0	0	20
01/08/2022	11:30	14:30	3	4	SW	0	6	2	2	0	0	20
03/08/2022	06:40	09:40	1	4	SW	0	7	2	2	0	0	15
03/08/2022	06:40	09:40	2	4	SW	0	8	1	2	0	0	15
03/08/2022	06:40	09:40	3	3	SW	1	8	1	2	0	0	17

Table A3-2
Weather During Breeding Wader Surveys

Date	Start	End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost	Temp (°c)
09/05/2022	18:00	21:00	All	4	S	1	8	1	2	0	0	13
17/05/2022	18:30	21:30	1	2	S	0	7	1	2	0	0	14
17/05/2022	18:30	21:30	2	2	S	0	6	1	2	0	0	13
17/05/2022	18:30	21:30	3	2	S	0	6	1	2	0	0	12

Table A3-3
Weather During Breeding Raptor Surveys

Date	Start	End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
09/05/2022	12:20	16:00	1	5	S	0	8	1	1	0	0	13
09/05/2022	12:20	16:00	2	4	S	0	8	2	2	0	0	13
09/05/2022	12:20	16:00	3	4	S	1	8	1	2	0	0	13
17/05/2022	1	3	S	1	8	1	2	0	0	12	1	3
17/05/2022	2	3	S	1	8	1	2	0	0	12	2	3
17/05/2022	3	3	S	2	8	1	2	0	0	12	3	3
17/05/2022	4	3	S	0	8	1	2	0	0	12	4	3
14/07/2022	07:00	10:00	All	3	SW	2	8	1	2	0	0	16
14/07/2022	17:00	22:00	All	3	S	0	8	2	2	0	0	23
02/08/2022	10:00	12:30	1	2	SW	1	8	1	2	0	0	17

APPENDIX 04

Flight activity survey data²²

²² Surveyor initials are given in Section 2.2 and BTO code information is given in Section 4.1

Table A4-1
Primary Target Species Recorded During Flight Activity Surveys Undertaken at VP3

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
18/05/2022	JD	1	K.	1	U	U	09:00	90
18/05/2022	JD	2	K.	1	U	U	09:04	60
18/05/2022	JD	3	BH	2	AD	U	09:14	120
18/05/2022	JD	4	K.	1	AD	M	09:27	45
18/05/2022	JD	5	PE	1	AD	M	09:27	30
18/05/2022	JD	6	BH	2	AD	U	09:33	87
18/05/2022	JD	7	BH	1	AD	U	09:47	10
18/05/2022	JD	8	BH	1	AD	U	10:11	48
18/05/2022	JD	9	BH	3	AD	U	10:55	25
18/05/2022	JD	10	BH	2	AD	U	11:47	5
20/05/2022	JD	1	L.	2	AD	U	16:00	10
20/05/2022	JD	2	L.	1	AD	U	16:05	10
20/05/2022	JD	3	BH	1	AD	U	16:05	20
20/05/2022	JD	4	L.	3	AD	U	16:38	30
20/05/2022	JD	5	L.	2	AD	U	16:40	20
20/05/2022	JD	6	BH	7	AD	U	16:40	120
20/05/2022	JD	7	BH	2	AD	U	16:40	20

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
20/05/2022	JD	8	L.	2	AD	U	17:00	20
20/05/2022	JD	9	L.	2	AD	U	17:00	60
20/05/2022	JD	10	L.	2	AD	U	17:05	240
20/05/2022	JD	11	BH	2	AD	U	18:00	35
24/05/2022	MMW	1	L.	1	AD	U	10:18	12
24/05/2022	MMW	2	L.	1	AD	U	10:19	29
24/05/2022	MMW	3	L.	1	AD	U	10:20	3
24/05/2022	MMW	4	L.	1	AD	U	10:22	55
24/05/2022	MMW	5	L.	1	AD	U	10:24	34
24/05/2022	MMW	6	L.	1	AD	U	10:28	22
24/05/2022	MMW	7	L.	1	AD	U	10:31	17
24/05/2022	MMW	8	L.	1	AD	U	10:33	9
24/05/2022	MMW	9	L.	1	AD	U	10:36	6
24/05/2022	MMW	10	L.	1	AD	U	10:39	11
24/05/2022	MMW	11	L.	1	AD	U	10:43	27
24/05/2022	MMW	12	L.	1	AD	U	10:45	51
24/05/2022	MMW	13	L.	1	AD	U	10:48	3
24/05/2022	MMW	14	L.	1	AD	U	10:57	39
24/05/2022	MMW	15	BH	2	AD	U	10:57	480
24/05/2022	MMW	15	BH	2	AD	U	10:57	480
24/05/2022	MMW	16	L.	1	AD	U	10:56	42

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
24/05/2022	MMW	17	BH	2	AD	U	11:00	36
24/05/2022	MMW	18	L.	1	AD	U	11:00	49
24/05/2022	MMW	19	BH	1	AD	U	11:02	66
24/05/2022	MMW	20	L.	1	AD	U	11:03	5
24/05/2022	MMW	21	BH	3	AD	U	11:07	92
24/05/2022	MMW	22	BH	4	AD	U	11:10	59
24/05/2022	MMW	23	L.	1	AD	U	11:11	13
24/05/2022	MMW	24	BH	2	AD	U	11:12	4
24/05/2022	MMW	25	L.	1	AD	U	11:13	2
24/05/2022	MMW	26	BH	5	AD	U	11:16	57
24/05/2022	MMW	27	L.	1	AD	U	11:17	27
24/05/2022	MMW	28	BH	1	AD	U	11:18	78
24/05/2022	MMW	29	BH	4	AD	U	11:18	65
24/05/2022	MMW	30	BH	3	AD	U	11:22	44
24/05/2022	MMW	31	L.	2	AD	U	11:22	38
24/05/2022	MMW	32	L.	1	AD	U	11:23	24
24/05/2022	MMW	33	L.	1	AD	U	11:29	55
24/05/2022	MMW	34	L.	1	AD	U	11:32	27
24/05/2022	MMW	35	BH	1	AD	U	11:33	12
24/05/2022	MMW	36	BH	1	AD	U	11:34	33
24/05/2022	MMW	37	BH	2	AD	U	11:38	64

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
24/05/2022	MMW	38	BH	3	AD	U	11:43	22
24/05/2022	MMW	39	BH	4	AD	U	11:47	73
24/05/2022	MMW	40	L.	1	AD	U	11:56	26
24/05/2022	MMW	41	BH	4	AD	U	12:02	31
24/05/2022	MMW	42	BH	2	AD	U	12:03	7
24/05/2022	MMW	43	L.	1	AD	U	12:04	18
24/05/2022	MMW	44	L.	1	AD	U	12:08	13
24/05/2022	MMW	45	BH	1	AD	U	12:09	129
24/05/2022	MMW	46	BH	2	AD	U	12:17	55
24/05/2022	MMW	47	BH	3	AD	U	12:28	156
24/05/2022	MMW	48	BH	7	AD	U	12:33	242
24/05/2022	MMW	49	L.	1	AD	U	12:34	11
24/05/2022	MMW	50	BH	2	AD	U	12:37	63
24/05/2022	MMW	51	BH	2	AD	U	12:43	30
24/05/2022	MMW	52	BH	1	AD	U	12:52	44
24/05/2022	MMW	53	BH	1	AD	U	12:58	28
24/05/2022	MMW	54	BH	1	AD	U	13:02	71
24/05/2022	MMW	55	L.	1	AD	U	13:05	23
24/05/2022	MMW	56	BH	1	AD	U	13:06	49
26/05/2022	MMW	1	BH	3	AD	U	12:57	48
26/05/2022	MMW	2	SN	1	AD	U	12:57	3

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
26/05/2022	MMW	3	BH	22	U	U	13:06	91
26/05/2022	MMW	4	K.	1	AD	U	13:12	47
26/05/2022	MMW	5	BH	2	AD	U	13:16	19
26/05/2022	MMW	6	L.	2	AD	U	13:21	142
26/05/2022	MMW	7	L.	1	AD	U	13:30	54
26/05/2022	MMW	8	L.	1	AD	U	13:31	16
26/05/2022	MMW	9	BH	3	AD	U	13:34	33
26/05/2022	MMW	10	K.	1	AD	U	13:36	11
26/05/2022	MMW	11	BH	1	AD	U	13:41	18
26/05/2022	MMW	12	L.	1	AD	U	13:45	27
26/05/2022	MMW	13	K.	1	AD	U	13:46	45
26/05/2022	MMW	14	BH	34	AD	U	13:50	44
26/05/2022	MMW	15	BH	1	AD	U	13:53	10
26/05/2022	MMW	16	BH	1	AD	U	13:58	13
26/05/2022	MMW	17	BH	1	AD	U	14:00	35
26/05/2022	MMW	18	BH	1	AD	U	14:07	22
26/05/2022	MMW	19	K.	1	AD	F	14:15	81
26/05/2022	MMW	20	K.	1	AD	F	14:21	367
26/05/2022	MMW	20	K.	1	AD	F	14:21	367
26/05/2022	MMW	21	L.	1	AD	U	14:27	3
26/05/2022	MMW	22	K.	1	AD	F	14:28	42

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
26/05/2022	MMW	23	L.	1	AD	U	14:28	17
26/05/2022	MMW	24	BH	2	AD	U	14:36	48
26/05/2022	MMW	25	BH	9	AD	U	14:39	63
26/05/2022	MMW	26	BH	8	AD	U	14:53	65
26/05/2022	MMW	27	BH	31	AD	U	15:07	61
26/05/2022	MMW	28	L.	1	AD	U	15:16	19
26/05/2022	MMW	29	BH	1	AD	U	15:27	50
26/05/2022	MMW	30	BH	1	AD	U	15:38	34
26/05/2022	MMW	31	BH	2	AD	U	15:49	48
13/06/2022	MMW	1	K.	1	AD	F	15:55	143
13/06/2022	MMW	2	K.	1	AD	F	16:08	237
13/06/2022	MMW	2	K.	1	AD	F	16:08	237
13/06/2022	MMW	3	K.	1	AD	F	16:13	8
13/06/2022	MMW	4	SN	1	AD	U	16:26	3
13/06/2022	MMW	5	BH	1	AD	U	16:28	29
13/06/2022	MMW	7	PE	1	AD	U	16:43	55
13/06/2022	MMW	8	PE	1	AD	U	17:00	61
13/06/2022	MMW	9	BH	1	AD	U	17:10	42
13/06/2022	MMW	10	BH	1	AD	U	17:28	44
13/06/2022	MMW	11	BH	1	AD	U	17:32	10
13/06/2022	MMW	12	K.	1	AD	F	17:34	5

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
13/06/2022	MMW	13	K.	1	AD	M	17:35	9
13/06/2022	MMW	14	K.	1	AD	F	17:35	3
13/06/2022	MMW	15	BH	1	AD	U	17:37	16
13/06/2022	MMW	16	SN	1	AD	U	17:46	130
13/06/2022	MMW	17	SN	1	AD	U	17:55	73
13/06/2022	MMW	18	SN	2	AD	U	17:58	249
13/06/2022	MMW	19	L.	1	AD	U	18:15	16
13/06/2022	MMW	20	SN	1	AD	U	18:17	28
13/06/2022	MMW	21	K.	1	AD	F	18:25	293
14/06/2022	MMW	1	K.	1	AD	F	19:04	6
14/06/2022	MMW	2	SN	1	AD	U	19:10	10
14/06/2022	MMW	4	SN	1	AD	U	19:19	34
14/06/2022	MMW	5	SN	1	AD	U	19:21	4
14/06/2022	MMW	6	BH	2	AD	U	19:22	52
14/06/2022	MMW	7	SN	1	AD	U	19:29	4
14/06/2022	MMW	8	K.	1	AD	U	19:32	267
14/06/2022	MMW	9	K.	1	AD	F	19:38	159
14/06/2022	MMW	10	K.	1	AD	F	19:41	446
14/06/2022	MMW	10	K.	1	AD	F	19:41	446
14/06/2022	MMW	11	K.	1	AD	U	19:48	5
14/06/2022	MMW	12	BH	1	AD	U	19:52	18

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
14/06/2022	MMW	13	L.	1	AD	U	19:58	31
14/06/2022	MMW	14	K.	1	AD	M	19:59	289
14/06/2022	MMW	15	SN	1	AD	U	20:01	10
14/06/2022	MMW	16	L.	1	AD	U	20:10	36
14/06/2022	MMW	17	K.	1	AD	F	20:13	257
14/06/2022	MMW	18	BH	1	AD	U	20:17	5
14/06/2022	MMW	19	L.	1	AD	U	20:17	46
14/06/2022	MMW	20	K.	1	AD	U	20:31	207
14/06/2022	MMW	21	K.	1	AD	U (M?)	20:37	33
14/06/2022	MMW	22	BH	1	AD	U	20:45	74
14/06/2022	MMW	23	BH	2	AD	U	20:58	25
14/06/2022	MMW	24	BH	2	AD	U	21:02	22
28/06/2022	MMW	1	L.	2	AD	U	06:19	43
28/06/2022	MMW	3	L.	1	AD	U	06:22	11
28/06/2022	MMW	4	L.	1	AD	U	06:27	46
28/06/2022	MMW	5	L.	1	AD	U	06:30	15
28/06/2022	MMW	6	L.	2	AD	U	06:31	50
28/06/2022	MMW	8	L.	1	AD	U	06:33	17
28/06/2022	MMW	10	L.	3	AD	U	06:37	63
28/06/2022	MMW	11	L.	11	U	U	06:43	88
28/06/2022	MMW	12	L.	1	AD	U	06:48	12

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
28/06/2022	MMW	14	SN	1	AD	U	06:58	54
28/06/2022	MMW	15	L.	1	AD	U	07:16	28
28/06/2022	MMW	16	SN	1	AD	U	07:24	7
28/06/2022	MMW	17	L.	1	AD	U	07:35	5
28/06/2022	MMW	19	L.	1	AD	U	07:41	12
28/06/2022	MMW	20	BH	2	AD	U	07:42	31
28/06/2022	MMW	21	SN	1	AD	U	07:46	78
28/06/2022	MMW	22	SN	1	AD	U	07:50	33
28/06/2022	MMW	23	K.	1	AD	U	07:57	232
28/06/2022	MMW	24	SN	1	AD	U	07:57	27
28/06/2022	MMW	25	L.	1	U	U	08:10	6
28/06/2022	MMW	26	SN	1	AD	U	08:16	237
28/06/2022	MMW	27	SN	1	AD	U	08:26	74
28/06/2022	MMW	28	L.	1	U	U	08:27	43
28/06/2022	MMW	29	L.	1	AD	U	08:33	11
28/06/2022	MMW	30	L.	1	AD	U	08:37	34
28/06/2022	MMW	31	BH	1	AD	U	08:48	44
28/06/2022	MMW	33	SN	1	AD	U	09:05	17
29/06/2022	MMW	1	L.	1	AD	U	09:47	40
29/06/2022	MMW	2	L.	1	AD	U	09:59	11
29/06/2022	MMW	3	L.	1	AD	U	10:18	6

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
29/06/2022	MMW	4	L.	1	AD	U	10:37	5
29/06/2022	MMW	5	L.	1	AD	U	10:42	34
29/06/2022	MMW	6	L.	2	AD	U	10:48	26
29/06/2022	MMW	8	L.	1	AD	U	10:50	5
29/06/2022	MMW	9	L.	2	AD	U	10:58	21
29/06/2022	MMW	11	L.	1	AD	U	11:04	17
29/06/2022	MMW	12	L.	3	AD	U	11:06	4
29/06/2022	MMW	13	L.	1	AD	U	11:08	78
29/06/2022	MMW	14	K.	1	AD	U	11:21	163
29/06/2022	MMW	15	SN	2	AD	U	11:59	102
29/06/2022	MMW	16	BH	2	AD	U	12:19	63
29/06/2022	MMW	17	K.	1	AD	F	12:25	21
29/06/2022	MMW	18	K.	1	AD	F	12:26	244
29/06/2022	MMW	19	L.	1	AD	U	12:26	7
11/07/2022	MMW	1	L.	1	U	U	16:06	9
11/07/2022	MMW	2	L.	1	AD	U	16:18	12
11/07/2022	MMW	3	L.	1	AD	U	17:01	26
11/07/2022	MMW	4	L.	1	U	U	17:06	10
11/07/2022	MMW	5	L.	3	U	U	17:27	93
11/07/2022	MMW	6	L.	2	U	U	17:49	78
11/07/2022	MMW	7	SN	1	U	U	18:06	88

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
11/07/2022	MMW	8	PE	1	AD	U	18:21	130
11/07/2022	MMW	9	K.	1	U	U	18:43	101
11/07/2022	MMW	10	K.	1	U	U	18:57	35
12/07/2022	MMW	1	L.	1	AD	U	07:22	5
12/07/2022	MMW	2	L.	4	AD	U	09:34	52
12/07/2022	MMW	3	SN	1	AD	U	09:45	44
12/07/2022	MMW	4	SN	1	AD	U	09:48	6
12/07/2022	MMW	5	L.	5	AD	U	09:51	161
12/07/2022	MMW	6	L.	5	AD	U	09:51	148
12/07/2022	MMW	7	L.	1	AD	U	09:57	45
12/07/2022	MMW	8	L.	1	AD	U	10:02	50
12/07/2022	MMW	9	L.	2	AD	U	10:05	140
12/07/2022	MMW	10	L.	5	AD	U	10:23	11
12/07/2022	MMW	11	L.	3	AD	U	10:25	65
12/07/2022	MMW	12	SN	1	AD	M	10:30	814
12/07/2022	MMW	13	SN	1	AD	U	10:57	13
12/07/2022	MMW	14	SN	1	AD	M	10:59	554
12/07/2022	MMW	14	SN	1	AD	M	10:59	554
12/07/2022	MMW	16	L.	1	AD	U	11:22	14
12/07/2022	MMW	17	SN	1	AD	U	11:58	10
12/07/2022	MMW	18	L.	10	U	U	12:05	8

Date	Surveyor	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	StartTime (hr:min)	Flight duration (s)
12/07/2022	MMW	19	L.	1	U	U	12:10	16
12/07/2022	MMW	20	L.	3	U	U	12:10	123
03/08/2022	MMW	1	L.	1	U	U	08:21	34

Table A4-2
Secondary Target Species Recorded During Flight Activity Surveys Undertaken at VP3

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
18/05/2022	09:00	12:00	09:00	09:05	RN	2	1	Buffer, beyond
18/05/2022	09:00	12:00	09:50	09:55	RN	1	2	Beyond
18/05/2022	09:00	12:00	10:40	10:45	BZ	2	2	Buffer
18/05/2022	09:00	12:00	10:25	10:30	RN	2	1	On site
20/05/2022	16:00	19:00	16:40	16:45	BZ	4	2	On site, buffer
24/05/2022	10:15	13:15	10:45	10:50	H.	2	1	On site
24/05/2022	10:15	13:15	11:05	11:10	BZ	1	3	Beyond
24/05/2022	10:15	13:15	11:10	11:15	BZ	1	2	Beyond
24/05/2022	10:15	13:15	11:20	11:25	RN	1	2	On site
24/05/2022	10:15	13:15	11:40	11:45	MA	1	1	On site
24/05/2022	10:15	13:15	12:00	12:05	H.	1	1	On site
24/05/2022	10:15	13:15	12:00	12:05	RN	1	2	On site
24/05/2022	10:15	13:15	12:20	12:25	RN	1	2	Beyond
24/05/2022	10:15	13:15	12:25	12:30	BZ	1	2	On site
24/05/2022	10:15	13:15	12:30	12:35	BZ	1	2	Buffer
24/05/2022	10:15	13:15	12:45	12:50	RN	3	2	On site
24/05/2022	10:15	13:15	13:00	13:05	BZ	1	2	On site
24/05/2022	10:15	13:15	13:10	13:15	BZ	1	2	Buffer
26/05/2022	12:50	15:50	13:05	13:10	BZ	1	2	Buffer, beyond
26/05/2022	12:50	15:50	13:05	13:10	HG	1	1	Onsite, buffer

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
26/05/2022	12:50	15:50	13:25	13:30	BZ	2	2	Buffer
26/05/2022	12:50	15:50	13:25	13:30	BZ	2	2	On site
26/05/2022	12:50	15:50	13:30	13:35	RN	1	1	On site
26/05/2022	12:50	15:50	13:40	13:45	BZ	3	2	Buffer
26/05/2022	12:50	15:50	13:40	13:45	BZ	3	2	On site, buffer
26/05/2022	12:50	15:50	13:40	13:45	BZ	3	2	Beyond
26/05/2022	12:50	15:50	13:45	13:50	LB	4	2	On site
26/05/2022	12:50	15:50	13:50	13:55	HG	8	1	On site
26/05/2022	12:50	15:50	13:50	13:55	CM	1	1	On site
26/05/2022	12:50	15:50	14:40	14:45	BZ	1	2	Buffer
26/05/2022	12:50	15:50	14:45	14:50	BZ	1	2	Buffer
26/05/2022	12:50	15:50	15:00	15:05	BZ	2	2	On site, buffer
26/05/2022	12:50	15:50	15:00	15:05	RN	1	1	On site
26/05/2022	12:50	15:50	15:10	15:15	BZ	1	2	On site
26/05/2022	12:50	15:50	15:25	15:30	SH	1	1	On site, buffer
26/05/2022	12:50	15:50	15:40	15:45	BZ	1	3	On site, buffer
26/05/2022	12:50	15:50	15:45	15:50	BZ	1	2	Buffer
13/06/2022	15:30	18:30	15:30	15:35	BZ	1	2	Buffer
13/06/2022	15:30	18:30	15:35	15:40	BZ	2	2	On site, buffer
13/06/2022	15:30	18:30	15:35	15:40	H.	1	2	On site
13/06/2022	15:30	18:30	15:40	15:45	BZ	2	2	On site, buffer
13/06/2022	15:30	18:30	15:45	15:50	BZ	3	2	On site, buffer

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
13/06/2022	15:30	18:30	16:30	16:35	RP	1	1	On site
13/06/2022	15:30	18:30	16:45	16:50	BZ	1	1	On site, buffer
13/06/2022	15:30	18:30	17:00	17:05	SH	1	1	Buffer
13/06/2022	15:30	18:30	17:15	17:20	BZ	1	2	Buffer
13/06/2022	15:30	18:30	17:40	17:45	H.	1	1	On site
13/06/2022	15:30	18:30	17:40	17:45	BZ	1	2	On site
13/06/2022	15:30	18:30	17:55	18:00	HG	2	2	On site, buffer
13/06/2022	15:30	18:30	18:00	18:05	BZ	2	2	On site, buffer
13/06/2022	15:30	18:30	18:10	18:15	BZ	1	2	Buffer
13/06/2022	15:30	18:30	18:15	18:20	BZ	1	2	On site
13/06/2022	15:30	18:30	18:20	18:25	BZ	1	2	Buffer
13/06/2022	15:30	18:30	18:25	18:30	BZ	1	2	Buffer
14/06/2022	19:00	22:00	19:10	19:15	RP	1	1	On site
14/06/2022	19:00	22:00	20:10	20:15	LB	1	2	On site
14/06/2022	19:00	22:00	20:20	20:25	BZ	1	1	On site
14/06/2022	19:00	22:00	20:20	20:25	BZ	1	2	On site
14/06/2022	19:00	22:00	21:15	21:20	HG	2	1	On site
28/06/2022	06:10	09:10	06:20	06:25	RP	2	1	On site
28/06/2022	06:10	09:10	06:30	06:35	RP	2	1	On site
28/06/2022	06:10	09:10	06:55	07:00	RP	3	1	On site
28/06/2022	06:10	09:10	07:35	07:40	BZ	1	2	On site, buffer
28/06/2022	06:10	09:10	07:35	07:40	RP	2	1	On site

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
28/06/2022	06:10	09:10	07:40	07:45	BZ	1	2	On site, buffer
28/06/2022	06:10	09:10	07:40	07:45	MA	1	1	On site
28/06/2022	06:10	09:10	07:45	07:50	BZ	1	2	Buffer
28/06/2022	06:10	09:10	08:55	09:00	RP	1	1	On site
29/06/2022	09:45	12:45	10:35	10:40	MA	2	1	On site
29/06/2022	09:45	12:45	10:50	10:55	RP	1	1	On site
29/06/2022	09:45	12:45	11:00	11:05	RP	1	1	On site
29/06/2022	09:45	12:45	11:10	11:15	BZ	2	2	On site, buffer
29/06/2022	09:45	12:45	11:10	11:15	BZ	2	2	On site, buffer
29/06/2022	09:45	12:45	11:20	11:25	BZ	2	2	On site, buffer
29/06/2022	09:45	12:45	11:25	11:30	BZ	2	2	On site, buffer
29/06/2022	09:45	12:45	12:30	12:35	BZ	2	2	On site, buffer
11/07/2022	16:00	19:00	16:30	16:35	BZ	1	2	On site
11/07/2022	16:00	19:00	16:35	16:40	LB	4	2	On site
11/07/2022	16:00	19:00	16:35	16:40	BZ	1	2	On site
11/07/2022	16:00	19:00	16:40	16:45	BZ	1	1	On site
11/07/2022	16:00	19:00	17:00	17:05	BZ	1	2	On site
11/07/2022	16:00	19:00	17:05	17:10	BZ	1	2	On site
11/07/2022	16:00	19:00	17:50	17:55	BZ	1	2	On site
11/07/2022	16:00	19:00	17:55	18:00	SH	1	2	On site
11/07/2022	16:00	19:00	18:00	18:05	SH	1	2	On site
12/07/2022	09:20	12:20	09:20	09:25	LB	1	1	On site

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
12/07/2022	09:20	12:20	09:30	09:35	SH	1	1	On site
12/07/2022	09:20	12:20	11:00	11:05	H	1	1	On site
12/07/2022	09:20	12:20	11:15	11:20	LB	2	2	On site
12/07/2022	09:20	12:20	11:15	11:20	RP	2	1	On site
12/07/2022	09:20	12:20	11:25	11:30	LB	1	2	On site
12/07/2022	09:20	12:20	11:40	11:45	BZ	1	2	On site, buffer
12/07/2022	09:20	12:20	11:45	11:50	BZ	1	2	On site, buffer
12/07/2022	09:20	12:20	12:10	12:25	RP	2	1,2	On site
12/07/2022	09:20	12:20	12:15	12:20	BZ	1	2	On site
01/08/2022	11:30	14:30	12:05	12:10	RN	1	2	On site
01/08/2022	11:30	14:30	12:30	12:35	BZ	1	2	Buffer
01/08/2022	11:30	14:30	12:45	12:50	BZ	1	2	On site
01/08/2022	11:30	14:30	13:05	13:10	SH	1	1	On site
01/08/2022	11:30	14:30	13:15	13:20	BZ	2	2	On site
01/08/2022	11:30	14:30	13:15	13:20	RN	1	2	On site
01/08/2022	11:30	14:30	13:15	13:20	BZ	2	2	Buffer
01/08/2022	11:30	14:30	13:20	13:25	LB	1	2	On site, buffer
01/08/2022	11:30	14:30	13:40	13:45	BZ	1	2	On site, buffer
01/08/2022	11:30	14:30	14:25	14:30	GB	2	2	Buffer
01/08/2022	11:30	14:30	14:25	14:30	GB	2	2	On site
03/08/2022	06:40	09:40	07:05	07:10	LB	1	2	Buffer
03/08/2022	06:40	09:40	07:25	07:30	MA	19	2	On site, buffer

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
03/08/2022	06:40	09:40	07:40	07:45	LB	3	2	On site, buffer
03/08/2022	06:40	09:40	07:50	07:55	LB	2	2	On site, buffer
03/08/2022	06:40	09:40	08:00	08:05	MA	6	2	On site, buffer
03/08/2022	06:40	09:40	08:15	08:20	MA	2	2	Buffer, beyond
03/08/2022	06:40	09:40	08:50	08:55	RN	1	2	On site
03/08/2022	06:40	09:40	08:55	09:00	RN	1	2	On site
03/08/2022	06:40	09:40	09:10	09:15	GB	1	2	On site, buffer
03/08/2022	06:40	09:40	09:10	09:15	RN	4	2	On site

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Bird Survey Report Non-Breeding 2022/23

Cush Wind Farm

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Client Reference No: N/A

21 August 2026

Revision: 0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	21 August 2026	Alice Magee	Aisling Kinsella	Dr Jonathon Dunn

Basis of Report

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1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd. (SLR) was commissioned by Galetech Energy Developments Ltd to carry out a bird survey programme for the proposed wind farm at Cush, Co. Offaly (hereafter 'the Project') during the non-breeding season in 2022/23. The purpose of this report is to describe these surveys and the resulting ornithological baseline.

1.1 Background to the Commission

The Project Site includes a phase 1 (eight turbines) and an extension area (three turbines, also known as Phase 2). Phase 1 was granted planning permission in November 2024. As the bird survey programme for the breeding season 2022 covered both phases, and the data are within date according to NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance¹, the results are considered to be relevant to the proposed extension area. This report focuses on the methodology and results that are relevant to extension area. The methodology and results of the entire bird survey programme can be found in the previously issued baseline non-breeding bird survey report².

Bird surveys have been previously undertaken at the proposed wind farm development site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR for the breeding 2020, non-breeding 2020/21, breeding 2021, non-breeding 2021/22, and breeding 2022 seasons. The Project Site also includes a linear area that was previously surveyed for a proposed overhead line³. Flight activity surveys were carried out at two vantage point locations along the proposed overhead line route corridor during the breeding season in 2018.

1.2 Site Description

The Project Site is located in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946. The habitats within the Project Site are dominated by conifer plantations of varying age classes (c.327 ha), cutaway bog (c.102 ha) and agricultural grasslands (ca. 327 ha; refer to Appendix A **Figure 1**). The Project Site is not designated for nature conservation.

1.3 Terminology

For this report, "flight line" refers to the line drawn to record avian movement during a vantage point (VP) survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as "a flight". Note that the "cumulative number of flights" reflects the occupancy of the study area by a particular species. It is not equivalent to the total number of unique individuals and should not be used to infer abundance.

1.4 Purpose of this Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The assessment of impacts resulting from the Project and the development of mitigation measures, if required, are beyond the scope of this report and will be covered in a separate Environmental Impact Assessment (EIA) Report in due course.

¹ Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

² SLR (2023) Cush Wind Farm Non-Breeding Bird Survey Report 2022/23..

³ SLR (2018) *Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018*. Prepared for Galetech Energy Services Ltd



2.0 Methods

2.1 Scope of Work

The scope of survey work was based on existing knowledge of the area and took into account current NS guidance⁴, with details provided in **Table 2-1**. Further details are provided in Section 2.0.

Surveys were undertaken by Senior Ecologist Aisling Kinsella (AK) BSc (Hons) MSc, Senior Field Ecologist Faolán Linnane BSc (Hons) MSc, Project Ecologist Darragh Nagle (DN) BSc (Hons), and Graduate Ecologist Hugo Brooks (HB) BSc (Hons).

Details of survey dates and times are provided in Appendix B and a record of weather conditions during surveys is provided in Appendix C.

Table 2-1: Scope of Ornithological Survey Work October 2022 to March 2023

Survey Type	Summary Methodology (see Section 2 for further details)
Vantage Point (VP) surveys	Six hours of survey per month were carried out from VP3 between October 2022 and March 2023.
Feeding distribution surveys	Feeding distribution surveys were carried out on a twice-monthly basis during the period October 2022 to March 2023 to search for swans and/or geese using the fields for foraging within 500 m of the Project Site.
Nocturnal golden plover surveys	Two nocturnal golden plover surveys (one in January and one in March) were carried out during the 2022/23 non-breeding season.

2.2 Desk-Based Review

The desk review collated any available information to date on the breeding and non-breeding bird populations and movements around the Project Site.

The following reports resulting from previous breeding and non-breeding bird surveys were reviewed for any relevant information that could be used to inform the current bird surveys:

- SLR (2018) Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018.
- SLR (2020) Cush Wind Farm Breeding Bird Survey Report 2020.
- SLR (2022) Cush Wind Farm Winter Bird Survey Report 2020-2021.
- SLR (2022) Cush Wind Farm Breeding and Winter Bird Survey Report 2021-2022.
- SLR (2022) Cush Wind Farm Breeding Bird Survey Report 2022.

The websites of the National Parks and Wildlife Service (NPWS)⁵, the UK and Ireland Bird Atlas 2007-2011⁶ and the National Biodiversity Data Centre (NBDC)⁷ were accessed for information on sites designated for nature conservation and notable bird species in the vicinity of the Project Site.

⁴ Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

⁵ www.npws.ie (Last accessed August 2023)

⁶ <https://app.bto.org/mapstore/StoreServlet> Accessed 29/08/2023

⁷ <http://maps.biodiversityireland.ie/#/Map> Accessed 29/08/2023



2.3 Flight Activity Surveys

VP locations, 2 km viewing arcs and viewsheds are shown in Appendix A **Figure 1**.

Three VP locations were selected that covered both phases of the Project Site. The viewsheds from VP1 and VP2 cover phase 1 of the Project, and the viewshed from VP3 covers the extension area. As VP3 was deemed to adequately cover the extension area without adding additional VPs, this report will focus on surveys conducted from VP3.

A total of 36 hours of flight activity surveys were conducted from VP3 during the 2022/23 non-breeding season, as summarised in **Table 2-2**.

VP watches aimed to quantify the flight activity of primary and secondary target species (as defined below) within the study area.

The main purpose of VP watches is to collect data on primary target species that will enable estimates to be made of:

- The time spent flying over the Project Site;
- The relative use by birds of different parts of the Project Site;
- The proportion of flying time spent within the provisional upper and lower risk height limits as determined by the potential rotor diameter and rotor hub height; and
- Ultimately, the analysis of the potential risk of collision of birds with rotating turbines.

Target species for the surveys were defined by legal and/or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS guidance.

Primary target species were limited to species upon which effects are most likely to be potentially significant in EIA and Appropriate Assessment (AA) terms e.g., species forming qualifying features for nearby Special Protection Areas (SPAs) or species listed on Annex 1 of the Birds Directive⁸. This enabled recording to focus on the species of greatest importance without the distraction of having to record detailed flight data for a larger number of more common species.

Primary target species included the following bird species:

- All Annex 1 raptor/owl species;
- Qualifying interest species for nearby SPAs⁹; and
- Other raptors, waders or wildfowl red-listed on the latest Birds of Conservation Concern in Ireland (BoCCI)¹⁰ scheme.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying bout;
- Species, age and sex (where determinable);
- Number of flights observed;
- Time spent within each height band; and
- Notes on observation.

⁸ Annex 1 of the Birds Directive (Directive 2009/147/EC)

⁹ The relevant SPAs are listed in Section 3.1.

¹⁰ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22



Local circumstances may indicate that survey information should also be acquired on other species, especially those of regional conservation concern. Such species are termed secondary species. Recording of secondary species is subsidiary to recording of primary target species. A summary of observations of secondary target species was recorded at the end of each five-minute period during each VP watch to provide an index of flight activity for secondary target species within and around the Project Site, in accordance with current NS guidance.

Secondary target species included:

- Any other wildfowl and wader species;
- Common buzzard *Buteo buteo*;
- Eurasian sparrowhawk *Accipiter nisus*;
- Northern raven *Corvus corax*;
- Grey heron *Ardea cinerea*; and
- Gulls *Larus* sp.

NS guidance states that “it is generally considered the passerine species are not significantly impacted by wind farms”. It goes on to state that “survey of woodland passerines, especially in commercial conifer forest is generally not required”. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that passerines red-listed under the latest BoCCI scheme¹⁰ should be considered as equivalent. No such species were returned during the desk-based review or data request. NS guidance also states that “surveys of farmland passerines especially on more intensive arable habitat are generally not required”. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

In the absence of detailed information regarding turbine specifications at the time of commencing surveys, a precautionary approach was taken in relation to recording height bands. For the 2022/23 non-breeding season, height bands were determined allowing for the maximum rotor tip height of 200 m and a lowest rotor swept height of 28 m. The relation of the height bands to the latest turbine specification is shown below.

Flight heights were attributed to four distinct height bands for the non-breeding season as follows:

- 1 = <25 m (below the likely rotor swept area);
- 2 = 25 m to 160 m (potentially within the likely rotor swept area, at least in part);
- 3 = 160 m to 200 m (within the likely rotor swept area); and
- 4 = >200 m (above the likely rotor swept area).

Table 2-2: Summary of VP Surveys Undertaken From VP3 during the Non-Breeding Season 2022/23

Month	VP3 (hours)
October	06:00
November	06:00
December	06:00
January	09:00
February	03:00
March	06:00
Total hrs	36:00



Month	VP3 (hours)
VP locations ITM (Figure 1)	607798 E 711305 N

2.4 Feeding Distribution Surveys

NS guidance recommends that for whooper swan *Cygnus cygnus*, Greenland white-fronted goose *Anser albifrons flavirostris* and other geese species, feeding distribution surveys should be undertaken in areas of suitable habitat when the survey area lies within the core foraging distance of SPAs or other major roosts for these species, unless it can be established from existing data that the area is not utilised for feeding. As there are SPAs for swans and geese located close to the Project Site, feeding distribution surveys were undertaken.

A buffer of 500 m around the Project Site was used for these surveys, which were undertaken by driven transects twice per month, stopping on a regular basis to check all fields for goose and swan feeding activity. The transect route is shown in Appendix A **Figure 3**, survey dates in Appendix B, weather conditions in Appendix C.

2.5 Nocturnal Golden Plover Surveys

Survey transects were identified that were representative of potentially suitable winter habitats (see Gillings et al., 2007)¹¹ for European golden plover *Pluvialis apricaria* and northern lapwing *Vanellus vanellus* (see **Figure 4**). Transects were focused on pastures and bog habitats.

Surveys were undertaken using a Helion 2 XP50 Pro Thermal Monocular. This enables birds to be readily detected by their body heat at up to c. 350 m range. Where birds were detected, images were recorded as videos.

Each transect was walked twice, once in January 2023 and once in March 2023, after dark using the thermal monocular to detect and identify the presence of target species. Birds were also detected and identified by sound, as appropriate. Nocturnal surveys were conducted by a pair of surveyors on the basis of health and safety.

Two golden plover surveys were completed. Full details of survey dates, times and observers are provided in Appendix B and details of the weather conditions during surveys are provided in Appendix C.

2.6 Survey Limitations

Most VP surveys were undertaken in optimal weather conditions. However, during such an extensive series of surveys carried out it was inevitable that some surveys were completed in suboptimal conditions. There were three hours out of the total of 36 during which the visibility was recorded as “moderate”, i.e. 1-3 km. This comprises 8% of the total survey effort but in almost all cases all the relevant 2 km viewing arc was visible. There was one hour during which visibility was recorded as “poor”, i.e. less than 1 km, which comprises 3% of the total survey effort. However, these conditions were not persistent through the affected survey and target species were still recorded. Therefore, these conditions are not considered to be significant limitations to the survey data obtained. Details regarding weather conditions during surveys are provided in Appendix C.

¹¹ Gillings, S., Fuller, R.J. and Sutherland, W.J. (2007). Winter field use and habitat selection by Eurasian Golden Plovers *Pluvialis apricaria* and Northern Lapwings *Vanellus vanellus* on arable farmland. *Ibis*. 149: 509 – 520.



3.0 Results

3.1 Desk Based Results

3.1.1 Natura 2000 Sites

The Project Site is not within or immediately adjacent to any SPA. However, there are a total of eight SPAs within a 20 km¹² radius with details shown in **Table 3-1**.

The closest SPAs to the Project Site are Dovegrove Callows SPA (Site Code: 004137), All Saints Bog SPA (Site Code: 004103) and River Little Brosna Callows SPA (Site Code: 004086) distances of 3.6 km, 5.1 km and 5.8 km, respectively. Dovegrove Callows SPA and All Saints Bog SPA are designated for the protection of wintering Greenland white-fronted geese, whereas the River Little Brosna Callows SPA is designated for several wintering gull, wader and wildfowl species.

Table 3-1: SPAs within 20 km of the Project Site and their Qualifying Interests (Species Present During the Non-Breeding Season)

Site Name	Site Code	Distance/Direction from Site Boundary	Species of Special Conservation Interest Relevant to the Non-Breeding Season
Dovegrove Callows SPA	004137	3.6 km southwest	<ul style="list-style-type: none"> Greenland white-fronted goose
All Saints Bog SPA	004103	5.1 km west	<ul style="list-style-type: none"> Greenland white-fronted goose
River Little Brosna Callows SPA	004086	5.8 km west	<ul style="list-style-type: none"> Whooper swan Eurasian wigeon <i>Mareca penelope</i> Eurasian teal <i>Anas crecca</i> Northern pintail <i>Anas acuta</i> Northern shoveler <i>Anas clypeata</i> European golden plover Northern lapwing Black-tailed godwit <i>Limosa limosa</i> Black-headed gull <i>Chroicocephalus ridibundus</i> Greenland white-fronted goose
Middle Shannon Callows SPA	004096	7.2 km northwest	<ul style="list-style-type: none"> Whooper swan Eurasian wigeon European golden plover Northern lapwing Black-tailed godwit Black-headed gull
Slieve Bloom Mountains SPA	004160	11.8 km southeast	<ul style="list-style-type: none"> Hen harrier <i>Circus cyaneus</i>
River Suck Callows SPA	004097	17.3 km northwest	<ul style="list-style-type: none"> Whooper swan Eurasian wigeon European golden plover Northern lapwing Greenland white-fronted goose

¹² A 20 km search radius was used as this represents the maximum core foraging distance used by Qualifying Interest species of SPAs in the UK and Ireland



Site Name	Site Code	Distance/Direction from Site Boundary	Species of Special Conservation Interest Relevant to the Non-Breeding Season
Lough Derg (Shannon) SPA	004058	17.5 km southwest	<ul style="list-style-type: none"> Great cormorant <i>Phalacrocorax carbo</i> Tufted duck <i>Aythya fuligula</i> Common goldeneye <i>Bucephala clangula</i>
Mongan Bog SPA		19.0 km northwest	<ul style="list-style-type: none"> Greenland white-fronted goose

3.1.2 Other Nature Conservation Sites

The Project Site is not within or immediately adjacent to any Natural Heritage Area (NHA) or proposed NHA (pNHA). However, there are a total of eight NHAs and 52 pNHAs within a 20 km radius, with details shown in **Table 3-2**.

River Little Brosna Callows NHA is located 9.4 km west of the Project Site and is the only NHA within a 20 km radius which is designated for its bird populations. The site has internationally important populations of Greenland white-fronted goose and black-tailed godwit, and a further seven species have populations of national importance: whooper swan, Eurasian wigeon, Eurasian teal, northern pintail, northern shoveler, European golden plover and lapwing¹³. All remaining NHAs within a 20 km radius are designated for peatlands.

The Project Site is not within or immediately adjacent to any Ramsar site. The Slieve Bloom Mountains Ramsar site is located 11.7 km east of the Project Site and is contained within the boundaries of the Slieve Bloom Mountains SPA. There are no other Ramsar sites within a 20 km radius of the Project Site.

Table 3-2: NHAs and pNHAs within 20 km of the Project Site and their Qualifying Interests (Sites Designated for Ornithological Qualifying Interests Only)¹⁴

Site Name	Site Code	Distance/Direction from Site Boundary	Qualifying Interests
Woodville Woods pNHA	000927	2.0 km southwest	Common snipe <i>Gallinago gallinago</i>
Arragh More Bog NHA	004137	12.5 km southwest	Hen harrier
Lough Nahinch (Tipperary) pNHA	000936	17.1 km southwest	Common redshank <i>Tringa totanus</i> Common snipe Water rail <i>Rallus aquaticus</i>
Pallas Lough pNHA	000916	18.3 km northeast	Mallard <i>Anas platyrhynchos</i> Eurasian teal Eurasian wigeon Western marsh harrier <i>Circus aeruginosus</i>

3.1.3 Species Records

The NBDC database was searched for records of bird species within the 2 km grid squares which overlap with the extension area (N01Q and N01V). All bird species are protected under the Wildlife Acts 1976 – 2018 but for the purposes of this report, only records of species that are Red or Amber-

¹³ NPWS (2014) Site Synopsis: River Little Brosna Callows SPA [000564] National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.

¹⁴ Only NHAs and pNHAs that do not overlap with SPAs are shown.



listed in BoCCI4 or listed on Annex 1 of the Birds Directive are included in the results. Details of the results are shown in **Table 3-3**.

Table 3-3: Species recorded within the 10 km grid squares N00 and N01 (Species Present During the Non-Breeding Season)

Grid Square	Species	Date of Last Record & Dataset	Designation
N01Q, N01V	Common buzzard <i>Buteo buteo</i>	2021, Birds of Ireland	BoCCI4 Green
N01V	Northern lapwing	2022, Birds of Ireland	BoCCI4 Red
N01V	Yellowhammer <i>Emberiza citrinella</i>	2021, Birds of Ireland	BoCCI4 Red

3.2 Flight Activity Surveys

Flight activity by primary target species is summarised in **Table 3-4**. Primary target species flight lines are shown in Appendix A Figures 2.1 to 2.10. Flight activity data are provided in more detail in Appendix D with full data retained in GIS and excel format for subsequent collision risk modelling.

3.2.1 Primary Target Species

A total of 54 flight lines by 11 primary target species were recorded between October 2022 and March 2023. No flight lines were recorded from VP3 in February. Common kestrel was the most frequently recorded species (12 flight lines), followed by northern lapwing (11 flight lines).

Table 3-4: Number of Primary Target Species Flights from VP3, October 2022 to March 2023

Species	Number of flight lines by month						Total number of flight lines	Time at risk height* (s)	Cumulative number of flights
	Oct	Nov	Dec	Jan	Feb	Mar			
Common kestrel	6	3	1	2	0	0	12	1,035	12
Common snipe	3	0	1	2	0	1	7	225	8
European golden plover	9	0	0	0	0	0	9	1,290	178
Great cormorant	0	0	2	0	0	0	2	30	2
Great white egret <i>Ardea alba</i>	1	0	0	0	0	0	1	0	1
Hen harrier	0	0	0	5	0	0	5	180	5
Mallard	0	1	0	0	0	0	1	105	5
Merlin	1	1	2	0	0	0	4	45	4
Northern lapwing	0	1	5	0	0	5	11	135	48
Peregrine falcon	0	1	0	0	0	0	1	0	1
Whooper swan	0	0	0	1	0	0	1	0	2
* precautionary risk height assumed to be between 28 – 200 m									

A summary description of flight activity by each species is presented below.



3.2.1.1 Common Kestrel

Twelve common kestrel flight lines were recorded during the flight activity surveys, all of which consisted of a single flight. The highest number of flight lines occurred in October. Nine flight lines (75%) were recorded within potential collision risk heights. Flight durations varied with a maximum duration of 330 seconds.

3.2.1.2 Common Snipe

Seven common snipe flight lines were recorded during the flight activity surveys, with a cumulative total of eight flights. Six flight lines (86%) were recorded within potential collision risk heights.

3.2.1.3 European Golden Plover

Nine European golden plover flight lines were recorded during the flight activity surveys, with a cumulative total of 178. All flight lines were recorded in October, suggesting they were of birds moving as part of autumn migration. Flock sizes ranged from four to 56 birds. Eight flight lines (89%) were recorded within potential collision risk heights. Flight durations varied with a maximum duration of 510 seconds. Activity was focused over the east of the 500 m survey buffer.

3.2.1.4 Great Cormorant

Two great cormorant flight lines were recorded during one survey in December, with both flight lines consisting of a single flight to the west of the 500 m survey buffer. One flight line was within collision risk heights and lasted for 74 seconds. The other flight line was below collision risk heights.

3.2.1.5 Great White Egret

A single great white egret was recorded in October flying south over an area of cutover bog outside of the Project Site in October. The flight line was below potential collision risk heights and lasted for 15 seconds. No other observations of this species were recorded during the 2022/23 non-breeding season.

3.2.1.6 Hen Harrier

Five hen harrier flight lines were recorded during one survey in January. All observations consisting of a single adult male flight hunting over an area of cutover bog within the Project Site. It is likely that these flights represented the same individual. Two flight lines (40%) were recorded within potential collision risk heights.

3.2.1.7 Mallard

One mallard flightline consisting of five flights was recorded in November. The flights were circling over cutover bog south of the Project Site within collision risk heights.

3.2.1.8 Merlin

Four merlin flight lines were recorded during the flight activity surveys from October to December 2022, with all flight lines consisting of a single flight. One flight line (25%) was recorded within potential collision risk heights; all were outside the Project Site on the edge of the 500 m survey buffer.

3.2.1.9 Northern Lapwing

Eleven northern lapwing flight lines were recorded during the flight activity surveys in November 2022, December 2022 and March 2023, with a cumulative total of 48 flights. Most flight lines consisted of a small number of flights (up to 12 flights in one flight line). Four flight lines (36%) were recorded within potential collision risk heights. Activity was focused to the west of the 500 m survey buffer.



3.2.1.10 Peregrine Falcon

A single peregrine falcon flight line was recorded flying east over the 500 m survey buffer in November. The flight line was below collision risk heights and lasted for 63 seconds. No other observations of this species were recorded from VP3 during the 2022/23 non-breeding season.

3.2.1.11 Whooper Swan

One whooper swan flight line consisting of two flights was recorded in January. The flights travelled west below collision risk heights before landing on cutover bog within the Project Site.

3.2.2 Secondary Target Species

Secondary species activity at the Project Site is summarised in **Table 3-5**. There were three secondary species recorded throughout the season. Common buzzard was the most frequently recorded secondary species (in 17 five-minute periods out of a possible 432).

Table 3-5: Secondary Species Activity Summary for VP3 – October 2022 to March 2023

Species	Number of 5 min periods recorded	Peak count of birds recorded in any 5 min period	Comments
Common buzzard	17	3	Activity in all months except February, within the Project Site and survey buffer.
Grey heron	15	2	Activity in October, November, January and March, within the Project Site, survey buffer and beyond.
Northern raven	4	3	Activity between October and January inclusive, within the Project Site, survey buffer and beyond.

3.3 Feeding Distribution Surveys

The feeding distribution surveys did not record any aggregations of swans or geese.

3.3.1 Incidental Records of Other Species

During the survey visits, the following incidental records were made of other species of conservation concern:

- Raptors: buzzard, kestrel, merlin, peregrine falcon and sparrowhawk;
- Waders: common snipe and northern lapwing; and
- Wildfowl: grey heron

3.4 Nocturnal Golden Plover Surveys

No European golden plover activity was recorded during surveys.

3.4.1 Incidental Records of Other Species

Incidental observations of common snipe, Eurasian curlew, northern lapwing and hen harrier were recorded during one survey in March 2023 near the western transect, c.470 m from the Project Site; there was no evidence of hen harrier roosting but passing through the area.



4.0 Summary and Conclusions

Flight activity surveys (VPs), feeding distribution surveys and nocturnal golden plover surveys were carried out at the Project Site during the non-breeding season in 2022/23.

The following primary target species were recorded during the non-breeding season flight activity surveys:

- Common snipe
- Common kestrel;
- Great cormorant;
- European golden plover;
- Great white egret;
- Hen harrier;
- Mallard;
- Merlin;
- Northern lapwing;
- Peregrine falcon; and
- Whooper swan.

Common kestrel was the most frequently recorded species (12 flight lines), followed by northern lapwing (11 flight lines).

Three secondary target species were recorded during the non-breeding season: common buzzard, grey heron and northern raven.

No aggregations of swans or geese were recorded during the feeding distribution surveys. No golden plover activity was recorded during the nocturnal golden plover surveys.

Incidental records made of species of conservation concern during taxon-specific surveys included the following:

- Raptors: buzzard, hen harrier, kestrel, merlin, peregrine falcon, and sparrowhawk;
- Waders: common snipe, Eurasian curlew and northern lapwing; and
- Wildfowl: grey heron



5.0 Legal and Conservation Status of Target Species Recorded

Table 5-1 summarises the legal and conservation status of the primary and secondary target species recorded during the range of ornithological surveys mentioned above. Note that all bird species in Ireland are afforded general protection by the Wildlife Acts 2000 (as amended).

Table 5-1: Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO code)	Legal and Conservation Status in Ireland
Primary	Black-headed gull (BH)	BoCCI4 Amber
	Common kestrel (K.)	BoCCI4 Red
	Common snipe (SN)	BoCCI4 Red
	European golden plover (GP)	Annex 1, BoCCI4 Red
	Great cormorant (CA)	BoCCI4 Amber
	Great white egret (HW)	Annex 1, not assessed under BoCCI4
	Hen harrier (HH)	Annex 1, BoCCI4 Amber
	Mallard (MA)	BoCCI4 Amber
	Merlin (ML)	Annex 1, BoCCI4 Amber
	Northern lapwing (L.)	BoCCI4 Red
	Peregrine falcon (PE)	Annex 1, BoCCI4 Green
	Whooper swan (WS)	Annex 1, BoCCI4 Amber
Secondary	Common buzzard (BZ)	BoCCI4 Green
	Grey heron (H.)	BoCCI4 Green
	Northern raven (RN)	BoCCI4 Green
	Eurasian sparrowhawk (SH)	BoCCI4 Green
Incidentals	Eurasian curlew (CU)	BoCCI4 Red
Key		Annex 1 – the species is listed in Annex 1 of the EC Birds Directive; and BoCCI4 status (green, amber or red) – indicates the current Birds of Conservation Concern in Ireland ¹⁰ status category.





Appendix A Figures

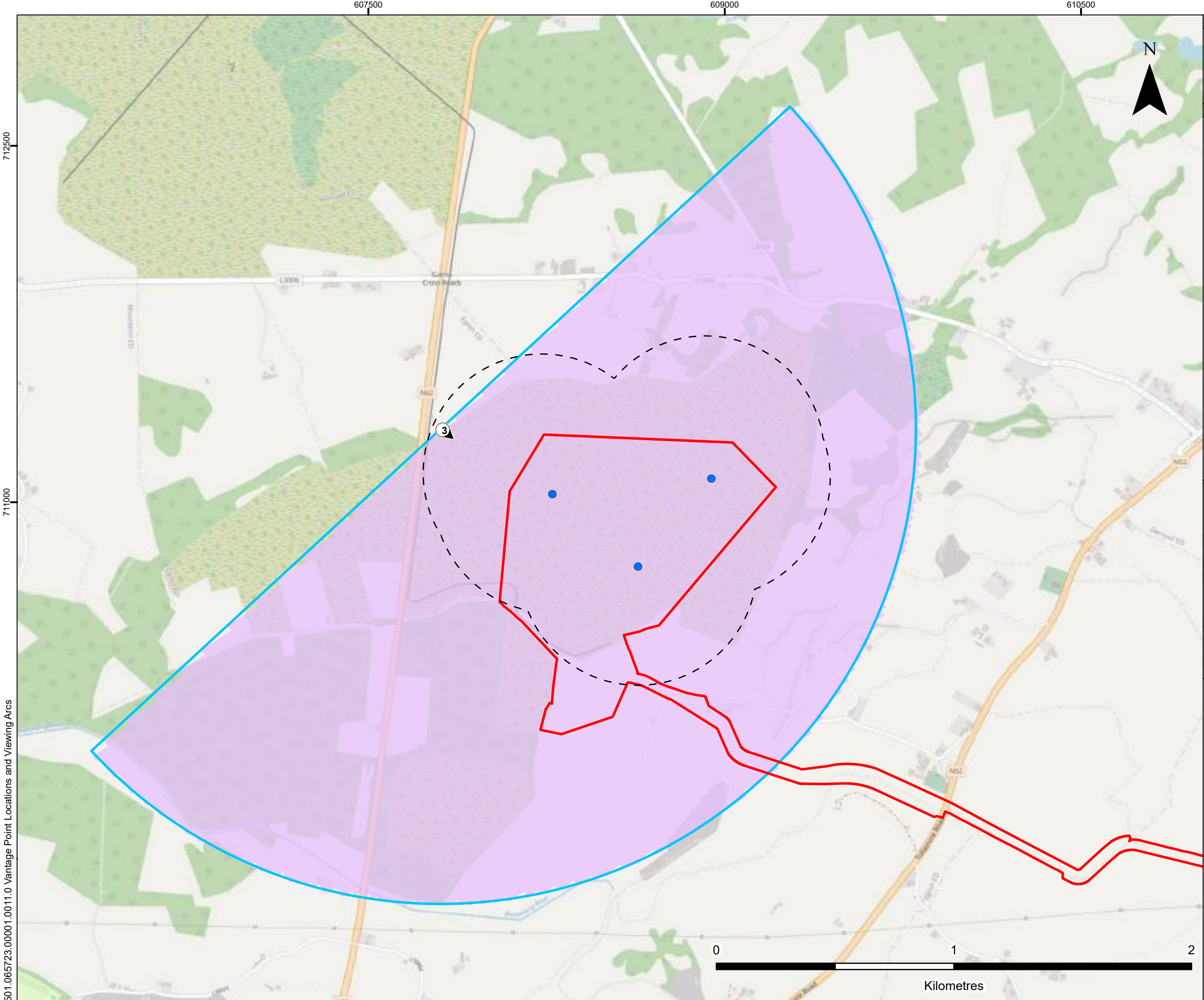
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Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.V64760.00001

21 August 2026



NOTES

1.The ZTV is calculated with a surface offset of 28m & from a viewing height of 1.8m above ground level. The terrain model is derived from EU-DEM data with a vertical accuracy of ± 7 m. The ZTV was calculated using ArcMAP 10.5.1 software.

- LEGEND
- Site Boundary
 - Turbine Location 500 m Buffer
 - Proposed Turbine Location
 - Vantage Point (VP) Location
 - Theoretical Visibility from VP3



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CUSH WIND FARM
WINTER BIRD SURVEYS
VANTAGEPOINTS

FIGURE 1

Scale 1:15,000 @ A3 Date AUGUST 2026



LEGEND

Site Boundary

Proposed Turbine Location

Flight Line



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CUSH WIND FARM

WINTER BIRD SURVEYS

FLIGHT LINES: WHOOPER SWAN

FIGURE 2.1

Scale 1:30,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line
 - Merlin



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CUSH WIND FARM
WINTER BIRD SURVEYS
FLIGHT LINES: MERLIN

FIGURE 2.2

Scale 1:30,000 @ A3 Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line**
 - Cormorant

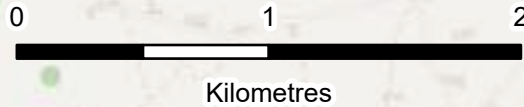


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CUSH WIND FARM
WINTER BIRD SURVEYS
FLIGHT LINES: CORMORANT

FIGURE 2.3

Scale 1:30,000 @ A3	Date AUGUST 2026
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LEGEND

-  Site Boundary
-  Proposed Turbine Location
-  Turbine Location 500 m Buffer
-  Proposed Met Mast
-  Vantage Point (VP) Location
- Flight Line**
-  Golden Plover



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CUSH WIND FARM
WINTER BIRD SURVEYS
FLIGHT LINES: GOLDEN PLOVER

FIGURE 2.4

Scale	1:30,000 @ A3	Date	AUGUST 2026
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LEGEND

Site Boundary

Proposed Turbine Location

Flight Line



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CUSH WIND FARM

WINTER BIRD SURVEYS

FLIGHT LINES: HEN HARRIER

FIGURE 2.5

Scale 1:30,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line
- Kestrel



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WINTER BIRD SURVEYS
FLIGHT LINES: KESTREL

FIGURE 2.6

Scale 1:30,000 @ A3 Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line**
 - Lapwing

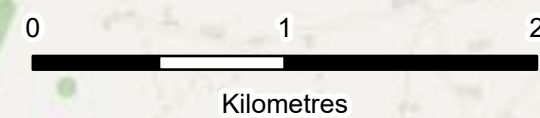


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WINTER BIRD SURVEYS
FLIGHT LINES: LAPWING

FIGURE 2.7

Scale 1:30,000 @ A3	Date AUGUST 2026
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LEGEND

Site Boundary

Proposed Turbine Location

Flight Line



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WINTER BIRD SURVEYS

FLIGHT LINES: MALLARD

FIGURE 2.8

Scale 1:30,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line
- Peregrine



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CUSH WIND FARM
WINTER BIRD SURVEYS
FLIGHT LINES: PEREGRINE

FIGURE 2.9

Scale 1:30,000 @ A3 Date AUGUST 2026



LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line**
 - Snipe



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CUSH WIND FARM

WINTER BIRD SURVEYS

FLIGHT LINES: SNIPE

FIGURE 2.10

Scale 1:30,000 @ A3	Date AUGUST 2026
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LEGEND

- Site Boundary
- Proposed Turbine Location
- Turbine Location 500 m Buffer
- Proposed Met Mast
- Vantage Point (VP) Location
- Flight Line**
 - Great White Egret



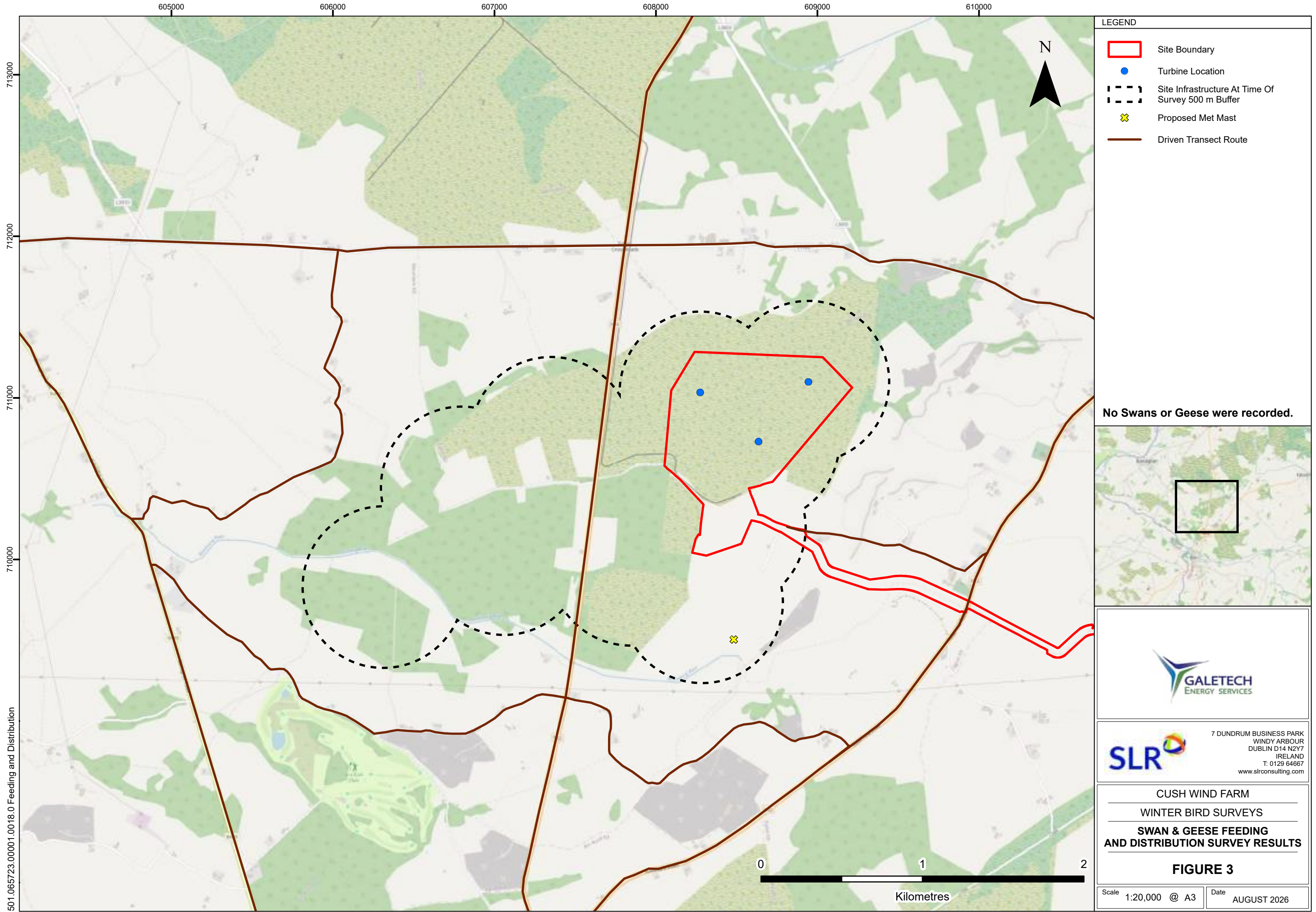


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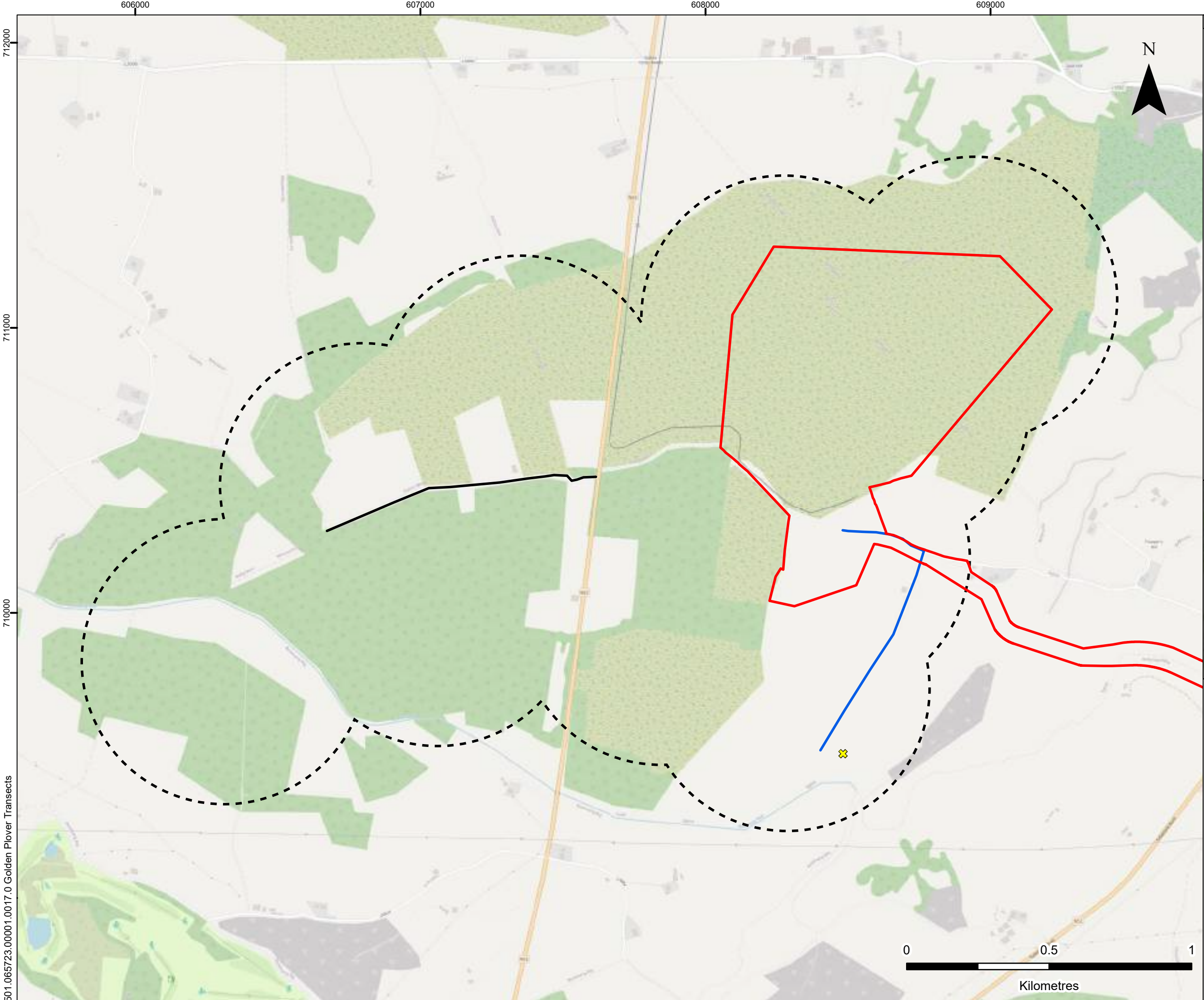
CUSH WIND FARM
WINTER BIRD SURVEYS
FLIGHT LINES: GREAT WHITE-EGRET

FIGURE 2.11

Scale 1:30,000 @ A3 Date AUGUST 2026



501.065723.00001.0018.0 Feeding and Distribution



LEGEND

- Site Boundary
- Site Infrastructure At The Time Of Survey 500 m Buffer
- Turbine Location
- Proposed Met Mast
- Golden Plover Transect West
- Golden Plover Transect East



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CUSH WIND FARM
WINTER BIRD SURVEYS
NOCTURNAL GOLDER PLOVER SURVEY

FIGURE 4

Scale 1:12,500 @ A3	Date AUGUST 2026
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Appendix B Survey dates, times and observers¹⁵

Bird Survey Report Non-Breeding 2022/23

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.V64760.00001

21 August 2026

¹⁵ Surveyor initials are given in Section 2.1

Table B-1: Details of VP Surveys Undertaken from VP3

Date	Surveyor	Start time	End time	No. Hours
18/10/2022	AK	15:25	18:25	03:00
19/10/2022	AK	07:45	10:45	03:00
01/11/2022	AK	14:00	17:00	03:00
15/11/2022	AK	13:45	16:45	03:00
01/12/2022	AK	13:30	16:30	03:00
15/12/2022	AK	13:45	16:45	03:00
04/01/2023	AK	13:20	16:20	03:00
26/01/2023	AK	11:05	14:05	03:00
31/01/2023	AK	14:15	17:15	03:00
15/02/2023	AK	15:00	18:00	03:00
15/03/2023	AK	13:40	16:40	03:00
16/03/2023	AK	09:55	12:55	03:00
Total hours				36

Table B-2: Details of Feeding Distribution Surveys

Date	Surveyor	Start time	End time	No. Hours
05/10/2022	AK	10:40	13:00	02:20
21/10/2022	AK	13:25	15:30	02:05
03/11/2022	AK	08:50	11:20	02:30
16/11/2022	AK	14:30	16:00	01:30
02/12/2022	AK	12:10	13:45	01:35
16/12/2022	AK	13:55	15:30	01:35
04/01/2023	AK	11:50	13:15	01:25
20/01/2023	DN	10:00	11:50	01:50
02/02/2023	AK	14:20	15:30	01:10
16/02/2023	AK	12:45	13:50	01:05
03/03/2023	AK	11:30	12:45	01:15
14/03/2023	AK	13:40	15:15	01:35
Total hours				19:55

Table B-3: Details of Nocturnal Golden Plover Surveys

Date	Surveyor	Start time	End time	No. Hours
03/01/2023	AK/FL	16:45	18:30	01:45
13/03/2023	AK/HB	19:20	21:00	01:40
Total hours				03:25



Appendix C Weather data

Bird Survey Report Non-Breeding 2022/23

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.V64760.00001

21 August 2026

Table C-1: Weather Data Collected During Flight Activity Surveys Undertaken from VP3

Date	Survey Start	Survey End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
18/10/2022	15:25	18:25	1	3	E	0	6	2	2	0	0	15
18/10/2022	15:25	18:25	2	3	E	0	4	2	2	0	0	15
18/10/2022	15:25	18:25	3	3	E	0	3	2	2	0	0	15
19/10/2022	07:45	10:45	1	4	SE	3	8	1	1	0	0	13
19/10/2022	07:45	10:45	2	4	E	3	8	1	2	0	0	12
19/10/2022	07:45	10:45	3	4	E	2	8	1	2	0	0	12
01/11/2022	14:00	17:00	1	2	SW	0	8	2	2	0	0	10
01/11/2022	14:00	17:00	2	2	W	0	6	2	2	0	0	10
01/11/2022	14:00	17:00	3	2	W	1	8	2	2	0	0	9
15/11/2022	13:45	16:45	1	2	S	0	3	2	2	0	0	9
15/11/2022	13:45	16:45	2	2	S	2	6	2	2	0	0	9
15/11/2022	13:45	16:45	3	2	S	0	3	2	2	0	0	8

¹⁶ Key: None = 0; Drizzle = 1; Light showers/snow = 2; Heavy showers/snow = 3; Heavy rain/snow = 4.

¹⁷ Expressed in oktas (n/8)

¹⁸ Key: Height of cloud above average height of viewshed. <150m = 0; 150-500m = 1; >500m = 2.

¹⁹ Key: Poor (<1km) = 0; Moderate (1-3km) = 1; Good (>3km) = 2.

²⁰ Key: Lying snow. None = 0; On site = 1; On higher ground = 2.

²¹ Key: None = 0; Ground = 1; All day = 2.



Date	Survey Start	Survey End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
01/12/2022	13:30	16:30	1	2	S	0	6	2	2	0	0	10
01/12/2022	13:30	16:30	2	2	S	0	5	2	2	0	0	10
01/12/2022	13:30	16:30	3	2	S	0	5	2	2	0	0	10
15/12/2022	13:45	16:45	1	2	NW	0	5	1	2	2	2	1
15/12/2022	13:45	16:45	2	2	NW	0	4	1	2	2	2	0
15/12/2022	13:45	16:45	3	2	NW	0	7	1	2	2	2	-1
04/01/2023	13:20	16:20	1	4	SW	0	7	1	2	0	0	10
04/01/2023	13:20	16:20	2	4	SW	1	6	1	2	0	0	10
04/01/2023	13:20	16:20	3	4	SW	0	4	2	2	0	0	9
26/01/2023	11:05	14:05	1	1	N	0	7	1	2	0	0	5
26/01/2023	11:05	14:05	2	1	N	0	8	1	2	0	0	7
26/01/2023	11:05	14:05	3	1	N	0	8	1	2	0	0	7
31/01/2023	14:15	17:15	1	4	W	0	5	2	2	0	0	8
31/01/2023	14:15	17:15	2	4	W	1	6	1	2	0	0	7
31/01/2023	14:15	17:15	3	4	W	1	6	1	2	0	0	7
15/02/2023	15:00	18:00	1	3	SW	0	8	2	2	0	0	9
15/02/2023	15:00	18:00	2	3	SW	2	8	2	2	0	0	9
15/02/2023	15:00	18:00	3	3	SW	2	8	1	2	0	0	8
15/03/2023	13:40	16:40	1	4	SE	3	8	1	1	0	0	8
15/03/2023	13:40	16:40	2	4	SE	3	8	0	0	0	0	8



Date	Survey Start	Survey End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
15/03/2023	13:40	16:40	3	4	SE	3	8	1	1	0	0	8
16/03/2023	09:55	12:55	1	3	S	0	6	1	2	0	0	12
16/03/2023	09:55	12:55	2	3	S	1	8	1	2	0	0	12
16/03/2023	09:55	12:55	3	3	S	2	8	2	2	0	0	12

Table C-2: Weather During Feeding Distribution Surveys

Date	Start	End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
05/10/2022	10:40	13:00	1	3	SW	0	4	2	2	0	0	11
05/10/2022	10:40	13:00	2	3	SW	2	5	1	2	0	0	12
05/10/2022	10:40	13:00	3	3	SW	2	7	2	2	0	0	12
21/10/2022	13:25	15:30	1	3	SE	2	6	2	2	0	0	14
21/10/2022	13:25	15:30	2	3	SE	1	6	2	2	0	0	14
03/11/2022	08:50	11:20	1	2	SE	0	3	2	2	0	0	6
03/11/2022	08:50	11:20	2	2	SE	0	3	2	2	0	0	7
03/11/2022	08:50	11:20	3	2	SE	0	5	2	2	0	0	8
16/11/2022	14:30	16:00	1	1	SE	0	2	2	2	0	0	9
16/11/2022	14:30	16:00	2	1	SE	0	2	2	2	0	0	8
02/12/2022	12:10	13:45	1	1	SE	0	6	2	2	0	0	9
02/12/2022	12:10	13:45	2	1	SE	0	8	2	2	0	0	10



Date	Start	End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
16/12/2022	13:55	15:30	1	0	NA	0	2	2	2	0	2	2
16/12/2022	13:55	15:30	2	0	NA	0	2	2	2	0	2	2
04/01/2023	11:50	13:15	1	4	SW	1	7	1	2	0	0	11
04/01/2023	11:50	13:15	2	4	SW	0	8	1	2	0	0	11
20/01/2023	10:00	11:50	1	2	W	0	8	2	2	0	0	7
20/01/2023	10:00	11:50	2	3	W	1	8	2	2	0	0	8
02/02/2023	14:20	15:30	1	3	SW	0	8	2	2	0	0	10
16/02/2023	12:45	13:50	1	2	W	0	6	2	2	0	0	9
03/03/2023	11:30	12:45	1	1	NE	0	8	2	2	0	0	6
03/03/2023	11:30	12:45	2	1	NE	0	8	2	2	0	0	6
14/03/2023	13:40	15:15	1	4	NW	0	4	2	2	0	0	6
14/03/2023	13:40	15:15	2	4	NW	0	4	2	2	0	0	6

Table C-3: Weather During Nocturnal Golden Plover Surveys

Date	Start	End	Hr	Wind Speed	Wind Direction	Rain ¹⁶	Cloud Cover ¹⁷	Cloud Height ¹⁸	Visibility ¹⁹	Snow ²⁰	Frost ²¹	Temp (°c)
03/01/2023	16:45	18:30	1	3	S	2	8	1	0	0	0	11
03/01/2023	16:45	18:30	2	3	S	2	8	1	0	0	0	10
13/03/2023	19:20	21:00	1	2	W	0	4	2	0	0	0	3
13/03/2023	19:20	21:00	2	2	W	0	4	2	0	0	0	3





Appendix D Flight activity survey data²²

Bird Survey Report Non-Breeding 2022/23

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.V64760.00001

21 August 2026

²² Surveyor initials are given in Section 2.1 and BTO code information is given in Section 5.0

Table D-1: Primary Target Species Recorded During Flight Activity Surveys Undertaken at VP3

Date	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	Start Time (hr:min)	Flight duration (s)
18-Oct-22	3.CU051.1.1	K.	1	AD	U	16:21	75
18-Oct-22	3.CU051.2.1	SN	1	AD	U	16:23	60
18-Oct-22	3.CU051.3.1	K.	1	AD	F	16:36	210
18-Oct-22	3.CU051.4.1	GP	56	U	U	16:37	510
18-Oct-22	3.CU051.5.1	GP	5	U	U	16:48	105
18-Oct-22	3.CU051.6.1	GP	11	U	U	16:53	60
18-Oct-22	3.CU051.7.1	K.	1	AD	F	16:53	120
18-Oct-22	3.CU051.8.1	GP	16	U	U	16:59	90
18-Oct-22	3.CU051.9.1	GP	24	U	U	17:05	120
18-Oct-22	3.CU051.10.1	GP	4	U	U	17:31	210
18-Oct-22	3.CU051.11.1	K.	1	AD	F	18:03	75
18-Oct-22	3.CU051.12.1	K.	1	AD	F	18:07	150
18-Oct-22	3.CU051.13.1	K.	1	AD	F	18:17	150
19-Oct-22	3.CU052.1.1	ML	1	U	U	07:40	15
19-Oct-22	3.CU052.2.1	SN	1	U	U	08:33	45



Date	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	Start Time (hr:min)	Flight duration (s)
19-Oct-22	3.CU052.3.1	GP	10	U	U	09:06	165
19-Oct-22	3.CU052.4.1	GP	36	U	U	09:20	90
19-Oct-22	3.CU052.5.1	SN	1	U	U	09:49	60
19-Oct-22	3.CU052.6.1	GP	16	U	U	10:19	210
19-Oct-22	3.CU052.7.1	HW	1	U	U	10:36	15
01-Nov-22	3.CU057.1.1	PE	1	AD	F	14:03	75
01-Nov-22	3.CU057.2.1	K.	1	AD	M	14:09	45
01-Nov-22	3.CU057.3.1	K.	1	AD	M	14:24	345
01-Nov-22	3.CU057.4.1	K.	1	AD	M	14:34	105
15-Nov-22	3.CU060.1.1	ML	1	U	U	14:08	45
15-Nov-22	3.CU060.2.1	MA	5	U	U	14:36	135
15-Nov-22	3.CU060.3.1	L.	12	U	U	16:24	105
01-Dec-22	3.CU065.1.1	CA	1	AD	U	14:04	75
01-Dec-22	3.CU065.2.1	CA	1	AD	U	14:32	45
01-Dec-22	3.CU065.3.1	ML	1	AD	U	15:28	75
15-Dec-22	3.CU069.1.1	L.	1	U	U	14:12	30
15-Dec-22	3.CU069.2.1	L.	3	U	U	14:46	45
15-Dec-22	3.CU069.3.1	L.	6	U	U	15:22	45
15-Dec-22	3.CU069.4.1	L.	8	U	U	15:45	60



Date	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	Start Time (hr:min)	Flight duration (s)
15-Dec-22	3.CU069.5.1	K.	1	A	F	15:47	30
15-Dec-22	3.CU069.6.1	ML	1	U	U	16:12	15
15-Dec-22	3.CU069.7.1	L.	5	U	U	16:27	45
15-Dec-22	3.CU069.8.1	SN	1	U	U	16:28	30
26-Jan-23	3.CU079.1.1	WS	2	A	U	13:02	30
31-Jan-23	3.CU080.1.1	HH	1	A	M	14:56	120
31-Jan-23	3.CU080.2.1	HH	1	A	M	15:02	195
31-Jan-23	3.CU080.3.1	HH	1	A	M	15:06	150
31-Jan-23	3.CU080.4.1	SN	2	U	U	15:06	60
31-Jan-23	3.CU080.5.1	HH	1	A	M	15:17	195
31-Jan-23	3.CU080.6.1	SN	1	U	U	15:18	45
31-Jan-23	3.CU080.7.1	K.	1	U	U	15:18	45
31-Jan-23	3.CU080.8.1	HH	1	A	M	15:26	105
31-Jan-23	3.CU080.9.1	K.	1	U	U	15:38	15
16-Mar-23	3.CU097.1.1	L.	1	U	U	09:56	30
16-Mar-23	3.CU097.2.1	L.	6	U	U	10:10	75
16-Mar-23	3.CU097.3.1	SN	1	U	U	10:10	15
16-Mar-23	3.CU097.4.1	L.	2	U	U	10:18	60
16-Mar-23	3.CU097.5.1	L.	1	U	U	10:41	45



Date	Flight ID	BTO Code	No. Birds	Age (Ad = adult; Imm = immature)	Sex (M = male; F = female; U = unknown)	Start Time (hr:min)	Flight duration (s)
16-Mar-23	3.CU097.6.1	L.	3	U	U	10:42	45

Table D-2: Secondary Target Species Recorded During Flight Activity Surveys Undertaken at VP3

Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
18/10/2022	15:25	18:25	16:55	17:00	H.	1	1	1
18/10/2022	15:25	18:25	17:05	17:10	BZ	1	1	2
18/10/2022	15:25	18:25	17:40	17:45	H.	1	1	1, 2
19/10/2022	07:45	10:45	09:10	09:15	RN	1	1	1
19/10/2022	07:45	10:45	09:30	09:35	BZ	1	1	1
19/10/2022	07:45	10:45	10:20	10:25	BZ	2	2	1, 2
19/10/2022	07:45	10:45	10:25	10:30	BZ	2	2	1, 2
15/11/2022	13:45	16:45	13:05	13:10	H.	1	1	1
15/11/2022	13:45	16:45	15:00	15:05	BZ	1	1	2
15/11/2022	13:45	16:45	16:10	16:15	RN	1	1	1
01/12/2022	13:30	16:30	13:50	13:55	BZ	1	1	2
01/12/2022	13:30	16:30	14:20	14:25	BZ	1	1	2
01/12/2022	13:30	16:30	14:40	14:45	RN	3	3	2
01/12/2022	13:30	16:30	15:00	15:05	BZ	1	1	1,2
15/12/2022	13:45	16:45	14:15	14:20	BZ	1	1	1



Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
04/01/2023	13:20	16:20	14:35	14:40	BZ	1	1	2
04/01/2023	13:20	16:20	14:50	14:55	H.	1	1	1
04/01/2023	13:20	16:20	16:00	16:05	RN	2	2	1
26/01/2023	11:05	14:05	11:05	11:10	H.	1	1	1
26/01/2023	11:05	14:05	11:20	11:25	H.	1	1	1
26/01/2023	11:05	14:05	11:55	12:00	H.	1	1	1
26/01/2023	11:05	14:05	12:00	12:05	H.	1	1	1
26/01/2023	11:05	14:05	12:10	12:15	H.	1	1	1
26/01/2023	11:05	14:05	13:20	13:25	H.	1	1	1
26/01/2023	11:05	14:05	13:30	13:35	H.	1	1	1
26/01/2023	11:05	14:05	13:30	13:35	BZ	1	1	2
26/01/2023	11:05	14:05	13:35	13:40	BZ	3	3	1, 2
26/01/2023	11:05	14:05	13:45	13:50	BZ	2	2	2
26/01/2023	11:05	14:05	13:50	13:55	BZ	1	1	1
26/01/2023	11:05	14:05	13:50	13:55	H.	1	1	1
26/01/2023	11:05	14:05	13:50	13:55	H.	1	1	1
31/01/2023	14:15	17:15	14:15	17:15	H.	2	2	1
31/01/2023	14:15	17:15	15:45	15:50	BZ	1	1	2
15/03/2023	13:40	16:40	13:40	13:45	H.	1	1	1
16/03/2023	09:55	12:55	10:00	10:05	BZ	1	1	1



Date	Survey start	Survey end	5 min period start time	5 min period end time	Species	Count Max	Height band	Location (on site, in buffer or beyond)
16/03/2023	09:55	12:55	10:45	10:50	BZ	1	1	2







Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

Clondargan, Stradone, Co. Cavan

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

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SLR Project No.: 501.065092.00001

Client Reference No: N/A

21 August 2026

Revision: 0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	21 August 2026	Alice Magee	Dr Jonathon Dunn	Dr Jonathon Dunn
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

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Appendices

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Appendix B	Weather Data
Appendix C	Flight Activity Survey Data
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Acronyms and Abbreviations

The Project	Cush Wind Farm
The Project Site	The application site
VP	Vantage Point



1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd (SLR) was commissioned by Galetech Energy Developments Ltd (Galetech) to carry out a bird survey programme for the proposed wind farm at Cush, Co. Offaly (hereafter 'the Project') during the breeding season in 2023. The purpose of this report is to describe these surveys and the resulting ornithological baseline.

1.1 Background to the Commission

The Project Site includes phase 1 (eight turbines) and an extension area (three turbines; also known as phase 2). Phase 1 was granted planning permission in November 2024. As the bird survey programme for the breeding season 2022 covered both phases, and the data are within date according to NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance¹, the results are considered to be relevant to the proposed extension area. This report focuses on the methodology and results that are relevant to extension area. The methodology and results of the entire bird survey programme can be found in the previously issued baseline breeding bird survey report².

Bird surveys have been previously undertaken at the proposed wind farm development site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR for the breeding 2020, non-breeding 2020/21, breeding 2021, non-breeding 2021/22, breeding 2022 and non-breeding 2022/23 seasons. The Project Site also includes a linear area that was previously surveyed for a proposed overhead line³. Flight activity surveys were carried out at two vantage point locations along the proposed overhead line route corridor during the breeding season in 2018.

1.2 Site Description

The Project Site is located in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946 (refer to Appendix D **Figure 1**). The habitats within the Project Site are dominated by conifer plantations of varying age classes (c.327 ha), cutaway bog (c.102 ha) and agricultural grasslands (ca. 327 ha). The Project Site is not designated for nature conservation.

1.3 Terminology

For this report, "flight line" refers to the line drawn to record avian movement during a Vantage Point (VP) survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as "a flight". Note that the "cumulative number of flights" reflects the occupancy of the study area by a particular species. It is not equivalent to the total number of unique individuals and should not be used to infer abundance.

1.4 Purpose of the Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

¹ Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

² SLR (2024) Cush Wind Farm Breeding Bird Survey Report 2023.

³ SLR (2018) *Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018*. Prepared for Galetech Energy Services Ltd



The assessment of impacts resulting from the proposed development and the development of mitigation measures, if required, are beyond the scope of this report and will be covered in a separate Environmental Impact Assessment (EIA) Report.

1.5 Relevant Legislation

Legislation relevant to this report includes the EC Birds Directives and the Wildlife Act (1976, as amended). Birds listed under Annex I of the Birds Directive are described in Section 5 and are afforded strict protection at the European and national level. All Irish birds are protected by the Wildlife Act.

2.0 Methodology

2.1 Scope of Work

The scope of survey work during the breeding season was based on knowledge of the Project Site acquired during the previous bird surveys, a desk-based review and access to lands within and surrounding the red line boundary. It also considered current NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance⁴. The details of the scope of work are provided in Table 2-1. Further details are provided in Sections 2.2.1 to 2.2.4, including study areas and target species.

Table 2-1: Scope of Ornithological Work April-August 2023

Survey Type	Summary Methodology
Vantage Point (VP) Surveys	Thirty-six hours of surveys (spread out as evenly as possible across the survey period) were carried out from each of three VPs between April and August 2023 inclusive.
Breeding Raptor Surveys	Four breeding raptor surveys were carried out within the period 26 th April to 14 th July to search for potential nesting territories within a 2 km radius of the Project Site.
Breeding Wader Surveys	Three lowland wader surveys were carried out within the period 25 th April to 14 th June to search for waders breeding in suitable habitat within the Project Site.
Points Counts for Passerines	Point counts for passerines were carried out at the same time as breeding raptor and wader surveys.
Kingfisher <i>Alcedo atthis</i> Habitat Assessment	A kingfisher habitat survey was conducted on the 25 th April to assess watercourses within the Project Site for their suitability to support breeding kingfisher.
Barn owl <i>Tyto alba</i> Breeding Surveys	Searches for breeding evidence at all structures that could be suitable for barn owl nesting or roosting was made within a 1 km radius of the Project Site on the 25 th April.

NS guidance states that “*it is generally considered the passerine species are not significantly impacted by wind farms*”. It goes on to state that “*survey of woodland passerines, especially in commercial conifer forest is generally not required*”. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that passerines red-listed under the latest Birds of Conservation Concern in Ireland (BoCCI) scheme⁵ should be

⁴ Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

⁵ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. *Irish Birds* 43: 1–22



considered as equivalent. No such species were returned during the desk-based review or data request. NS guidance also states that “*surveys of farmland passerines especially on more intensive arable habitat are generally not required*”. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

2.2 Desk-based Review

The desk review collated any available information to date on the breeding and non-breeding bird populations and movements around the Project Site.

The following reports resulting from previous breeding and non-breeding bird surveys were reviewed for any relevant information that could be used to inform the current bird surveys:

- SLR (2018) Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018;
- SLR (2020) Cush Wind Farm Breeding Bird Survey Report 2020;
- SLR (2022) Cush Wind Farm Winter Bird Survey Report 2020-2021;
- SLR (2022) Cush Wind Farm Breeding and Winter Bird Survey Report 2021-2022;
- SLR (2022) Cush Wind Farm Breeding Bird Survey Report 2022; and
- SLR (2023a) Cush Wind Farm Non-Breeding Bird Survey Report 2022-2023.

The websites of the National Parks and Wildlife Service (NPWS)⁶, the UK and Ireland Bird Atlas 2007-2011⁷ and the National Biodiversity Data Centre (NBDC)⁸ were also accessed for information on sites designated for nature conservation in the vicinity of the Project Site.

2.2.1 Flight Activity Surveys

Existing VP locations chosen for the previous breeding bird surveys were used. The adequacy of these VPs was checked by carrying out a desk-based viewshed analysis using a bespoke GIS tool for calculating the visible area from each VP. The Zones of Theoretical Visibility (ZTV) from each VP were calculated using ArcMAP 10.5.1 Spatial Analyst using a terrain model derived from EU-DEM data with a vertical accuracy of ± 7 m. The ZTVs were calculated with a surface offset of 28 m and are based on a viewing height of 1.8 m above ground level. The VPs, viewsheds and viewing arcs are shown in Appendix D **Figure 1**.

The viewsheds from VP1 and VP2 cover phase 1 of the Project, and the viewshed from VP3 covers the extension area (phase 2). As VP3 was deemed to adequately cover the extension area without adding additional VPs, this report will focus on surveys conducted from VP3.

There were 36 hours of watches undertaken at VP3 during the survey period. Survey start times ranged from 04:53 to 19:17 (with the latest survey finishing at 22:17).

The VP survey effort undertaken during the breeding season of 2023 is summarised in Table 2-2, with full details of survey dates, times and observers provided in Appendix A and details of weather conditions during the surveys provided in Appendix B.

⁶ www.npws.ie (last accessed September 2023)

⁷ <https://app.bto.org/mapstore/StoreServlet> (last accessed September 2023)

⁸ <http://maps.biodiversityireland.ie/#/Map> (last accessed September 2023)



Table 2-2: VP Survey Effort Undertaken at VP3 During the Breeding Bird Season 2023

Month	VP3
April	06:00
May	06:00
June	06:00
July	12:00
August	06:00
Total hrs	36:00

VP watches aimed to quantify the flight activity of primary and secondary target species (as defined below) within the study area.

The main purpose of VP watches is to collect data on primary target species that will enable estimates to be made of:

- The time spent flying over the Project Site;
- The relative use by birds of different parts of the Project Site;
- The proportion of flying time spent within the provisional upper and lower risk height limits as determined by the potential rotor diameter and rotor hub height; and
- Ultimately, the analysis of the potential risk of collision of birds with rotating turbines.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying bout;
- Species, age and sex (where determinable);
- Number of birds observed;
- Time spent within each height band and;
- Notes on observation.

Recording height bands were determined based on the likely turbine specifications under consideration at the time of survey (upper tip height 200 m and lower tip height 28 m). Flight heights were attributed to four distinct height bands as follows:

- 1 = < 20 m (below the likely rotor swept area);
- 2 = 20 m to 150 m (potentially within the likely rotor swept area, at least in part);
- 3 = 150 m to 200 m (potentially within the likely rotor swept area);
- 4 = >200 m (above the likely rotor swept area).

In addition, a summary of observations of secondary target species was recorded at the end of each five-minute period during each VP watch to provide an index of flight activity for secondary target species within the Project Site, in accordance with current NS guidance. Data collected on secondary species included:

- The five-minute period start and end time;
- Species;
- Number of birds observed;
- If flying, the height band in which birds were observed flying;



- Whether birds were observed onsite, in the 500 m buffer or beyond;
- Flight behaviour; and
- Notes on observation.

2.2.1.1 Target Species

Target species for the surveys were defined by legal and/or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS guidance.

Primary Target Species

The list of primary target species was limited to species upon which effects are most likely to be potentially significant in EIA and Appropriate Assessment (AA) terms e.g., species forming qualifying features for nearby Special Protection Areas (SPAs) or species listed on Annex I of the Birds Directive⁹. This enabled recording to focus on the species of greatest importance without the distraction of having to record detailed flight data for a larger number of more common species.

Primary target species included the following bird species:

- All Annex I raptor/owl species;
- Qualifying interest species for nearby SPAs¹⁰; and
- Other raptors, waders or wildfowl red-listed on the latest Birds of Conservation Concern in Ireland (BoCCI)⁵ scheme.

Secondary Species

Local circumstances may indicate that survey information should also be acquired on other species, especially those of regional conservation concern. Such species are termed secondary species. Recording of secondary species is subsidiary to recording of primary target species.

Secondary species included:

- Any other wildfowl and wader species that are not primary species;
- All gull species that are not primary species;
- Common buzzard *Buteo buteo*;
- Eurasian sparrowhawk *Accipiter nisus*;
- Northern raven *Corvus corax*;
- Grey heron *Ardea cinerea*; and
- Great cormorant *Phalacrocorax carbo*.

2.2.2 Breeding Raptor Surveys

The survey methodology for breeding raptors used a driven transect, with regular stops, to carry out watches of suitable habitat from appropriate viewpoints to identify potential nesting territories. A total of eight unique stops were made along the transect around the Project Site overlooking potentially suitable breeding habitat. The locations of these viewpoints are

⁹ Annex I of the Birds Directive (Directive 2009/147/EC)

¹⁰ The relevant SPAs are listed in Section 3.1.



presented in Appendix D **Figure 3** together with the outline of the survey route and the results of the surveys.

Suitable breeding habitat differs for each raptor species¹¹. Table 2-3 provides a summary of the potentially suitable raptor habitats within the 2 km buffer zone of the Site and the approximate locations of these in relation to the viewpoints used during the survey.

Table 2-3: Potentially Suitable Habitats for Breeding Raptors within the Study Area

Raptor Viewpoint	Month Surveyed	Habitat Type Visible	Target Raptor Species Potentially Present
rVPA	All months but July	Quarry cliff faces	Peregrine falcon <i>Falco peregrinus</i> , common kestrel <i>Falco tinnunculus</i>
rVPB	April, May, June, July	Edge of quarry, broadleaf woodland	Peregrine falcon, common kestrel, red kite <i>Milvus milvus</i> , common buzzard, Eurasian sparrowhawk
rVPC	April	Broadleaf woodland & treelines	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk
rVPD	April	Broadleaf woodland	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk
rVPE	May, July	Broadleaf woodland	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk
rVPF	May, July	Lowland cutover bog, conifer plantation, treelines & broadleaf woodland	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk, hen harrier <i>Circus cyaneus</i> , merlin <i>Falco columbarius</i>
rVPG	June, July	Lowland cutover bog, conifer plantation, treelines & broadleaf woodland	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk, hen harrier, merlin
rVPH	June, July	Lowland cutover bog, conifer plantation, treelines & broadleaf woodland	Common kestrel, red kite, common buzzard, Eurasian sparrowhawk, hen harrier, merlin

2.2.3 Breeding Wader Surveys

Lowland breeding wader surveys followed an adapted version of the methodology described in O'Brien & Smith¹², as recommended by NS guidance. Lowland breeding wader surveys were conducted in the grasslands in the western section of the Project Site and the bog in the eastern section of the Project Site. The surveys involved a walked transect which covered all habitat potentially suitable for breeding waders within the Project Site.

Surveys were carried out three hours before dusk and until too dark to see to search for crepuscular Eurasian woodcock *Scolopax rusticola*.

¹¹ Hardey, J., Crick, H.Q.P., Wernham, C., Riley, H., Etheridge, B., Thompson, D. (2013). Raptors: A field guide for surveys and monitoring (3rd Edition). The Stationery Office Edinburgh.

¹² O'Brien & K. W. Smith (1992) Changes in the status of waders breeding on wet lowland grasslands in England and Wales between 1982 and 1989, Bird Study, 39:3, 165-176



The location, movement and behaviour of all wader species were recorded onto field maps using standard BTO species codes. The following criteria was recorded for each species:

- Northern lapwing *Vanellus vanellus* – the total numbers of birds seen from the transect;
- Common snipe *Gallinago gallinago* – the number of drumming plus chipping birds heard or seen from the transect; and
- Other species – the number of pairs (where 'pairs' = (paired individuals/2), displaying birds, nests or broods and other single birds not in flocks).

Birds were considered to be confirmed breeding if one or more of the following criteria were met:

- They were observed displaying or singing on more than one visit;
- Nests, eggs, or young were located;
- Adults repeatedly alarm called;
- Distraction displays were seen; and/ or
- Territorial disputes were observed.

Birds were considered to be probably or possibly (i.e. unconfirmed) breeding if:

- They were observed displaying or singing on one visit (i.e. possibly breeding) or more than one visit (i.e. probably breeding) (with the exception of obvious passage migrants in spring); or
- A pair of birds was observed in suitable habitat for nesting.

Other records were considered to be of non-breeding birds, failed breeders, birds loafing, feeding or on passage to other areas.

Please see Appendix D **Figure 4** for an outline of the walked transect and Appendices A and B for metadata relating to these surveys.

2.2.4 Kingfisher Habitat Assessment

NS guidance does not specifically mention surveys for kingfisher; however, a precautionary survey for this species was undertaken due to sightings made during habitat surveys along the Rapemills River.

The survey methodology used was an adapted version of that used by Crowe *et al.* (2008)¹³. The kingfisher habitat assessment consisted of two surveyors walking the length of all watercourses within the Project Site and assessing them for their suitability to support breeding kingfisher. The watercourses were evaluated by section. Different sections were areas which differed significantly from each other in relation to the following characteristics¹⁴:

- Water quality;
- River flow;
- Angle of bank; and
- Bank substrate or features.

¹³ Crowe, O., G. Webb, E. Collins and P. Smiddy 2008. Assessment of the distribution and abundance of Kingfisher *Alcedo atthis* and other riparian birds on two SAC river systems in Ireland. Unpublished BirdWatch Ireland report to the National Parks and Wildlife Service. Newtownmountkenedy, Co. Wicklow.

¹⁴ Details for distinguishing the characteristics can be found in Section 3.5.



Each section was then evaluated for its suitability to support breeding kingfisher through the following characteristics:

- Bank substrate or features;
- Availability of perches;
- Disturbance; and
- Foraging suitability.

Any live sightings of kingfisher or kingfisher nests observed were also recorded on maps using a GPS.

Details of survey dates, times and observers are provided in Appendix A and details of weather conditions in Appendix B. Please see Appendix D **Figure 5** for an outline of the areas surveyed.

2.2.5 Barn Owl Breeding Survey

A sighting of an adult barn owl was made during bat activity transect surveys in the summer of 2022 near the meteorological mast. NS guidance mentions that breeding surveys for owls should be undertaken according to the methods supplied by Hardey et al. (2009) up to 1 km from the Project Site.

According to Hardey et al. (2009), the number of visits required are dependent on whether suitable nesting sites are occupied. All suitable roost / nest sites for barn owl were surveyed as part of summer roost surveys for bats in 2022, with no signs (such as feathers, pellets and droppings) detected. Bat surveys (including survey area) are described in SLR (2023b)¹⁵ and included searches within optioned lands (access to areas outside these was not possible).

As a precaution, additional surveys of structures were made on the same date as for the kingfisher habitat assessment. The aim of these surveys was to locate active barn owl nests (corresponding to visit 2 in Hardey et al. (2009)). None of the trees searched as part of bat surveys had large cavities suitable for nesting barn owl, so focus was given to structures.

Locations surveyed for barn owl are shown below in Table 2-4.

Table 2-4: Locations Surveyed for Barn Owl

Potential Nest Type	Description	X (ITM)	Y(ITM)	Distance/Direction from Extension Area
Structure	Agricultural shed	608696.95	710083.15	400 m south
	Concrete shed	608481.14	710291.66	<100 m south
	Stone buildings	607538.66	710053.68	450 m south
	Small farm canopy	607308.78	710481.14	200 m west
	Concrete shed	607324.83	710501.79	200 m west
	Slatted units and hay shed	606433.05	708963.74	1.9 km southwest
	Concrete shed	606474.72	708955.77	1.9 km southwest
	Ruins	607620.09	710098.05	400 m south

¹⁵ SLR (2023b). Baseline Bat Report. Cush Wind Farm. SLR Environmental Consulting (Ireland) Ltd



Project Team

Details of the project team are described below with those involved in field surveys only described in Section 2.4.1.

2.2.6 Dr Jonathon Dunn (JD) MA (Cantab.) MSc PhD MCIEEM –Technical Reviewer & Approver

Jonathon is an Associate Ecologist with SLR and holds an MA (Cantab.) in Zoology from Homerton College, Cambridge, an MSc in Ecology, Evolution and Conservation from Imperial College London, and a PhD in avian ecology from Newcastle University. He is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and has worked in the environmental sector since 2014. He has experience as a project manager on many wind farm developments throughout Ireland. Jonathon conducted the technical review and approvals of this report.

2.2.7 Aisling Kinsella (AK) BSc (Hons) MSc – Project Manager and Report Author

Aisling is a Senior Ecologist with SLR and holds a BSc in Zoology from University College Cork and an MSc in Wildlife Management and Conservation from University College Dublin. Aisling has three years' experience with breeding and non-breeding bird surveys (vantage point surveys, breeding wader and raptor surveys, winter feeding and distribution surveys, goose roost and winter hen harrier surveys). She is also involved with project management, report writing and technical reviews, survey scheduling and training new staff in bird survey work. Aisling is the project manager for Cush Wind Farm. She also carried out surveys at the Project Site during the 2023 breeding season and is the author of this report.

2.3 Field Survey Team

2.3.1 Kieran Moynihan (KM) – Project Ecologist

Kieran Moynihan is a Project Ecologist with SLR and has worked in ecological consultancy since July 2022. Kieran holds a BSc in Ecology from University College Cork. Since joining SLR Kieran has gained experience in a range of ornithological surveys, plant identification and habitat surveys. He has helped prepare AA screenings for a range of projects. Kieran is a qualifying member of CIEEM.

2.3.2 Michael James (MJ) – Graduate Ecologist

Michael is a Graduate Ecologist with SLR. Michael holds a BA (Hons) in Zoology from Trinity College Dublin. Since starting at SLR, Michael has been involved in various surveys. These include bird surveys (vantage point and breeding raptor) and bat transects for wind farms. He has also conducted bat emergence surveys and habitat surveys for other projects.

2.3.3 Nick Veale (NV) – Subcontractor

Nick is the Principal Ecologist for Veale Ecology and has a lifetime experience as an ornithologist and 22 years professional experience as a consulting ornithologist. Nick has worked on a large number of renewable energy projects.

2.4 Survey Limitations

Most VP surveys were undertaken in optimal weather conditions. There were five hours out of the total 36 during which the visibility was recorded as “moderate” i.e. 1-3 km (comprising 14% of total survey effort). In most cases where the visibility was recorded as “moderate”,



the relevant 2 km viewing arcs were still visible. Further details regarding weather conditions during surveys are provided in Appendix B.

A section of grassland at approximate ITM coordinates 606819, 710474 could not be accessed for the breeding wader survey in May due to the road being blocked. However, it was accessible for all other breeding wader surveys. It should also be noted that during the breeding 2023 survey period this habitat was no longer considered suitable for breeding waders, as it had been during previous years, due to the presence of grazing donkeys and the resultant short sward.

One flight line of black headed gull *Chroicocephalus ridibundus* was accidentally recorded as secondary target species in July and as such, does not have the primary target species attribute data. However, this is not considered to have the potential to significantly affect the output of any subsequent collision risk modelling.

Access to structures / trees within third-party lands in the 1 km survey buffer was not possible for barn owl breeding surveys, so only those within optioned lands could be searched.



3.0 Results

3.1 Desk-based Review

3.1.1 Species Records

Species records collated via desk-based review are shown in Appendix E.

3.1.2 Natura 2000 Sites

The Project Site is not within or immediately adjacent to any SPA. However, there are a total of eight SPAs within a 20 km¹⁶ radius with details shown in Table 3-1.

Table 3-1: SPAs within 20 km of the Project Site and their Qualifying Interests

Site Name	Site Code	Distance/Direction from Extension Area Boundary	Qualifying Interest Species Relevant to the Breeding Season
Dovegrove Callows SPA	004137	3.6 km southwest	• N/A
All Saints Bog SPA	004103	5.1 km west	• N/A
River Little Brosna Callows SPA	004086	5.8 km west	• N/A
Middle Shannon Callows SPA	004096	7.2 km northwest	• Corncrake <i>Crex crex</i> • Northern lapwing
Slieve Bloom Mountains SPA	004160	11.8 km southeast	• Hen harrier
River Suck Callows SPA	004097	17.3 km northwest	• N/A
Lough Derg (Shannon) SPA	004058	17.5 km southwest	• Great cormorant • Tufted duck <i>Aythya fuligula</i> • Common tern <i>Sterna hirundo</i>
Mongan Bog SPA	004017	19.0 km northwest	• N/A

3.1.3 Other Nature Conservation Sites

The Project Site is not within or immediately adjacent to any Natural Heritage Area (NHA) or proposed NHA (pNHA). However, there are a total of 14 NHAs and 50 pNHAs within a 20 km radius, with details shown in Table 3-2.

River Little Brosna Callows NHA is located 1.65 km west of the Project Site and is the only NHA within a 20 km radius which is designated for its bird populations. The site is of importance for breeding common redshank *Tringa totanus* and common snipe¹⁷.

The Project Site is not within or immediately adjacent to any Ramsar site. The Slieve Bloom Mountains Ramsar site is located 11.7 km east of the Project Site and is contained within the boundaries of the Slieve Bloom Mountains SPA.

¹⁶ A 20 km search radius was used as this represents the maximum core foraging distance used by Qualifying Interest species of SPAs in the UK and Ireland

¹⁷ NPWS (2014) Site Synopsis: River Little Brosna Callows SPA [000564] National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.



Table 3-2: NHAs and pNHAs within 20 km of the Project Site and their Qualifying Interests (Sites Designated for Ornithological Qualifying Interests Only)¹⁸

Site Name	Site Code	Distance/Direction from Extension Area Boundary	Qualifying Interests Relevant to the Breeding Season
Woodville Woods pNHA	000927	2.0 km southwest	Common snipe
Lough Nahinch (Tipperary) pNHA	000936	12.5 km southwest	Common redshank Common snipe Water rail <i>Rallus aquaticus</i>
Roscrea Bog pNHA	000583	17.1 km southwest	Common snipe Eurasian curlew <i>Numenius arquata</i>
Pallas Lough pNHA	000916	18.3 km northeast	Mallard <i>Anas platyrhynchos</i> Eurasian teal Eurasian wigeon Western marsh harrier <i>Circus aeruginosus</i>

3.2 Flight Activity Surveys

Flight lines of primary target species recorded at the proposed wind farm site throughout the 2023 breeding season are presented in Appendix D **Figures 2.1 to 2.7** and a summary of the survey findings are provided in Sections 3.2.1 and 3.2.2 for primary and secondary target species, respectively. Flight data for both primary and secondary target species are provided in Appendix C with full data retained in GIS and excel format for subsequent collision risk modelling, if required.

3.2.1 Primary Target Species

In total, flight lines by seven primary target species were recorded from VP3 during the five-month survey period. Flight activity recorded is summarised in Table 3-3. Northern lapwing was the most frequently recorded species (17 flight lines), followed by common snipe (13 flight lines).

Table 3-3: Number of Primary Target Species Flights

Species	Number of flight lines by month					Total no. of flight lines	Time at risk height* (s)	Cumulative no. of flights
	April	May	June	July	August			
Black-headed gull	5	0	3	0	0	8	450	23
Common kestrel	2	3	0	4	0	9	1,260	9
Common snipe	0	2	10	1	0	13	975	17
Little egret <i>Egretta garzetta</i>	0	0	2	0	0	2	120	2

¹⁸ Only NHAs and pNHAs that do not overlap with SPAs are shown.



Species	Number of flight lines by month					Total no. of flight lines	Time at risk height* (s)	Cumulative no. of flights
	April	May	June	July	August			
Mallard	1	1	1	0	0	3	105	6
Northern lapwing	2	3	7	3	2	17	375	25
Teal	4	0	0	0	0	4	135	8
* precautionary risk height assumed to be between 28 – 200 m								

A summary of flight activity by species is presented below.

3.2.1.1 Black-Headed Gull

Eight flight lines of black-headed gull were recorded during the flight activity surveys (Appendix D **Figure 2.1**). The peak number of flights per any one flight line was eight. Flight lines were recorded from VP3 in April and June. Seven flight lines were within collision risk heights. Activity was mostly located in the west of the 500 m survey buffer.

3.2.1.2 Common Kestrel

Nine flight lines of common kestrel were recorded during the flight activity surveys (Appendix D **Figure 2.3**). All flight lines consisted of a single flight. Eight flight lines were within collision risk heights. Activity was mostly outside the 500 m survey buffer.

3.2.1.3 Common Snipe

Thirteen flight lines of common snipe recorded across May, June and July (Appendix D **Figure 2.6**). Nearly half of these (n=6) included breeding behaviour (courtship display or movement to / from breeding sites). Activity was mostly located within the northwest part of the 500 m survey buffer.

3.2.1.4 Little Egret

Two flight lines of little egret were recorded in June (Appendix D **Figure 2.2**). Both flight lines consisted of a single flight and occurred at collision risk heights.

3.2.1.5 Mallard

Three flight lines of mallard were recorded across April, May and June (Appendix D **Figure 2.5**). Two flight lines occurred at collision risk heights.

3.2.1.6 Northern Lapwing

Seventeen flight lines of northern lapwing were recorded during the flight activity surveys (Appendix D **Figure 2.4**). Six flight lines included breeding behaviour (territorial / nest defending, courtship display, or to/from breeding sites). Activity was mostly to the west of the 500 m survey buffer and Project Site.

3.2.1.7 Teal

There were four flight lines of teal comprising a total of eight flights recorded in April (Appendix D **Figure 2.7**). All flight lines occurred at collision risk heights and were to the west of the Project Site.



3.2.2 Secondary Species

Secondary species activity at the Project Site is summarised in Table 3-4. Common buzzard was the most frequently recorded secondary species (recorded in 21 out of a possible 432 five-minute periods).

Table 3-4: Secondary Species Activity Summary

Species	Number of 5 min periods recorded	Peak count of birds recorded in any 5 min period	Comments
Common buzzard	21	2	Activity in all months except June within the Project Site, buffer & beyond
Common gull	5	8	Activity in July only within the Project Site and buffer.
Grey heron	15	2	Activity in all months within the Project Site, buffer & beyond
Herring gull	3	5	Activity in July only within the Project Site and buffer.
Lesser black-backed gull	2	4	Activity in April only within the Project Site and buffer.
Northern raven	4	2	Activity in July & August within the Project Site, buffer & beyond
Ringed plover	5	3	Activity in May and June within the Project Site

3.2.3 Incidental records of other species

Fallow deer *Dama dama* (Wildlife Act 1976, as amended) was frequently observed foraging within the Project Site.

3.3 Breeding Raptor Surveys

Three species of raptor were recorded during the breeding raptor surveys. The following species accounts provide summary details of the primary raptor species encountered during the 2023 surveys. The results of the breeding raptor survey, with the rVPs and species locations, can be found in Appendix D **Figure 3**.

3.3.1 Common kestrel

Common kestrel was observed in the lands surrounding Loughnane Quarry (c. 2 km of the extension area) on multiple occasions. No nest sites were identified within the quarry itself, but it is likely that a breeding territory exists within the lands surrounding it which are under third-party ownership. During flight activity surveys from VP2 (located 2 km southwest of the extension area and 2 km northwest of Loughnane Quarry), a flight line comprising of a



female and two juveniles was observed in July, confirming the presence of a breeding territory within the general area of the Project Site.

3.3.2 Peregrine falcon

A single bird was observed on the northeast quarry face within Loughnane Quarry c. 2 km south of the Project Site, during the first breeding raptor survey in April. During the VP surveys from VP2, an adult male and female were observed displaying courtship behaviour, which is indicative of probable breeding according to the criteria outlined by BTO. During the second breeding raptor survey, a possible nest site was observed within the quarry, but no birds were present. During subsequent visits, this possible nest site was no longer identifiable, and peregrine was not observed again.

3.3.3 Secondary target species

Common buzzard was frequently observed within the 2 km survey buffer. Two likely breeding territories was identified during the breeding raptor surveys at approx. ITM coordinates 608452, 709186 and 608266, 710201.

3.4 Breeding Wader Surveys

No wader nest sites were confirmed during the breeding wader surveys. However, two species of wader were confirmed as breeding and one as probably breeding within the Project Site during flight activity surveys, based on the criteria set out in Section 2.2.3.

Lapwing, ringed plover and common snipe were frequently observed displaying courtship behaviour on the bog in the northern section of the Project Site during the VP surveys.

On 23rd May, ringed plover was observed mating during a survey at VP3, at approximate ITM coordinates 607939, 711107, which is indicative of confirmed breeding.

Additionally, common snipe was observed foraging and displaying courtship behaviour in the grassland surrounding the met mast (wader transect to the west of the N62 road) during the April and June breeding wader surveys. On the 19th July, during the flight activity surveys, an adult and juvenile were observed on the bog by VP3 at approximate ITM coordinates 607895 711211 within suitable breeding habitat, confirming successful breeding of this species within the Project Site.

There were three observations of northern lapwing in the same area where breeding was recorded during previous breeding surveys. All were of birds present in suitable breeding habitats, which is indicative of probable breeding. A juvenile lapwing with two adults was recorded within the Project Site during a survey at VP3 in July. This area was c.350 m from the nearest turbine location.

3.5 Kingfisher Habitat Assessment

Four watercourses, split into six separate sections based on their distinguishing characteristics, within the Project Site were surveyed to determine their potential to support breeding kingfisher. The watercourses and their sections are presented in Appendix D **Figure 5**. Sections 1, 2, 5 and 6 overlap with the extension area.

No section was deemed suitable to support breeding kingfisher. No potential kingfisher nests were identified and there were no live sightings of kingfisher during the survey. Three sections (sections 1, 2 and 4) were deemed suitable for foraging, given the availability of perches. The findings of the survey are detailed in Table 3-5 below.



Table 3-5: Details of the Kingfisher Habitat Assessment

Section of Watercourse	Water Quality ¹⁹	River Flow ²⁰	Angle of Bank ²¹	Bank Substrate or Features ²²	Agriculture ²³	Availability of Perches ²⁴	Disturbance ²⁵	Section Suitable for foraging? (Y/N)	Section Suitable for nesting? (Y/N)	Nest notes	Kingfisher sighting notes
1	Clear	Slow	Steep	Wet earth	Improved	Lots	Regular disturbance	Y	N	-	-
2	Clear	Slow	Steep	Vegetated	Improved	Some	Regular disturbance	Y	N	-	-
3	Clear	Slow	Steep	Dry earth	Improved	No	Regular disturbance	N	N	-	-
4	Clear	Medium	Steep	Vegetated	Highly improved	Some	No	Y	N	-	-
5	Slightly silty	Slow	Vertical	Vegetated	Highly improved	Some	Slight	N	N	-	-
6	Silty	Slow	Vertical	Wet earth	Slightly improved	No	Slight	N	N	-	-

¹⁹ Clear, slightly silty, silty (but still can see the bottom), polluted.

²⁰ Slow, medium, rapid

²¹ Vertical (90° to water surface), steep (40-80° to water surface), gentle 20-40° to water surface), very slight (0-20° to water surface)

²² Loose earth, dry earth, wet earth, vegetated, gravel, stony, rock

²³ Not improved, slightly improved, improved, highly improved

²⁴ Lots of overhanging branches, some overhanging branches, no branches

²⁵ No disturbance, slight disturbance, anglers, regular disturbance



3.6 Barn Owl Breeding Surveys

There was no evidence of barn owls using any of the structures within the optioned lands for breeding. It is possible that they breed elsewhere outside the optioned lands, as they are known to forage up to 5 km from a nest site (Hardey et al., 2009). Similarly, the bird observed in 2022 may have simply been passing through the area, as evidence for territorial behaviour is weak (Hardey et al, 2009). This is reinforced further by the fact that no crepuscular activity of barn owl was observed during dusk wader surveys, where it might be expected that barn owl would be recorded as an incidental sighting, if present.



4.0 Summary and Conclusions

A range of ornithology surveys were carried out at the site of the proposed Cush Wind Farm during the 2023 breeding season. These were:

- Flight activity (VP) surveys;
- Breeding wader surveys;
- Breeding raptor surveys; and
- Kingfisher habitat assessment.

The following primary target species were recorded during flight activity surveys at VP3:

- Black-headed gull;
- Common kestrel;
- Common snipe;
- Little egret;
- Mallard;
- Northern lapwing; and
- Teal.

The most frequent flight activity was by northern lapwing (n=17), followed by common snipe (n=13), common kestrel (n=9) and black-headed gull (n=8). These species are likely to have the highest levels of collision risk during the breeding season.

Three species of waders were confirmed breeding within the Project Site: ringed plover, common snipe and northern lapwing.

Breeding raptor surveys recorded two primary target species and one secondary species:

- Common kestrel (suspected breeding territory within the 2 km buffer);
- Peregrine falcon (possible failed breeding attempt at Loughnane Quarry); and
- Common buzzard (two suspected breeding territories within 2 km buffer).

No suitable habitat for breeding kingfisher was identified within the Project Site although there is some suitability for foraging kingfisher present.

No evidence of breeding barn owl was identified during surveys, although it is acknowledged that it was not possible to survey every potential nest site within a 1 km buffer due to lack of access to third-party land.



5.0 Legal and Conservation Status of Target Species Recorded

Table 5-1 summarises the legal and conservation status of the target species recorded during the range of ornithology surveys mentioned above. All birds are protected by the Wildlife Acts 1976 (as amended) in Ireland.

Table 5-1: Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO Code)	Legal & Conservation Status in Ireland
Primary	Black-headed gull	BoCCI4 Amber
	Common kestrel (K.)	BoCCI4 Red
	Common snipe (SN)	BoCCI4 Red
	Little egret (ET)	Annex I; BoCCI4 Green
	Mallard (MA)	BoCCI4 Amber
	Northern lapwing (L.)	BoCCI4 Red
	Peregrine falcon (PE)	Annex I; BoCCI4 Green
	Teal (T.)	BoCCI4 Amber
Secondary	Common buzzard (BZ)	BoCCI4 Green
	Common gull (CM)	BoCCI4 Amber
	Eurasian sparrowhawk (SH)	BoCCI4 Green
	Grey heron	BoCCI4 Green
	Herring gull (HG)	BoCCI4 Amber
	Lesser black-backed gull (LB)	BoCCI4 Amber
	Northern raven (RN)	BoCCI4 Green
	Ringed plover (RP)	BoCCI4 Amber





Appendix A Survey Dates, Times and Surveyors²⁶

Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.065092.00001

21 August 2026

²⁶ Surveyors initials can be found in Section 0

Table A-3: Details of VP Surveys Undertaken from VP3

Date	Surveyor	Start	End	Survey Duration
27/04/2023	AK	12:45	15:45	03:00
28/04/2023	AK	06:00	09:00	03:00
18/05/2023	AK	15:15	18:15	03:00
23/05/2023	AK	13:30	16:30	03:00
13/06/2023	AK	19:00	22:00	03:00
20/06/2023	AK	18:00	21:00	03:00
29/08/2023	MJ	17:45	20:45	03:00
30/08/2023	MJ	06:15	09:15	03:00
13/07/2023	NV	13:40	16:40	03:00
18/07/2023	NV	04:55	07:55	03:00
19/07/2023	NV	10:20	13:20	03:00
20/07/2023	NV	19:15	22:15	03:00
Total Hours				36:00

Table A-2: Details of Breeding Raptor Surveys

Date	Surveyor	Start	End	Survey Duration
26/04/2023	AK	10:00	14:30	04:30
25/05/2023	AK	12:00	17:00	05:00
14/06/2023	AK	09:45	14:30	04:45
14/07/2023	KM	07:40	13:15	05:35
Total Hours				19:50

Table A-3: Details of Breeding Wader Surveys

Date	Type	Surveyor	Start	End	Survey Duration
25/04/2023	Wader east	AK	19:15	20:30	01:15
26/04/2023	Wader west	AK	19:00	20:00	01:00
23/05/2023	Wader	AK	19:50	20:30	00:40
14/06/2023	Wader	AK	20:05	21:40	01:35
Total Hours					04:30



Appendix B Weather Data

Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.065092.00001

21 August 2026

Table B-1: Weather Data Collected During Flight Activity Surveys Undertaken at VP3

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
27/04/2023	AK	12:45	15:45	1	2	SE	0	8	2	2	0	0	12
27/04/2023	AK	12:45	15:45	2	2	SE	0	8	2	2	0	0	12
27/04/2023	AK	12:45	15:45	3	2	SE	0	8	2	2	0	0	12
28/04/2023	AK	06:00	09:00	1	1	SW	1	8	0	1	0	0	11
28/04/2023	AK	06:00	09:00	2	1	SW	1	8	0	1	0	0	11
28/04/2023	AK	06:00	09:00	3	1	SW	0	8	1	2	0	0	11
18/05/2023	AK	15:15	18:15	1	2	SW	0	8	2	2	0	0	15
18/05/2023	AK	15:15	18:15	2	2	SW	2	8	2	2	0	0	15
18/05/2023	AK	15:15	18:15	3	2	SW	2	8	2	2	0	0	15
23/05/2023	AK	13:30	16:30	1	1	NW	0	3	2	2	0	0	15
23/05/2023	AK	13:30	16:30	2	1	NW	0	3	2	2	0	0	15

²⁷ Key: None = 0; Drizzle = 1; Light showers/snow = 2; Heavy showers/snow = 3; Heavy rain/snow = 4.

²⁸ Expressed in oktas (n/8)

²⁹ Key: Height of cloud above average height of viewshed. <150m = 0; 150-500m = 1; >500m = 2.

³⁰ Key: Poor (<1km) = 0; Moderate (1-3km) = 1; Good (>3km) = 2.

³¹ Key: Lying snow. None = 0; On site = 1; On higher ground = 2.

³² Key: None = 0; Ground = 1; All day = 2.



Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
23/05/2023	AK	13:30	16:30	3	1	NW	0	3	2	2	0	0	15
13/06/2023	AK	19:00	22:00	1	1	E	0	2	2	2	0	0	22
13/06/2023	AK	19:00	22:00	2	1	E	0	2	2	2	0	0	22
13/06/2023	AK	19:00	22:00	3	1	E	0	2	2	2	0	0	20
20/06/2023	AK	18:00	21:00	1	2	SW	2	7	2	2	0	0	18
20/06/2023	AK	18:00	21:00	2	2	SW	0	6	2	2	0	0	18
20/06/2023	AK	18:00	21:00	3	2	SW	0	6	2	2	0	0	18
29/08/2023	MJ	17:45	20:45	1	3	NW	1	8	2	2	0	0	16
29/08/2023	MJ	17:45	20:45	2	4	NW	0	8	2	2	0	0	15
29/08/2023	MJ	17:45	20:45	3	4	NW	0	7	2	2	0	0	15
30/08/2023	MJ	06:15	09:15	1	1	W	0	5	2	2	0	0	10
30/08/2023	MJ	06:15	09:15	2	1	W	0	6	2	2	0	0	10
30/08/2023	MJ	06:15	09:15	3	2	W	0	6	2	2	0	0	10
13/07/2023	NV	13:40	16:40	1	1	SW	0	6	1	2	0	0	18
13/07/2023	NV	13:40	16:40	2	2	SW	1	7	1	2	0	0	19
13/07/2023	NV	13:40	16:40	3	2	SW	0	7	1	2	0	0	18
18/07/2023	NV	04:55	07:55	1	2	SE	1	8	1	1	0	0	14
18/07/2023	NV	04:55	07:55	2	2	SE	1	8	1	1	0	0	14
18/07/2023	NV	04:55	07:55	3	1	SE	1	8	1	1	0	0	15
19/07/2023	NV	10:20	13:20	1	2	NW	0	3	2	2	0	0	17



Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
19/07/2023	NV	10:20	13:20	2	2	NW	0	2	2	2	0	0	18
19/07/2023	NV	10:20	13:20	3	2	NW	0	1	2	2	0	0	18
20/07/2023	NV	19:15	22:15	1	3	NW	0	3	2	2	0	0	17
20/07/2023	NV	19:15	22:15	2	2	NW	0	3	2	2	0	0	16
20/07/2023	NV	19:15	22:15	3	1	W	0	2	2	2	0	0	16

Table B-2: Weather Data Collected During Breeding Raptor Surveys

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
26/04/2023	AK	10:00	14:30	1	2	SE	0	4	2	2	0	0	11
26/04/2023	AK	10:00	14:30	2	2	SE	0	7	2	2	0	0	11
26/04/2023	AK	10:00	14:30	3	2	SE	0	7	2	2	0	0	11
26/04/2023	AK	10:00	14:30	4	2	SE	0	5	2	2	0	0	12
26/04/2023	AK	10:00	14:30	5	2	SE	0	5	2	2	0	0	12
25/05/2023	AK	12:00	17:00	1	2	N	0	6	2	2	0	0	19
25/05/2023	AK	12:00	17:00	2	2	N	0	6	2	2	0	0	19
25/05/2023	AK	12:00	17:00	3	2	N	0	4	2	2	0	0	20
25/05/2023	AK	12:00	17:00	4	2	N	0	3	2	2	0	0	20
25/05/2023	AK	12:00	17:00	5	2	N	0	3	2	2	0	0	20
14/06/2023	AK	09:45	14:30	1	1	E	0	4	2	2	0	0	24
14/06/2023	AK	09:45	14:30	2	1	E	0	4	2	2	0	0	24



Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
14/06/2023	AK	09:45	14:30	3	1	E	0	3	2	2	0	0	25
14/06/2023	AK	09:45	14:30	4	1	E	0	5	2	2	0	0	25
14/06/2023	AK	09:45	14:30	5	1	E	0	4	2	2	0	0	26
14/07/2023	KM	07:40	13:15	1	2	E	2	8	2	2	0	0	12
14/07/2023	KM	07:40	13:15	2	2	E	2	8	2	2	0	0	14
14/07/2023	KM	07:40	13:15	3	2	E	2	8	2	2	0	0	14
14/07/2023	KM	07:40	13:15	4	2	E	2	8	2	2	0	0	14
14/07/2023	KM	07:40	13:15	5	2	E	2	8	2	2	0	0	14

Table B-3: Weather Data Collected During Breeding Wader Surveys

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain ²⁷	Cloud Cover ²⁸	Cloud Height ²⁹	Visibility ³⁰	Snow ³¹	Frost ³²	Temp (°C)
25/04/2023	AK	19:15	20:30	1	2	SE	0	8	2	2	0	9	9
25/04/2023	AK	19:15	20:30	2	2	SE	0	8	2	2	0	9	9
26/04/2023	AK	19:00	20:00	1	2	SE	0	8	2	2	0	0	13
23/05/2023	AK	19:50	20:30	1	2	NW	0	2	2	2	0	0	17
14/06/2023	AK	20:05	21:40	1	2	SW	0	4	2	2	0	0	21
14/06/2023	AK	20:05	21:40	2	2	SW	0	4	2	2	0	0	21





Appendix C Flight Activity Survey Data³³

Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.065092.00001

21 August 2026

³³ The key to BTO Codes can be found in Section 5.0.

Primary Target Species

Table C-1: Primary Target Species Recorded During Flight Activity Surveys Undertaken at VP3

Date	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
27-Apr-23	3.CU007.1.1	BH	1	AD	U	12:56	60
27-Apr-23	3.CU007.2.1	K.	1	U	U	12:57	15
27-Apr-23	3.CU007.3.1	BH	8	AD	U	13:08	75
27-Apr-23	3.CU007.4.1	BH	5	AD	U	13:11	45
27-Apr-23	3.CU007.5.1	BH	4	AD	U	13:14	60
27-Apr-23	3.CU007.6.1	T.	2	AD	M&F	13:26	45
27-Apr-23	3.CU007.7.1	K.	1	U	U	13:39	180
27-Apr-23	3.CU007.8.1	BH	2	AD	U	13:41	60
28-Apr-23	3.CU008.1.1	T.	2	AD	M	06:46	60
28-Apr-23	3.CU008.2.1	T.	3	AD	2M & 1F	07:28	60
28-Apr-23	3.CU008.3.1	L.	1	AD	U	07:35	45
28-Apr-23	3.CU008.4.1	MA	1	AD	M	07:37	45
28-Apr-23	3.CU008.5.1	L.	1	AD	U	07:43	30
28-Apr-23	3.CU008.6.1	T.	1	AD	M	08:03	45
18-May-23	3.CU012.1.1	K.	1	AD	F	15:47	225
18-May-23	3.CU012.2.1	K.	1	AD	F	16:21	240
18-May-23	3.CU012.3.1	L.	1	U	U	16:23	75
18-May-23	3.CU012.4.1	SN	2	U	U	16:23	45
18-May-23	3.CU012.5.1	SN	1	AD	U	16:27	525
18-May-23	3.CU012.6.1	K.	1	AD	M	17:08	150
18-May-23	3.CU012.7.1	MA	3	AD	2M 1F	17:18	60
23-May-23	3.CU015.1.1	L.	1	AD	U	14:44	75
23-May-23	3.CU015.3.1	L.	2	AD	U	16:13	45
13-Jun-23	3.CU019.1.1	L.	1	AD	U	19:04	60
13-Jun-23	3.CU019.2.1	L.	1	AD	U	19:11	15
13-Jun-23	3.CU019.3.1	SN	1	AD	U	19:13	45
13-Jun-23	3.CU019.4.1	SN	1	AD	U	19:23	15
13-Jun-23	3.CU019.5.1	SN	2	AD	U	19:27	15
13-Jun-23	3.CU019.6.1	ET	1	AD	U	19:32	60
13-Jun-23	3.CU019.7.1	L.	2	AD	U	19:35	105



Date	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
13-Jun-23	3.CU019.8.1	L.	1	AD	U	19:50	30
13-Jun-23	3.CU019.9.1	L.	1	AD	U	19:55	45
13-Jun-23	3.CU019.11.1	L.	1	AD	U	20:28	30
13-Jun-23	3.CU019.12.1	ET	1	AD	U	20:56	60
20-Jun-23	3.CU024.2.1	SN	1	AD	U	18:34	75
20-Jun-23	3.CU024.3.1	SN	1	AD	U	18:37	105
20-Jun-23	3.CU024.4.1	SN	1	U	U	18:41	90
20-Jun-23	3.CU024.5.1	SN	2	U	U	18:45	15
20-Jun-23	3.CU024.7.1	SN	1	AD	U	18:54	15
20-Jun-23	3.CU024.8.1	SN	1	AD	U	18:56	15
20-Jun-23	3.CU024.9.1	SN	1	AD	U	19:47	60
20-Jun-23	3.CU024.10.1	MA	2	AD	F	19:54	45
20-Jun-23	3.CU024.11.1	BH	1	AD	U	20:13	75
20-Jun-23	3.CU024.12.1	BH	1	AD	U	20:33	75
20-Jun-23	3.CU024.13.1	BH	1	AD	U	20:39	75
20-Jun-23	3.CU024.14.1	L.	1	AD	U	20:49	15
30-Aug-23	3.CU033.1.1	L.	4	AD	U	07:27	30
30-Aug-23	3.CU033.2.1	L.	4	AD	U	07:33	45
18-Jul-23	3.CU043.1.1	L.	1	AD	U	06:41	105
18-Jul-23	3.CU043.2.1	L.	1	AD	U	07:26	60
18-Jul-23	3.CU043.3.1	K.	1	AD	U	07:43	90
19-Jul-23	3.CU044.1.1	K.	1	AD	M	10:38	210
19-Jul-23	3.CU044.2.1	L.	1	AD	U	11:14	60
20-Jul-23	3.CU045.1.1	K.	1	AD	F	20:31	120
20-Jul-23	3.CU045.2.1	SN	2	AD	F	20:56	60
20-Jul-23	3.CU045.3.1	K.	1	AD	F	21:11	150



Secondary Target Species

**Table C-6: Secondary Target Species Recorded During Flight Activity Surveys
Undertaken at VP3**

Date	Survey Start	Survey End	5 min period	BTO Code	Count
27/04/2023	12:45	15:45	13:25	BZ	1
27/04/2023	12:45	15:45	13:50	LB	4
27/04/2023	12:45	15:45	14:10	BZ	1
27/04/2023	12:45	15:45	14:50	H.	1
27/04/2023	12:45	15:45	14:55	BZ	2
27/04/2023	12:45	15:45	15:05	BZ	1
28/04/2023	06:00	09:00	06:55	H.	1
28/04/2023	06:00	09:00	07:45	LB	1
28/04/2023	06:00	09:00	07:50	H.	1
28/04/2023	06:00	09:00	08:25	H.	1
18/05/2023	15:15	18:15	15:15	H.	1
18/05/2023	15:15	18:15	15:35	H.	2
18/05/2023	15:15	18:15	15:55	H.	1
18/05/2023	15:15	18:15	16:40	BZ	1
18/05/2023	15:15	18:15	17:25	H.	1
23/05/2023	13:30	16:30	14:35	BZ	2
23/05/2023	13:30	16:30	14:50	BZ	2
23/05/2023	13:30	16:30	14:55	RP	3
23/05/2023	13:30	16:30	15:20	BZ	1
23/05/2023	13:30	16:30	15:30	BZ	1
23/05/2023	13:30	16:30	15:40	BZ	1
23/05/2023	13:30	16:30	15:50	BZ	1
23/05/2023	13:30	16:30	15:55	BZ	1
23/05/2023	13:30	16:30	16:00	BZ	2
23/05/2023	13:30	16:30	16:05	BZ	1
23/05/2023	13:30	16:30	16:10	RP	1
13/06/2023	19:00	22:00	19:15	H.	1
13/06/2023	19:00	22:00	20:18	RP	2
20/06/2023	18:00	21:00	18:18	RP	3
20/06/2023	18:00	21:00	18:50	RP	1
29/08/2023	17:45	20:45	17:50	RN	2
29/08/2023	17:45	20:45	18:10	H.	1
29/08/2023	17:45	20:45	19:35	H.	1



Date	Survey Start	Survey End	5 min period	BTO Code	Count
30/08/2023	06:15	09:15	06:15	BZ	1
30/08/2023	06:15	09:15	07:20	RN	2
30/08/2023	06:15	09:15	08:35	H.	1
13/07/2023	13:40	16:40	13:40	BZ	1
13/07/2023	13:40	16:40	14:20	RN	2
18/07/2023	04:55	07:55	05:20	CM	6
18/07/2023	04:55	07:55	05:20	HG	3
18/07/2023	04:55	07:55	06:05	CM	2
18/07/2023	04:55	07:55	06:05	BH	4
18/07/2023	04:55	07:55	06:25	H.	1
18/07/2023	04:55	07:55	06:55	BZ	1
18/07/2023	04:55	07:55	07:15	HG	3
18/07/2023	04:55	07:55	07:15	CM	4
19/07/2023	10:20	13:20	10:55	H.	1
19/07/2023	10:20	13:20	12:05	BZ	2
19/07/2023	10:20	13:20	12:10	BZ	2
19/07/2023	10:20	13:20	12:30	RN	1
19/07/2023	10:20	13:20	12:45	H.	1
20/07/2023	19:15	22:15	20:20	BZ	1
20/07/2023	19:15	22:15	20:25	BZ	1
20/07/2023	19:15	22:15	21:30	CM	6
20/07/2023	19:15	22:15	21:35	CM	8
20/07/2023	19:15	22:15	21:35	HG	5





Appendix D Figures

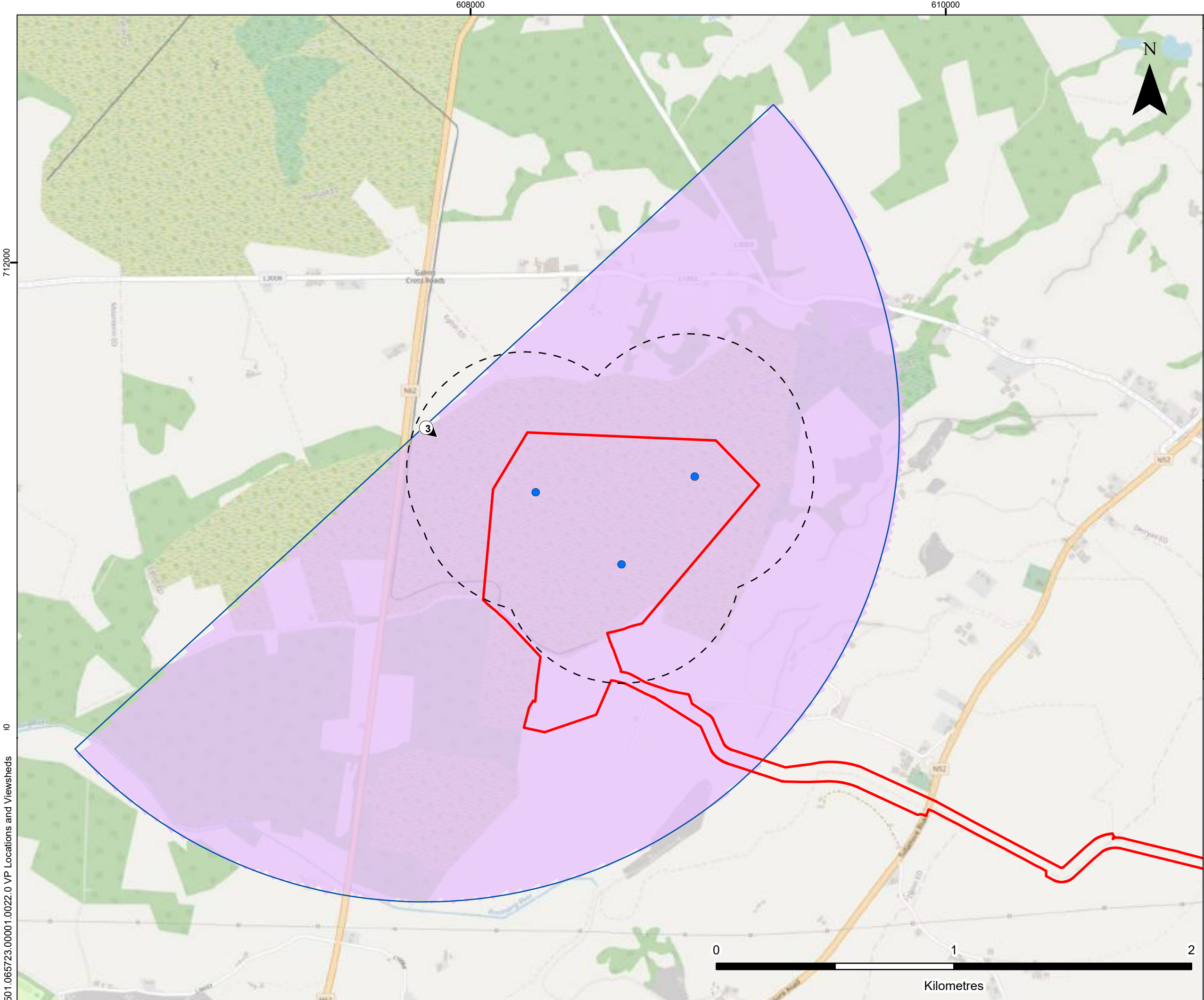
Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.065092.00001

21 August 2026



- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Vantage Point (VP) Location
- Vantage Point 2 km Viewing Arc
- Theoretical Visibility from VP3

Note: The ZTV is calculated with a surface offset of 28m and from a viewing height of 1.8m above ground level. The terrain model is derived from EU-DEM data with a vertical accuracy of $\pm 7m$. The ZTV was calculated using ArcMAP 10.5.1 software.



7 DUNDRUM BUSINESS PARK
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CUSH WIND FARM
WINTER BIRD SURVEYS
VANTAGE POINTS AND VIEWSHEDS

FIGURE 1

Scale 1:15,000 @ A3 Date AUGUST 2026





LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Little Egret



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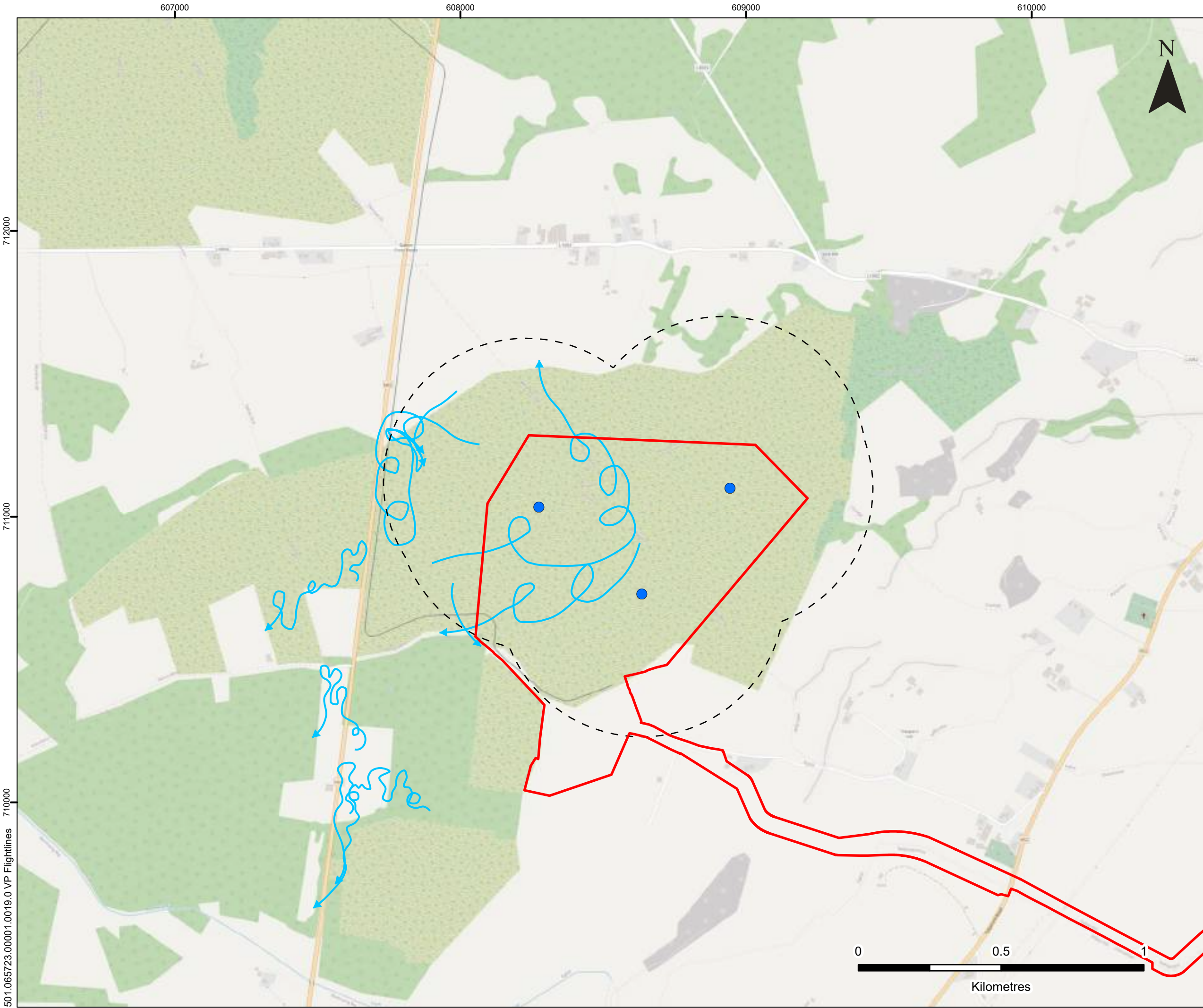
CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
LITTLE EGRET**

FIGURE 2.2

Scale 1:12,500 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location
- Species Flightline**
- Kestrel



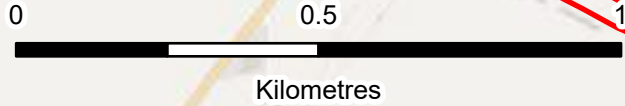
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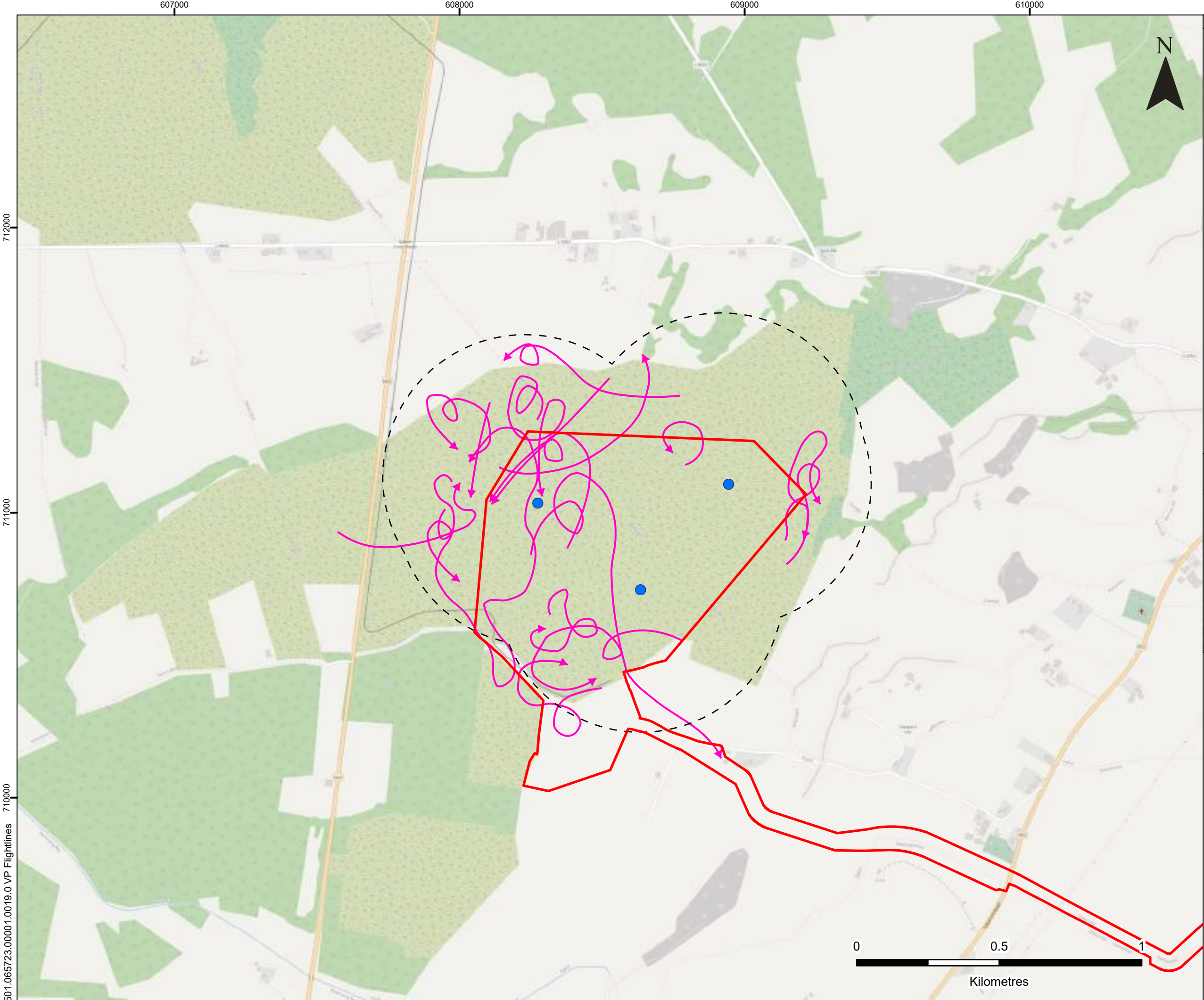
CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
KESTREL**

FIGURE 2.3

Scale 1:12,500 @ A3	Date AUGUST 2026
------------------------	---------------------





LEGEND

Site Boundary

Site Infrastructure 500 m Buffer

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CUSH WIND FARM

BIRD SURVEY REPORT
BREEDING SEASON 2023

VANTAGE POINT FLIGHTLINES
LAPWIND

FIGURE 2.4

Scale 1:12,500 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Mallard



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BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
MALLARD**

FIGURE 2.5

Scale 1:12,500 @ A3	Date AUGUST 2026
------------------------	---------------------

607000

608000

609000

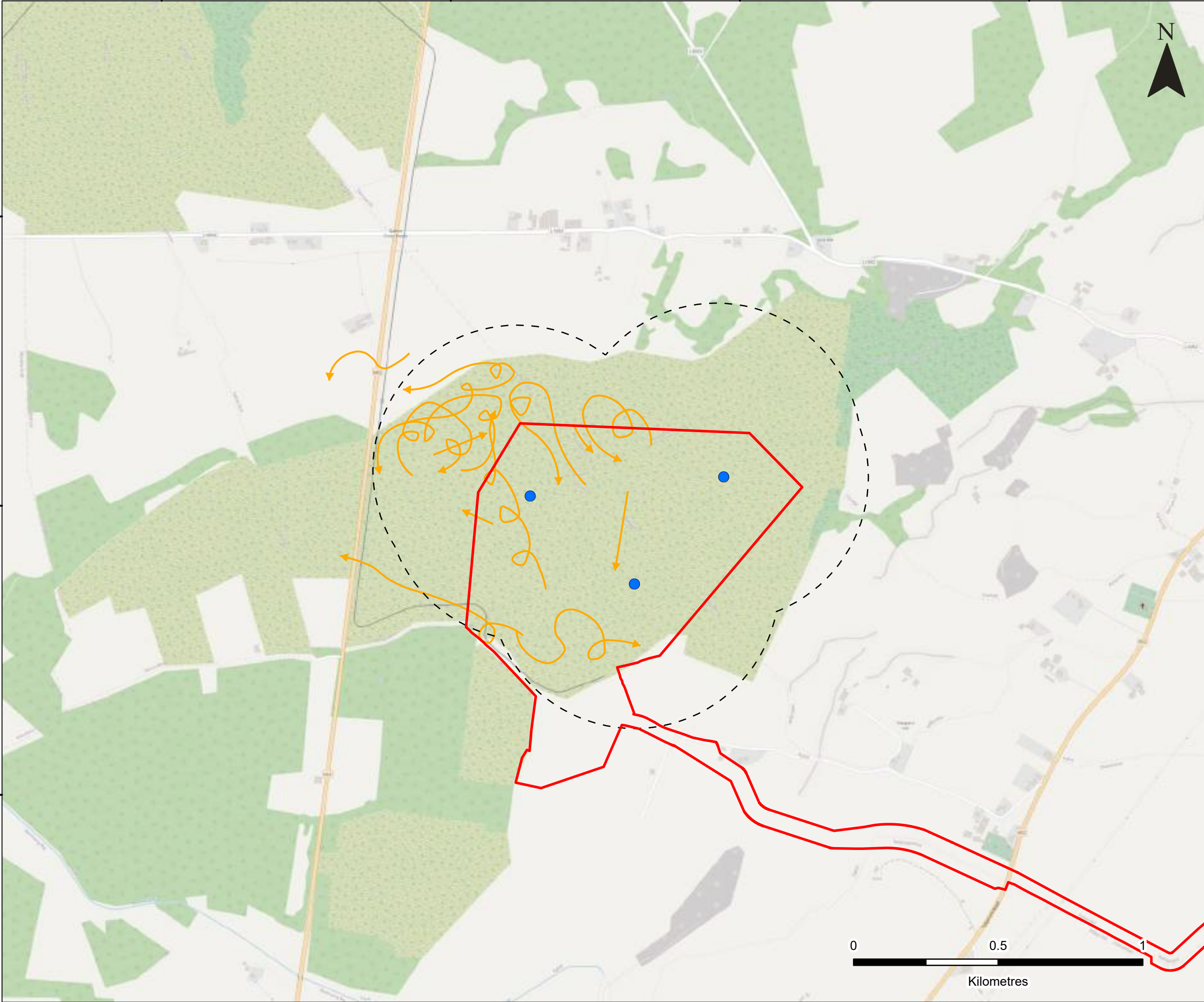
610000

712000

711000

710000

501.065723.00001.0019.0 VP Flightlines



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location
- Species Flightline**
 - Snipe



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BREEDING SEASON 2023

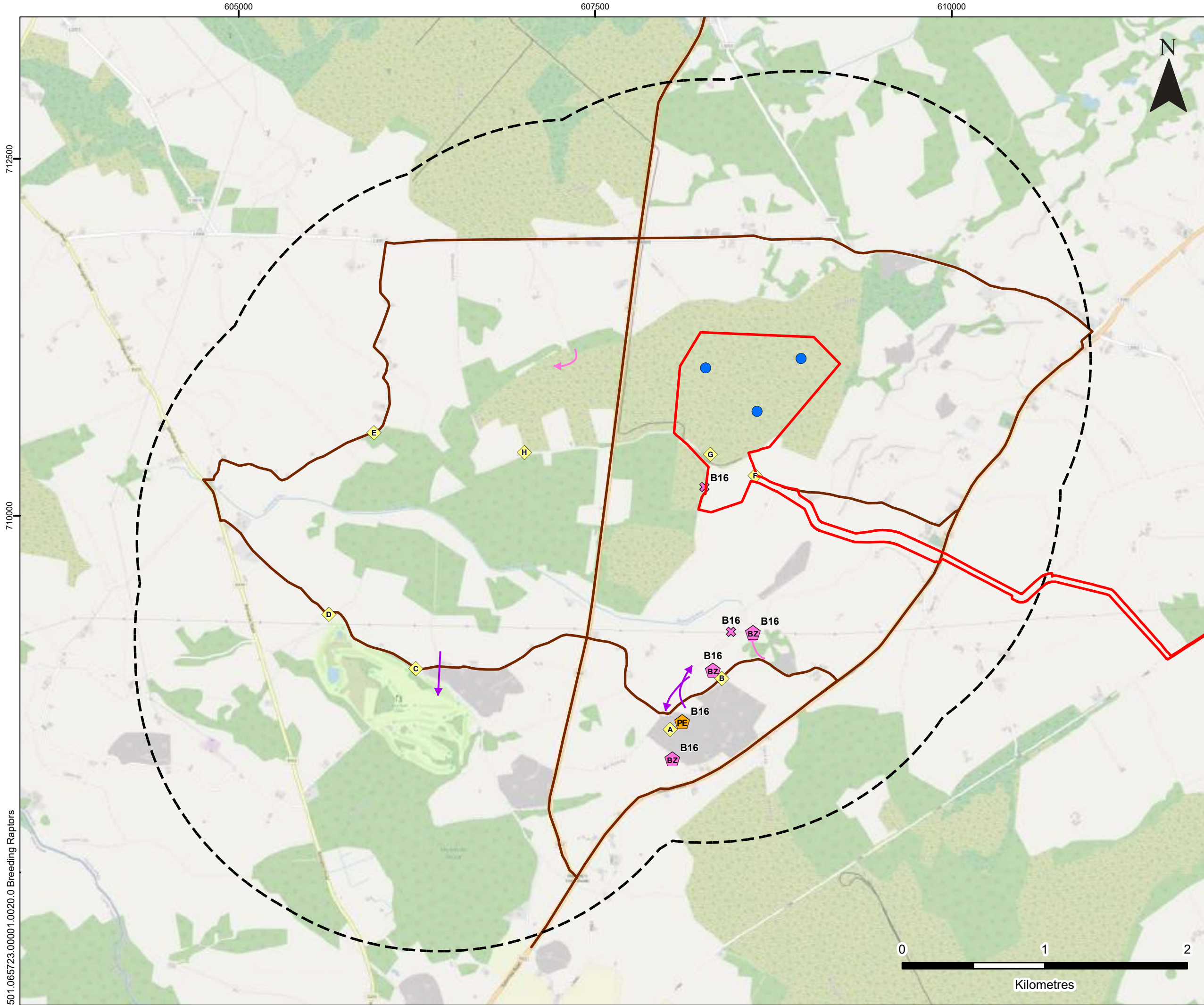
VANTAGE POINT FLIGHTLINES
SNIPE

FIGURE 2.6

Scale 1:12,500 @ A3

Date AUGUST 2026





LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 2 km Buffer
- Turbine Location
- Raptor Vantage Point (rVP)
- Driven Transect Route
- Raptor Record (Labelled with Behaviour Code)
 - BZ Buzzard
 - BZ Buzzard Breeding Territory
 - PE Peregrine
- Raptor Flightline
 - Buzzard
 - Kestrel

Breeding Raptor Behaviour Codes:
B16 - Present in Suitable Habitat

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CUSH WIND FARM

BIRD SURVEY REPORT
BREEDING SEASON 2023

BREEDING RAPTORS

FIGURE 3

Scale 1:25,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 500 m Buffer
- Turbine Location
- Walked Transect Route

Wader Species Record (Labelled with Behaviour Code)

- Lapwing
- Ringed Plover
- Snipe

Breeding Wader Behaviour Codes:
B2 - Courtship or Display Behaviour Seen, Including Copulation
B16 - Present in Suitable Habitat

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BIRD SURVEY REPORT
BREEDING SEASON 2023

BREEDING WADERS

FIGURE 4

Scale
1:12,500 @ A3

Date
JULY 2026



LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 500 m Buffer
- Turbine Location
- Kingfisher River Surveyed (Labelled with Section)



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BIRD SURVEY REPORT
BREEDING SEASON 2023

KINGFISHER SURVEY RESULTS

FIGURE 5

Scale 1:12,500 @ A3 Date AUGUST 2026



Appendix E Species Records

Bird Survey Report Breeding Season 2023

Cush Wind Farm

Galetech Energy Developments Ltd

SLR Project No.: 501.065092.00001

21 August 2026

The NBDC database was searched for records of bird species within the 10 km grid squares which overlap the Project Site (N00 and N01). All bird species are protected under the Wildlife Acts (1976, as amended) but for the purposes of this report, only records of species that are Red or Amber-listed in Birds of Conservation Concern in Ireland or listed under Annex I of the Birds Directive are included in the results. Only records within the last 10 years are considered within this report as older records are unlikely to be relevant. Details of the results are shown in Table E-1 .

Table E-1: Species recorded within the 10 km grid squares N00 and N01 (Species Present During the Breeding Season)

Species name	Season	Grid square	Last Record Year	Designation
Barn owl	Breeding	N01	2019	BoCCI4 Red
Black-headed gull	Breeding and wintering	N01	2022	BoCCI4 Amber
Common gull <i>Larus canus</i>	Breeding and wintering	N00	2019	BoCCI4 Amber
Common kestrel	Breeding	N00, N01	2023	BoCCI4 Red
Common kingfisher	Breeding	N00, N01	2022	Annex 1, BoCCI4 Amber
Common linnet <i>Linaria cannabina</i>	Breeding	N00, N01	2019	BoCCI4 Amber
Common pochard <i>Aythya ferrina</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Common redshank	Breeding and wintering	N00	2019	BoCCI4 Red
Common snipe	Breeding and wintering	N01	2022	BoCCI4 Red
Common starling <i>Sturnus vulgaris</i>	Breeding	N00, N01	2019	BoCCI4 Amber
Dunlin <i>Calidris alpina</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Eurasian curlew	Breeding and wintering	N01	2019	BoCCI4 Red
Eurasian skylark <i>Alauda arvensis</i>	Breeding	N01	2019	BoCCI4 Amber
Eurasian teal	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
Eurasian wigeon	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
European golden plover	Breeding and wintering	N01	2019	Annex 1, BoCCI4 Red
Gadwall <i>Mareca strepera</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
Hen harrier	Breeding	N01	2014	BoCCI4 Amber
House sparrow <i>Passer domesticus</i>	Breeding	N00, N01	2022	BoCCI4 Amber



Species name	Season	Grid square	Last Record Year	Designation
Little egret	Breeding and wintering	N00	2020	Annex 1, BoCCI4 Green
Mallard	Breeding and wintering	N00, N01	2023	BoCCI4 Amber
Meadow pipit <i>Anthus pratensis</i>	Breeding	N00, N01	2019	BoCCI4 Red
Merlin	Breeding	N01	2017	Annex 1, BoCCI4 Amber
Mute swan <i>Cygnus olor</i>	Breeding and wintering	N00, N01	2022	BoCCI4 Amber
Northern lapwing	Breeding and wintering	N00, N01	2022	BoCCI4 Red
Northern shoveler	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Peregrine falcon	Breeding	N00, N01	2023	Annex 1, BoCCI4 Green
Tufted duck	Breeding and wintering	N01	2018	BoCCI4 Amber
Willow warbler <i>Phylloscopus trochilus</i>	Breeding	N00, N01	2019	BoCCI4 Amber
Yellowhammer	Breeding	N00, N01	2021	BoCCI4 Red
Key	<p>Season – indicates which season was assessed for each species under the Birds of Conservation Concern in Ireland³⁴;</p> <p>Annex 1 – the species is listed in Annex 1 of the EC Birds Directive; and</p> <p>BoCCI4 status (green, amber or red) – indicates the current Birds of Conservation Concern in Ireland status category.</p>			

³⁴ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22







Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

Clondargan, Stradone, Co. Cavan

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14 N2Y7

SLR Project No.: 501.065092.00001

Client Reference No: N/A

21 August 2026

Revision: 0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	21 August 2026	Aisling Kinsella	Dr Jonathon Dunn	Dr Jonathon Dunn

Basis of Report

This document has been prepared by SLR Environmental Consulting (Ireland) Ltd (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Cush Wind Farm Ltd (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

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Acronyms and Abbreviations

AA	Appropriate Assessment
BoCCI	Birds of Conservation Concern Ireland
CIEEM	Chartered Institute of Ecology and Environmental Management
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
GIS	Geospatial Information Systems
NBDC	National Biodiversity Data Centre
NHA	Natural Heritage Area
NS	NatureScot
NPWS	National Parks and Wildlife Service
pNHA	proposed Natural Heritage Area
The Project	Cush Wind Farm
The Project Site	The application site
SNH	Scottish Natural Heritage
SPA	Special Protection Area
VP	Vantage Point
ZTV	Zones of Theoretical Visibility



1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd (SLR) was commissioned by Cush Wind Farm Ltd to carry out a bird survey programme for an extension area (hereafter 'the Project') at a proposed wind farm at Cush, Co. Offaly during the non-breeding season 2023/24. The purpose of this report is to describe these surveys and the resulting ornithological baseline.

1.1 Background to the Commission

No previous planning permission has been sought on the application site for the development of wind farms by Cush Wind Farm Ltd or any other party.

Bird surveys have been previously undertaken at the proposed wind farm development site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR for the breeding 2020, non-breeding 2020/21, breeding 2021, non-breeding 2021/22, breeding 2022, non-breeding 2022/23 and breeding 2023 seasons. These surveys targeted a larger survey area than for the current season.

This larger area also included a linear area that was previously surveyed for a proposed overhead line¹. Flight activity surveys were carried out at two vantage point locations along the proposed overhead line route corridor during the breeding season in 2018.

1.2 Site Description

The Project Site is in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946 (refer to **Appendix D Figure 1**). The habitats within the Project Site are dominated by conifer plantations of varying age classes (c.327 ha), cutaway bog (c.102 ha) and agricultural grasslands (ca. 327 ha). The Project Site is not designated for nature conservation.

1.3 Terminology

For this report, "flight line" refers to the line drawn to record avian movement during a Vantage Point (VP) survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as "a flight". Note that the "cumulative number of flights" reflects the occupancy of the study area by a particular species. It is not equivalent to the total number of unique individuals and should not be used to infer abundance.

1.4 Purpose of the Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The assessment of impacts resulting from the proposed development and the development of mitigation measures, if required, are beyond the scope of this report and are covered in a separate Environmental Impact Assessment (EIA) report and Natura Impact Statement (NIS).

1.5 Relevant Legislation

Legislation relevant to this report includes the EC Birds Directives and the Wildlife Act (1976, as amended). Birds listed under Annex I of the Birds Directive are described in Section 5.0

¹ SLR (2018) *Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018*. Prepared for Galetch Energy Services Ltd



and are afforded strict protection at the European and national level. All Irish birds are protected by the Wildlife Act.



2.0 Methodology

2.1 Scope of Work

The scope of survey work during the non-breeding season was based on knowledge of the Project Site acquired during the previous bird surveys, a desk-based review and access to lands within and surrounding the red line boundary. It also considered current NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance². The details of the scope of work are provided in Table 2-1. Further details are provided in sections 2.3 to 2.5, including study areas and target species.

Table 2-1: Scope of Ornithological Work October 2023-March 2024

Survey Type	Summary Methodology
Vantage Point (VP) Surveys	Thirty-six hours of surveys (spread out as evenly as possible across the survey period) were carried out from a single VP between October 2023 and March 2024 inclusive.
Feeding Distribution Surveys	Feeding distribution surveys were carried out on a twice-monthly basis to search for swans and/or geese using the fields for foraging within 500 m of the Project Site.

NS guidance states that “*it is generally considered the passerine species are not significantly impacted by wind farms*”. It goes on to state that “*survey of woodland passerines, especially in commercial conifer forest is generally not required*”. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that passerines red-listed under the latest Birds of Conservation Concern in Ireland (BoCCI) scheme³ should be considered as equivalent. No such species were returned during the desk-based review or data request. NS guidance also states that “*surveys of farmland passerines especially on more intensive arable habitat are generally not required*”. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

2.2 Desk-based Review

The desk review collated any available information to date on the breeding and non-breeding bird populations and movements around the Project Site.

The following reports resulting from previous breeding and non-breeding bird surveys were reviewed for any relevant information that could be used to inform the current bird surveys:

- SLR (2018) Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018;
- SLR (2020) Cush Wind Farm Breeding Bird Survey Report 2020;
- SLR (2022) Cush Wind Farm Winter Bird Survey Report 2020-2021;
- SLR (2022) Cush Wind Farm Breeding and Winter Bird Survey Report 2021-2022;
- SLR (2022) Cush Wind Farm Breeding Bird Survey Report 2022; and
- SLR (2023a) Cush Wind Farm Non-Breeding Bird Survey Report 2022-2023; and

² Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

³ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. *Irish Birds* 43: 1–22



- SLR (2023b) Cush Wind Farm Breeding Bird Survey Report 2023.

The websites of the National Parks and Wildlife Service (NPWS)⁴, the UK and Ireland Bird Atlas 2007-2011⁵ and the National Biodiversity Data Centre (NBDC)⁶ were also accessed for information on sites designated for nature conservation in the vicinity of the Project Site.

2.3 Flight Activity Surveys

A single VP location ("VP 3") was used for the current suite of surveys. The name reflects the fact that three VP locations were used from the start of the 2022 breeding season to survey a bigger area than currently considered here.

The adequacy of this VP was checked by carrying out a desk-based viewshed analysis using a bespoke GIS tool for calculating the visible area from the VP. The Zone of Theoretical Visibility (ZTV) from the VP was calculated using ArcMAP 10.5.1 Spatial Analyst using a terrain model derived from EU-DEM data with a vertical accuracy of ± 7 m. The ZTV was calculated with a surface offset of 28 m and is based on a viewing height of 1.8 m above ground level. The VP, viewshed and viewing arc is shown in **Appendix D Figure 1**.

Six hours of watches were undertaken at VP3 per month (October-March), culminating in a total of 36 hours of watches during the survey period. Survey start times ranged from 07:50 to 15:10 (with the latest survey finishing at 18:10).

Full details of survey dates, times and observers are provided in **Appendix A** and details of weather conditions during the surveys are provided in **Appendix B**.

VP watches aimed to quantify the flight activity of primary and secondary target species (as defined below) within the study area.

The main purpose of VP watches is to collect data on primary target species that will enable estimates to be made of:

- The time spent flying over the Project Site;
- The relative use by birds of different parts of the Project Site;
- The proportion of flying time spent within the provisional upper and lower risk height limits as determined by the potential rotor diameter and rotor hub height; and
- Ultimately, the analysis of the potential risk of collision of birds with rotating turbines.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying bout;
- Species, age and sex (where determinable);
- Number of birds observed;
- Time spent within each height band and;
- Notes on observation.

Recording height bands were determined based on the likely turbine specifications under consideration at the time of survey (upper tip height 200 m and lower tip height 28 m). Flight heights were attributed to four distinct height bands as follows:

⁴ www.npws.ie (last accessed April 2024)

⁵ <https://app.bto.org/mapstore/StoreServlet> (last accessed April 2024)

⁶ <http://maps.biodiversityireland.ie/#/Map> (last accessed April 2024)



- 1 = < 20 m (below the likely rotor swept area);
- 2 = 20 m to 150 m (potentially within the likely rotor swept area, at least in part);
- 3 = 150 m to 200 m (potentially within the likely rotor swept area);
- 4 = >200 m (above the likely rotor swept area).

In addition, a summary of observations of secondary target species was recorded at the end of each five-minute period during each VP watch to provide an index of flight activity for secondary target species within the Project Site, in accordance with current NS guidance. Data collected on secondary species included:

- The five-minute period start and end time;
- Species;
- Number of birds observed;
- If flying, the height band in which birds were observed flying;
- Whether birds were observed onsite, in the 500 m buffer or beyond;
- Flight behaviour; and
- Notes on observation.

Target Species

Target species for the surveys were defined by legal and/or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS guidance.

2.3.1 Primary Target Species

The list of primary target species was limited to species upon which effects are most likely to be potentially significant in EIA and Appropriate Assessment (AA) terms e.g., species forming qualifying features for nearby Special Protection Areas (SPAs) or species listed on Annex I of the Birds Directive⁷. This enabled recording to focus on the species of greatest importance without the distraction of having to record detailed flight data for a larger number of more common species.

Primary target species included the following bird species:

- All Annex I raptor/owl species;
- Qualifying interest species for nearby SPAs⁸; and
- Other raptors, waders or wildfowl red-listed on the latest Birds of Conservation Concern in Ireland (BoCCI)³ scheme.

2.3.2 Secondary Species

Local circumstances may indicate that survey information should also be acquired on other species, especially those of regional conservation concern. Such species are termed secondary species. Recording of secondary species is subsidiary to recording of primary target species.

Secondary species included:

⁷ Annex I of the Birds Directive (Directive 2009/147/EC)

⁸ The relevant SPAs are listed in Section 3.1.



- Any other wildfowl and wader species that are not primary species;
- All gull species that are not primary species;
- Common buzzard *Buteo buteo*;
- Eurasian sparrowhawk *Accipiter nisus*;
- Northern raven *Corvus corax*;
- Grey heron *Ardea cinerea*; and
- Great cormorant *Phalacrocorax carbo*.

2.4 Feeding Distribution Surveys

NS guidance recommends that for whooper swan *Cygnus cygnus*, Greenland white-fronted goose *Anser albifrons flavirostris* and other geese species, feeding distribution surveys should be undertaken in areas of suitable habitat when the survey area lies within the core foraging distance of SPAs or other major roosts for these species, unless it can be established from existing data that the area is not utilised for feeding. As there are SPAs for swans and geese located close to the Project Site, feeding distribution surveys were undertaken.

A buffer of at least 500 m around the Project Site was used for these surveys, which were undertaken by driven transects twice per month, stopping on a regular basis to check all fields for goose and swan feeding activity. The driven transect also covered areas beyond 500 m from the Project Site to inform the locations of other potential Project infrastructure. All areas within the Project Site were visible from the driven transect.

Full details of survey dates, times and observers are provided in **Appendix A**, details of weather conditions during the surveys are provided in **Appendix B** and the transect route is shown in **Appendix D Figure 3.1**.

2.5 Survey Limitations

Most flight activity surveys were undertaken in optimal weather conditions. However, during the winter period it is inevitable that some surveys were completed in suboptimal conditions. There were 9 hours out of the total of 36 during which the visibility was recorded as “moderate”, i.e. 1-3 km. This comprises 25% of the total survey effort but in almost all cases all the relevant 2 km viewing arc was visible.

2.6 Project Team

Details of the project team are described below with those involved in field surveys only described in Section 2.6.1.

Dr Jonathon Dunn (JD) MA (Cantab.) MSc PhD MCIEEM – Project Manager, Technical Reviewer & Approver

Jonathon is an Associate Ecologist with SLR and holds an MA (Cantab.) in Zoology from Homerton College, Cambridge, an MSc in Ecology, Evolution and Conservation from Imperial College London, and a PhD in avian ecology from Newcastle University. He is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and has worked in the environmental sector since 2014. He has experience as a project manager on many wind farm developments throughout Ireland. Jonathon conducted the technical review and approvals of this report.



Aisling Kinsella (AK) BSc (Hons) MSc – Project Manager and Report Author

Aisling is a Senior Ecologist with SLR and holds a BSc in Zoology from University College Cork and an MSc in Wildlife Management and Conservation from University College Dublin. Aisling has three years' experience with breeding and non-breeding bird surveys (vantage point surveys, breeding wader and raptor surveys, winter feeding and distribution surveys, goose roost and winter hen harrier *Circus cyaneus* surveys). She is also involved with project management, report writing and technical reviews, survey scheduling and training new staff in bird survey work. Aisling assisted Jonathon as project manager for Cush Wind Farm and she is the author of this report.

2.6.1 Field Survey Team

Darragh Nagle – Project Ecologist

Darragh graduated from University College Cork in 2020 with a BSc degree in Ecology and Environmental Ecology. Since joining SLR Darragh's field experience includes multiple bird surveys on windfarm sites across Ireland with experience in VP, breeding wader, breeding raptor, feeding distribution, hen harrier roost and intertidal bird surveys. Darragh is a qualifying member of CIEEM.

Hugo Brooks (HB) – Graduate Ecologist

Hugo is a Graduate Ecologist with SLR. Hugo has a BSc (Hons) in Zoology from University College Dublin. Hugo's first professional role in ecology was as a temporary consultant ecologist with Scott Cawley Ltd. (March – October 2022), where he gained experience in bat surveys, bat call analysis and breeding bird surveys. Since joining SLR, Hugo has worked on multiple renewable energy projects. He has carried out various bird surveys including vantage point, breeding wader, breeding raptor, hen harrier, swan and goose feeding/distribution and intertidal surveys. Hugo has also gained experience in bat transect surveys, bat roost potential surveys and general walkover habitat surveys.

Michael James (MJ) – Graduate Ecologist

Michael is a Graduate Ecologist with SLR. Michael holds a BA (Hons) in Zoology from Trinity College Dublin. Since starting at SLR, Michael has been involved in various surveys. These include bird surveys (vantage point and breeding raptor) and bat transects for wind farms. He has also conducted bat emergence surveys and habitat surveys for other projects.

(Ray Browne) – Subcontractor

Ray is an experienced bird surveyor who has worked on multiple wind farm projects in Ireland.



3.0 Results

3.1 Desk-based Review

3.1.1 Species Records

Species records collated via desk-based review are shown in **Appendix E**.

3.1.2 Natura 2000 Sites

The Project Site is not within or immediately adjacent to any SPA. However, there are a total of seven SPAs within a 20 km⁹ radius with details shown in **Table 3-1**.

Table 3-1: SPAs within 20 km of the Project Site and their Qualifying Interests

Site Name	Site Code	Distance/Direction from Site Boundary	Qualifying Interest Species Relevant to the Non-Breeding Season
Dovegrove Callows SPA	004137	1.5 km southwest	<ul style="list-style-type: none"> Greenland white-fronted goose
All Saints Bog SPA	004103	3.1 km west	<ul style="list-style-type: none"> Greenland white-fronted goose
River Little Brosna Callows SPA	004086	3.1 km west	<ul style="list-style-type: none"> Whooper swan Wigeon <i>Anas penelope</i> Teal <i>Anas crecca</i> Pintail <i>Anas acuta</i> Shoveler <i>Anas clypeata</i> Golden plover <i>Pluvialis apricaria</i> Lapwing <i>Vanellus vanellus</i> Black-tailed godwit <i>Limosa limosa</i> Black-headed gull <i>Chroicocephalus ridibundus</i> Greenland white-fronted goose
Middle Shannon Callows SPA	004096	6.6 km northwest	<ul style="list-style-type: none"> Whooper swan Wigeon Golden plover Lapwing Black-tailed godwit Black-headed gull
Slieve Bloom Mountains SPA	004160	11.7 km east	<ul style="list-style-type: none"> Hen harrier
River Suck Callows SPA	004097	17.3 km northwest	<ul style="list-style-type: none"> Whooper swan Wigeon Golden plover Lapwing Greenland white-fronted goose
Lough Derg (Shannon) SPA	004058	17.5 km southwest	<ul style="list-style-type: none"> Great cormorant Tufted duck <i>Aythya fuligula</i> Goldeneye <i>Bucephala clangula</i>

⁹ A 20 km search radius was used as this represents the maximum core foraging distance used by Qualifying Interest species of SPAs in the UK and Ireland



3.1.3 Other Nature Conservation Sites

The Project Site is not within or immediately adjacent to any Natural Heritage Area (NHA) or proposed NHA (pNHA). However, there are a total of 14 NHAs and 50 pNHAs within a 20 km radius, with details shown in **Table 3-2**.

River Little Brosna Callows NHA is located 1.65 km west of the Project Site and is the only NHA within a 20 km radius which is designated for its bird populations. The site is of importance for wintering swans, geese and other wetland birds.

The Project Site is not within or immediately adjacent to any Ramsar site. The Slieve Bloom Mountains Ramsar site is located 11.7 km east of the Project Site and is contained within the boundaries of the Slieve Bloom Mountains SPA.

Table 3-2: NHAs and pNHAs within 20 km of the Project Site and their Qualifying Interests (Sites Designated for Ornithological Qualifying Interests Only)¹⁰

Site Name	Site Code	Distance/Direction from Project Site Boundary	Qualifying Interests Relevant to the Non-Breeding Season
Woodville Woods pNHA	000927	0.02 km south	<ul style="list-style-type: none"> Common snipe <i>Gallinago gallinago</i>
River Little Brosna Callows NHA	000564	1.65 km west	<ul style="list-style-type: none"> Winter birds (as listed in Table 3-1 for SPA of same name)
Lough Nahinch (Tipperary) pNHA	000936	13.95 km southwest	<ul style="list-style-type: none"> Winter migratory birds
Roscrea Bog pNHA	000583	18.82 km southeast	<ul style="list-style-type: none"> Common snipe Eurasian curlew <i>Numenius arquata</i>
Pallas Lough pNHA		19.37 km northeast	<ul style="list-style-type: none"> Mallard <i>Anas platyrhynchos</i> Eurasian teal Eurasian wigeon Western marsh harrier <i>Circus aeruginosus</i>

¹⁰ Only pNHAs that do not overlap with SPAs are shown.



3.2 Flight Activity Surveys

Flight lines of primary target species recorded at the proposed wind farm site throughout the 2023/24 non-breeding season are presented in **Appendix D Figures 2.1 to 2.5** and a summary of the survey findings are provided in Sections 3.2.1 and 3.2.2 for primary and secondary target species, respectively. Flight data for both primary and secondary target species are provided in **Appendix C** with full data retained in GIS and excel format for subsequent collision risk modelling, if required.

3.2.1 Primary Target Species

Flight activity recorded is summarised in **Table 3-3**.

Table 3-3: Number of Primary Target Species Flights

Species	Number of flight lines by month						Total no. of flight lines	Time at risk height* (s)	Cumulative no. of flights
	October	November	December	January	February	March			
Common kestrel <i>Falco tinnunculus</i>	0	0	2	0	2	4	8	240	9
Hen harrier	0	0	1	0	1	0	2	0	2
Northern lapwing	0	0	0	0	2	4	6	120	28
Peregrine falcon <i>Falco peregrinus</i>	0	0	0	0	1	0	1	0	1
* precautionary risk height assumed to be between 25 – 200 m									

A summary of flight activity by species is presented below.

3.2.1.1 Common kestrel

Eight flight lines of common kestrel were recorded during the flight activity surveys (**Appendix D Figure 2.3**). All flight lines were of a single flight except for one flight line in March which consisted of a pair of flights. Most flight lines occurred outside the 500 m buffer.

3.2.1.2 Hen harrier

Two flight lines of hen harrier were recorded during the flight activity surveys, each consisting of a single flight (**Appendix D Figure 2.2**). Both flight lines occurred within the 500 m survey buffer but below potential collision risk height.

3.2.1.3 Northern lapwing

There were six flight lines of northern lapwing recorded (**Appendix D Figure 2.4**). The peak number of flights per flightline was 17 with activity focused around turbine T10.

3.2.1.4 Peregrine falcon

One flight line of peregrine falcon was recorded during the flight activity surveys (**Appendix D Figure 2.5**). This consisted of a single flight, occurred within the 500 m buffer but below potential collision risk height.



3.2.2 Secondary Species

Secondary species activity at the Project Site is summarised in **Table 3-4**.

Table 3-4: Secondary Species Activity Summary

Species	Number of 5 min periods recorded	Peak count of birds recorded in any 5 min period	Comments
Common buzzard	1	1	Activity in March within the buffer & beyond
Great cormorant	1	1	Activity in March within the Project Site, buffer & beyond
Grey heron	1	1	Activity in December within the Project Site, buffer & beyond
Greylag goose	1	9	Activity in March within the buffer
Mallard	1	4	Activity in February within the Project Site, buffer & beyond
Northern raven	9	3	Activity in October & November within the Project Site, buffer & beyond

3.2.3 Incidental records of other species

During the VP surveys, incidental records were made of other species with a legal or conservation status of concern. The only incidental record was of a single Irish hare *Lepus timidus subsp. hibernicus* on the site in February. Irish hare is protected by the Wildlife Act 1976, as amended.

3.3 Feeding Distribution Surveys

There were no records of geese during the feeding distribution surveys including at Dovegrove Callows SPA.

There were no swan observations recorded within 500 m of the Project Site. All swan observations were restricted to Dovegrove Callows SPA, located c.4 km southwest of the Project Site. Swan observations are detailed in **Table 3-5** below.

Records of other important species (i.e. QI wildfowl/wader species of any designated site, Annex I wildfowl/waders or any red- or amber-listed wildfowl/waders) are detailed in **Table 3-6** below. The transect route and observation locations are shown in **Appendix D Figure 3.1** to **3.8**.



Table 3-5: Records of swans during the feeding distribution surveys

Date	Species	No. of birds	Closest Location
27/11/2023	Whooper swan	4	Dovegrove Callows (c. 4 km SW)
26/02/2024	Mute swan <i>Cygnus olor</i>	2	Dovegrove Callows (c. 4 km SW)
01/03/2024	Mute swan	1	Dovegrove Callows (c. 4 km SW)
11/03/2024	Whooper swan	5	Dovegrove Callows (c. 4 km SW)

Table 3-6: Records of other target wildfowl/wader species during the feeding distribution surveys

Date	Species	No. of birds	Location
01/03/2024 11/03/2024	Black-tailed godwit	375 270	Dovegrove Callows (c. 4 km SW)
11/03/2024	Great cormorant	2	Dovegrove Callows (c. 4 km SW)
12/02/2024	Little egret <i>Egretta garzetta</i>	2	Dovegrove Callows (c. 4 km SW)
29/01/2024 12/02/2024	Mallard	10 4	Dovegrove Callows and peatland near N62 road (>1.5 km N)
27/11/2023	Northern lapwing	400	Dovegrove Callows (c. 4 km SW)
01/03/2024 11/03/2024	Wigeon	26 18	Dovegrove Callows (c. 4 km SW)

3.3.1 Incidental records of other species

During the feeding distribution surveys, incidental records were made of non-wildfowl/wader secondary target bird species. The following species were observed:

- Common buzzard;
- Common gull *Larus canus*;
- Common kestrel;
- Eurasian sparrowhawk;
- Grey heron;
- Hen harrier;
- Herring gull *Larus argentatus*;
- Northern raven; and
- Peregrine falcon.



The observation locations of common gull, hen harrier, kestrel and peregrine falcon are shown in **Appendix D Figure 3.2**.



4.0 Summary and Conclusions

Flight activity (or VP) surveys and feeding distribution surveys were carried out at the Project Site during the non-breeding bird season 2023/24.

The following primary target species were recorded during flight activity surveys:

- Common kestrel;
- Greylag goose;
- Hen harrier;
- Northern lapwing; and
- Peregrine falcon.

The most frequent flight activity was by common kestrel (n=8), followed by northern lapwing (n=6) and hen harrier (n=2).

While these results indicate low collision risk for primary target species at the Project Site, these results should be interpreted cumulatively with previous data collected at the Project Site.

The following primary target species were recorded during feeding distribution surveys:

- Whooper swan; and
- Mute swan.

No swans or geese were recorded in proximity to the Project Site, which accords with all previous survey results carried out to date. Wildfowl and waders were found mainly near Dovegrove Callows SPA, which is c. 4 km from the Project Site.

The following incidental spp. were recorded during feeding distribution surveys:

- Black-tailed godwit;
- Great cormorant;
- Little egret;
- Mallard;
- Northern lapwing; and
- Wigeon.



5.0 Legal and Conservation Status of Target Species Recorded

Table 5-1 summarises the legal and conservation status of the target species recorded during the range of ornithology surveys mentioned above. All birds are protected by the Wildlife Acts 1976 (as amended) in Ireland.

Table 5-1: Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO Code)	Legal & Conservation Status in Ireland
Primary	Common kestrel (K.)	BoCCI4 Red
	Greylag goose (GJ)	BoCCI4 Amber (non-domestic)
	Hen harrier (HH)	Annex I; BoCCI4 Amber
	Mute swan (MS)	BoCCI4 Amber
	Northern lapwing (L.)	BoCCI4 Red
	Peregrine falcon (PE)	Annex I; BoCCI4 Green
	Whooper swan (WS)	Annex I; BoCCI4 Amber
Secondary/ Incidental	Black-tailed godwit (BW)	BoCCI4 Red
	Common buzzard (BZ)	BoCCI4 Green
	Common gull (CM)	BoCCI4 Amber
	Eurasian sparrowhawk (SH)	BoCCI4 Green
	Great cormorant (CA)	BoCCI4 Amber
	Grey heron (H.)	BoCCI4 Green
	Herring gull (HG)	BoCCI4 Amber
	Little egret (ET)	Annex I; BoCCI4 Green
	Mallard (MA)	BoCCI4 Amber
	Northern raven (RN)	BoCCI4 Green
	Wigeon (WN)	BoCCI4 Amber





Appendix A Survey Dates, Times and Surveyors¹¹

Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065092.00001

21 August 2026

¹¹ Surveyors initials can be found in Section 2.6

Table A-1: Details of VP surveys undertaken from Vantage Point 3

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
03/10/2023	MJ	15:10	18:10	03:00
18/10/2023	MJ	10:20	13:20	03:00
21/11/2023	MJ	12:40	15:40	03:00
23/11/2023	MJ	07:50	10:50	03:00
18/01/2024	DN	09:31	12:31	03:00
29/01/2024	DN	12:52	15:52	03:00
12/02/2024	MJ	12:00	15:00	03:00
26/02/2024	MJ	14:20	17:20	03:00
01/03/2024	MJ	11:20	14:20	03:00
11/03/2024	MJ	08:50	11:50	03:00
05/12/2023	RB	13:00	16:00	03:00
30/12/2023	RB	13:10	16:10	03:00
Total Hours				36:00

Table A-2: Details of feeding distribution surveys

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
03/10/2023	MJ	11:35	13:55	02:20
18/10/2023	MJ	14:05	16:20	02:15
15/11/2023	HB	10:00	12:38	02:38
27/11/2023	HB	08:45	11:15	02:30
18/01/2024	DN	12:33	15:00	02:27
29/01/2024	DN	10:23	12:50	02:27
12/02/2024	MJ	09:20	11:55	02:35
26/02/2024	MJ	11:30	13:50	02:20
01/03/2024	MJ	09:05	11:10	02:05
11/03/2024	MJ	11:55	14:00	02:05
05/12/2023	RB	08:50	12:14	03:24
30/12/2023	RB	09:14	12:48	03:34
Total Hours				30:40





Appendix B Weather Data

Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065092.00001

21 August 2026

Table B-1: Weather data collected during flight activity surveys undertaken at VP3

Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
03/10/2023	15:10	18:10	1	4	W	0	5	2	2	0	0	15
03/10/2023	15:10	18:10	2	4	W	2	5	1	2	0	0	15
03/10/2023	15:10	18:10	3	4	W	2	7	2	2	0	0	13
18/10/2023	10:20	13:20	1	4	E	3	8	1	2	0	0	12
18/10/2023	10:20	13:20	2	4	E	3	8	1	2	0	0	12
18/10/2023	10:20	13:20	3	4	E	3	8	1	2	0	0	13
21/11/2023	12:40	15:40	1	2	NW	0	6	2	2	0	0	9
21/11/2023	12:40	15:40	2	2	W	0	7	2	2	0	0	9
21/11/2023	12:40	15:40	3	2	W	0	7	2	2	0	0	9
23/11/2023	07:50	10:50	1	3	W	0	8	1	2	0	0	11
23/11/2023	07:50	10:50	2	4	W	0	8	1	2	0	0	11
23/11/2023	07:50	10:50	3	4	W	0	8	2	2	0	0	11
18/01/2024	09:31	12:31	1	1	NW	0	1	2	2	0	2	-6
18/01/2024	09:31	12:31	2	1	NW	0	1	2	2	0	2	-3
18/01/2024	09:31	12:31	3	1	NW	0	1	2	2	0	2	-1
29/01/2024	12:52	15:52	1	2	N	0	8	2	2	0	0	5
29/01/2024	12:52	15:52	2	2	N	0	8	2	2	0	0	5
29/01/2024	12:52	15:52	3	2	N	0	7	2	2	0	0	5
12/02/2024	12:00	15:00	1	4	SW	2	5	1	2	0	0	7



Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
12/02/2024	12:00	15:00	2	4	SW	0	4	2	2	0	0	7
12/02/2024	12:00	15:00	3	4	SW	0	4	1	2	0	0	7
26/02/2024	14:20	17:20	1	3	N	0	5	2	2	0	0	8
26/02/2024	14:20	17:20	2	3	N	0	3	2	2	0	0	8
26/02/2024	14:20	17:20	3	3	N	0	1	2	2	0	0	7
01/03/2024	11:20	14:20	1	3	N	3	8	1	1	1	0	2
01/03/2024	11:20	14:20	2	2	N	2	8	1	1	1	0	2
01/03/2024	11:20	14:20	3	3	N	0	8	1	2	0	0	3
11/03/2024	08:50	11:50	1	2	SW	0	8	1	1	0	0	7
11/03/2024	08:50	11:50	2	2	W	0	8	1	1	0	0	8
11/03/2024	08:50	11:50	3	2	SW	0	8	1	1	0	0	8
05/12/2023	13:00	16:00	1	1	NW	0	4	2	2	0	0	6
05/12/2023	13:00	16:00	2	1	NW	0	4	2	2	0	0	6
05/12/2023	13:00	16:00	3	1	NW	0	4	2	2	0	0	5
30/12/2023	13:10	16:10	1	3	S	0	4	2	2	0	0	5
30/12/2023	13:10	16:10	2	3	S	0	4	2	2	0	0	6
30/12/2023	13:10	16:10	3	3	S	0	4	2	2	0	0	6
Cloud Cover			Visibility			Lying Snow			Frost			
Expressed in oktas (n/8)			Poor (<1km) 0			None 0			None 0			
Cloud Height			Moderate (1-3km) 1			On site 1			Ground 1			



Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2			Good (>3km) 2			On higher ground 2			All day 2			

Table B-2: Weather data collected during feeding distribution surveys

Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
03/10/2023	11:35	13:55	1	5	W	0	3	2	2	0	0	15
03/10/2023	11:35	13:55	2	4	W	0	4	2	2	0	0	15
03/10/2023	11:35	13:55	3	4	W	2	6	1	1	0	0	15
18/10/2023	14:05	16:20	1	4	E	2	8	2	2	0	0	13
18/10/2023	14:05	16:20	2	4	E	3	8	1	2	0	0	13
18/10/2023	14:05	16:20	3	4	E	3	8	1	2	0	0	13
15/11/2023	10:00	12:38	1	3	W	0	1	2	2	0	0	8
15/11/2023	10:00	12:38	2	3	W	0	4	2	2	0	0	10
15/11/2023	10:00	12:38	3	3	W	0	7	2	2	0	0	10



Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
27/11/2023	08:45	11:15	1	2	NW	1	8	1	1	0	0	8
27/11/2023	08:45	11:15	2	2	NW	0	5	2	2	0	0	8
27/11/2023	08:45	11:15	3	3	N	0	3	2	2	0	0	8
18/01/2024	12:33	15:00	1	1	NW	0	1	2	2	0	2	-1
18/01/2024	12:33	15:00	2	1	NW	0	1	2	2	0	2	-1
18/01/2024	12:33	15:00	3	1	NW	0	1	2	2	0	2	-1
29/01/2024	10:23	12:50	1	2	N	0	8	2	2	0	0	4
29/01/2024	10:23	12:50	2	2	N	1	8	2	2	0	0	4
29/01/2024	10:23	12:50	3	2	N	1	8	2	2	0	0	4
12/02/2024	09:20	11:55	1	4	SW	0	3	2	2	0	0	4
12/02/2024	09:20	11:55	2	4	SW	1	6	1	2	0	0	5
12/02/2024	09:20	11:55	3	4	SW	0	6	1	2	0	0	6
26/02/2024	11:30	13:50	1	3	N	0	2	2	2	0	0	7
26/02/2024	11:30	13:50	2	4	N	0	4	2	2	0	0	8
26/02/2024	11:30	13:50	3	3	N	0	5	2	2	0	0	8
01/03/2024	09:05	11:10	1	4	W	2	8	1	2	0	1	2
01/03/2024	09:05	11:10	2	3	W	2	8	1	1	0	1	2
01/03/2024	09:05	11:10	3	3	N	3	8	1	1	1	0	2
11/03/2024	11:55	14:00	1	2	W	0	8	1	2	0	0	9
11/03/2024	11:55	14:00	2	2	W	0	8	1	2	0	0	9



Date	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
11/03/2024	11:55	14:00	3	2	W	0	8	1	2	0	0	9
05/12/2023	08:50	12:14	1	1	NW	0	3	2	2	0	0	4
05/12/2023	08:50	12:14	2	1	NW	0	3	2	2	0	0	5
05/12/2023	08:50	12:14	3	1	N	0	3	2	2	0	0	5
30/12/2023	09:14	12:48	1	3	S	0	4	2	2	0	0	5
30/12/2023	09:14	12:48	2	3	S	0	4	2	2	0	0	6
30/12/2023	09:14	12:48	3	3	S	0	4	2	2	0	0	6





Appendix C Flight Activity Survey Data¹²

Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065092.00001

21 August 2026

¹² The key to BTO Codes can be found in Section 5.0.

Primary Target Species

Table C-1: Primary target species recorded during flight activity surveys undertaken at VP3

Date	Flight ID	BTO Code	Num. Birds	Age ¹³	Sex ¹⁴	Obs. Time	Avg. flight height (m)	Flight time (s)
12/02/2024	1	PE	1	AD	U	12:03	13	61
12/02/2024	2	L.	17	U	U	12:16	9	24
12/02/2024	3	HH	1	AD	M	13:21	5	127
12/02/2024	4	K.	1	U	U	13:36	15	17
12/02/2024	5	K.	1	U	U	14:25	17	29
26/02/2024	1	L.	3	AD	U	16:21	22	85
01/03/2024	1	K.	1	AD	M	13:25	14	26
01/03/2024	2	K.	2	U	U	13:32	30	79
01/03/2024	3	K.	1	AD	M	13:47	16	64
01/03/2024	4	K.	1	AD	M	14:13	23	97
11/03/2024	1	L.	2	AD	U	08:57	4	19
11/03/2024	2	L.	1	AD	U	09:01	5	65
11/03/2024	3	L.	4	AD	U	09:11	21	42
11/03/2024	4	L.	1	AD	U	09:58	16	58
05/12/2023	1	K.	1	Juv	U	13:35	40	40
05/12/2023	2	HH	1	Juv	F	14:08	10	77
05/12/2023	3	K.	1	AD	M	15:20	35	112

Secondary Target Species

Table C-4: Secondary target species recorded during flight activity surveys undertaken at VP3

Date	Survey Start	Survey End	5 min period	BTO Code	Count
03/10/2023	15:10	18:10	15:15	H.	1
03/10/2023	15:10	18:10	16:10	RN	1
03/10/2023	15:10	18:10	17:35	RN	1
18/10/2023	10:20	13:20	12:50	H.	1
18/10/2023	10:20	13:20	13:05	H.	1
21/11/2023	12:40	15:40	13:00	RN	1
21/11/2023	12:40	15:40	14:10	RN	2

¹³ Age letters refer to; A=Adult, U=Unrecorded

¹⁴ Sex letters refer to; M=Male, F=Female, U=Unrecorded



Date	Survey Start	Survey End	5 min period	BTO Code	Count
21/11/2023	12:40	15:40	14:25	RN	2
21/11/2023	12:40	15:40	14:45	RN	3
21/11/2023	12:40	15:40	14:50	RN	3
23/11/2023	07:50	10:50	08:40	RN	2
23/11/2023	07:50	10:50	09:30	H.	1
23/11/2023	07:50	10:50	09:35	H.	1
23/11/2023	07:50	10:50	10:15	RN	1
18/01/2024	09:31	12:31	11:50	H.	1
29/01/2024	12:52	15:52	13:40	H.	2
12/02/2024	12:00	15:00	11:55	H.	1
12/02/2024	12:00	15:00	14:00	H.	1
12/02/2024	12:00	15:00	14:15	H.	1
26/02/2024	14:20	17:20	15:20	H.	1
26/02/2024	14:20	17:20	17:00	MA	4
01/03/2024	11:20	14:20	12:45	H.	1
01/03/2024	11:20	14:20	13:15	H.	1
01/03/2024	11:20	14:20	13:30	BZ	1
11/03/2024	08:50	11:50	11:25	GJ	9
11/03/2024	08:50	11:50	08:45	H.	1
11/03/2024	08:50	11:50	11:45	CA	1
05/12/2023	13:00	16:00	14:21	H.	1

Table C-5: Secondary target species recorded during feeding distribution surveys

Date	BTO Code	Count	Observation time	Notes
03/10/2023	RN	2	11:55	Flying over bog
03/10/2023	RN	7	12:28	Circling over field
03/10/2023	K.	1	13:25	Disappeared into field
15/11/2023	BZ	1	10:10	Perched in tree
27/11/2023	H.	2	09:35	
27/11/2023	L.	400	10:52	Dovegrove Callows
27/11/2023	BZ	1	11:10	
18/01/2024	H.	1	12:45	
18/01/2024	K.	1	13:20	Chasing corvid
18/01/2024	BZ	1	13:50	Perched on pole, flew N
29/01/2024	MA	10	11:15	8M/ 2F. Flew into site



Date	BTO Code	Count	Observation time	Notes
12/02/2024	ET	2	10:38	
12/02/2024	HG	21	10:40	
12/02/2024	MA	4	10:41	
26/02/2024	H.	1	11:35	
26/02/2024	BZ	1	11:38	Calling from trees
26/02/2024	BZ	1	11:57	
26/02/2024	BZ	1	13:17	
01/03/2024	WN	26	10:31	
01/03/2024	BW	375	10:32	
01/03/2024	H.	1	11:09	
11/03/2024	BW	270	12:56	
11/03/2024	H.	1	12:58	
11/03/2024	SH	2	13:00	
11/03/2024	WN	18	13:00	
11/03/2024	CA	2	13:10	
11/03/2024	BZ	1	13:50	
05/12/2023	K.	1	NA	Juvenile
05/12/2023	H.	1	NA	Juvenile
05/12/2023	K.	1	NA	
05/12/2023	CM	3	NA	
05/12/2023	SH	1	NA	
05/12/2023	BZ	1	NA	
05/12/2023	HH	1	NA	Ringtail
30/12/2023	BZ	1	NA	
30/12/2023	BZ	1	NA	
30/12/2023	K.	1	NA	Juvenile
30/12/2023	BZ	1	NA	
30/12/2023	H.	1	NA	
30/12/2023	PE	1	NA	





Appendix D Figures

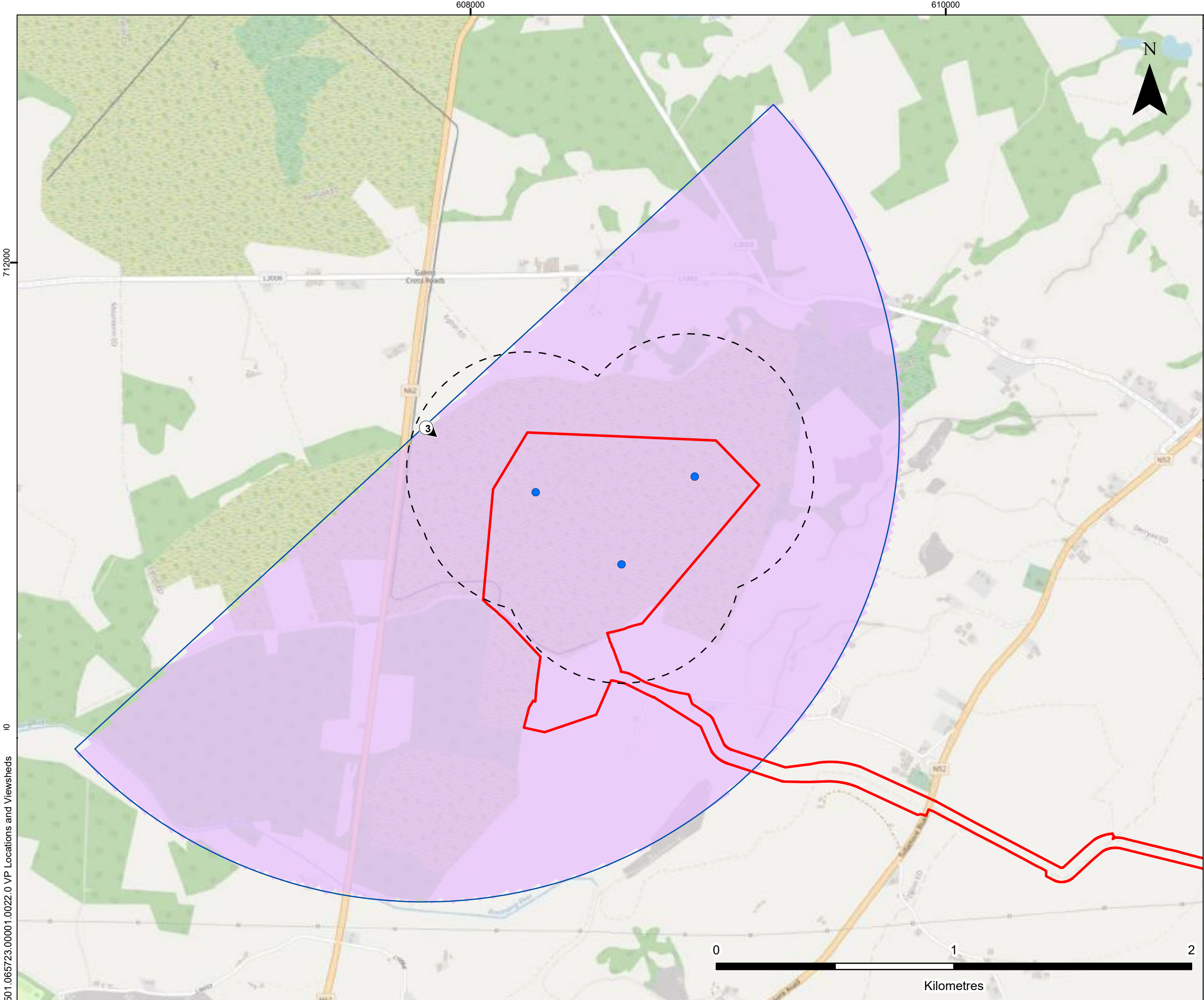
Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065092.00001

21 August 2026



- Site Boundary
- Turbine Location 500 m Buffer
- Turbine Location
- Vantage Point (VP) Location
- Vantage Point 2 km Viewing Arc
- Theoretical Visibility from VP3

Note: The ZTV is calculated with a surface offset of 28m and from a viewing height of 1.8m above ground level. The terrain model is derived from EU-DEM data with a vertical accuracy of $\pm 7m$. The ZTV was calculated using ArcMAP 10.5.1 software.



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CUSH WIND FARM
WINTER BIRD SURVEYS
VANTAGE POINTS AND VIEWSHEDS

FIGURE 1

Scale 1:15,000 @ A3 Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Black-Headed Gull



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CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
BLACK-HEADED GULL**

FIGURE 2.1

Scale 1:12,500 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Little Egret



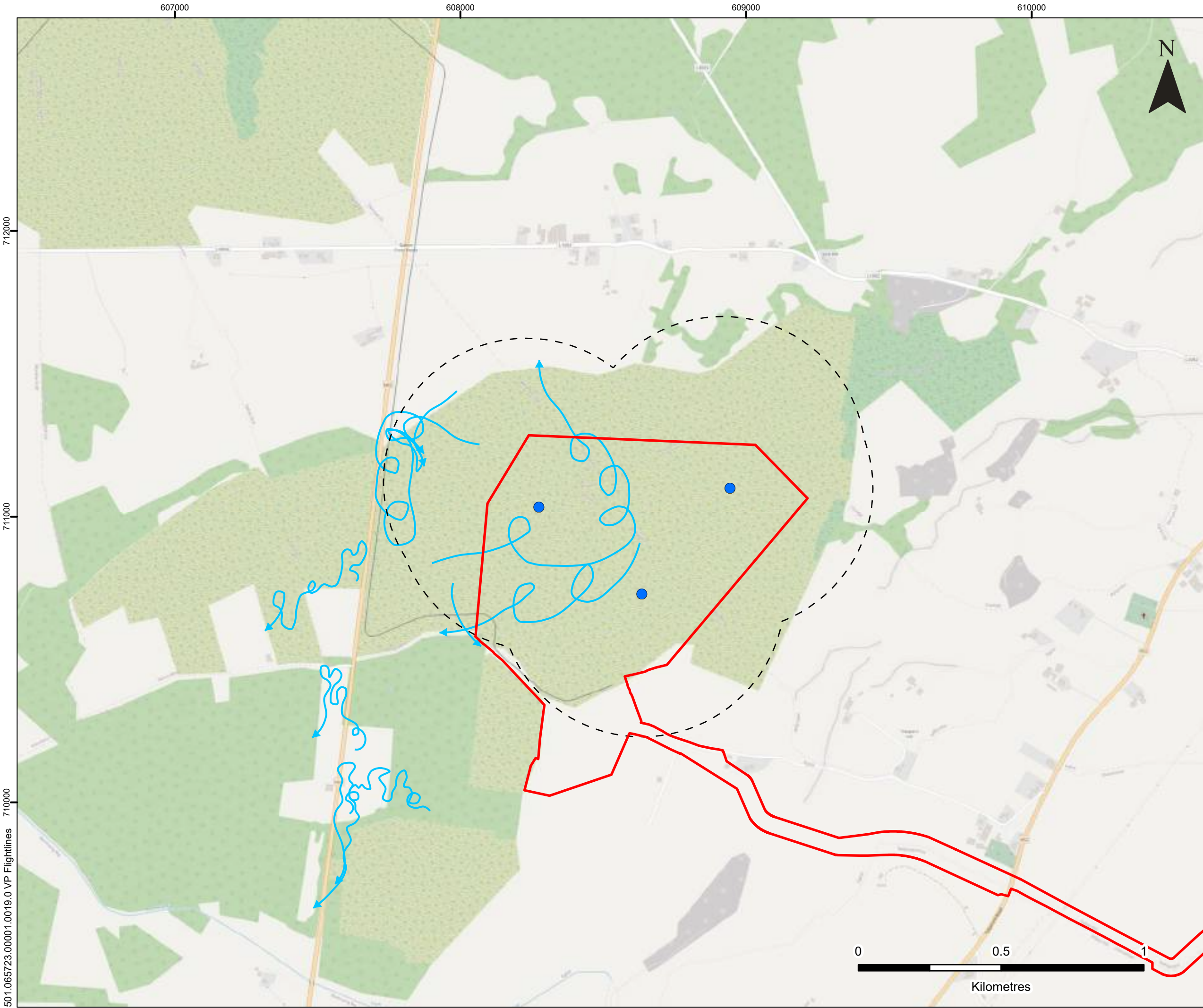
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BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
LITTLE EGRET**

FIGURE 2.2

Scale	1:12,500 @ A3	Date	AUGUST 2026
-------	---------------	------	-------------



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location
- Species Flightline**
- Kestrel



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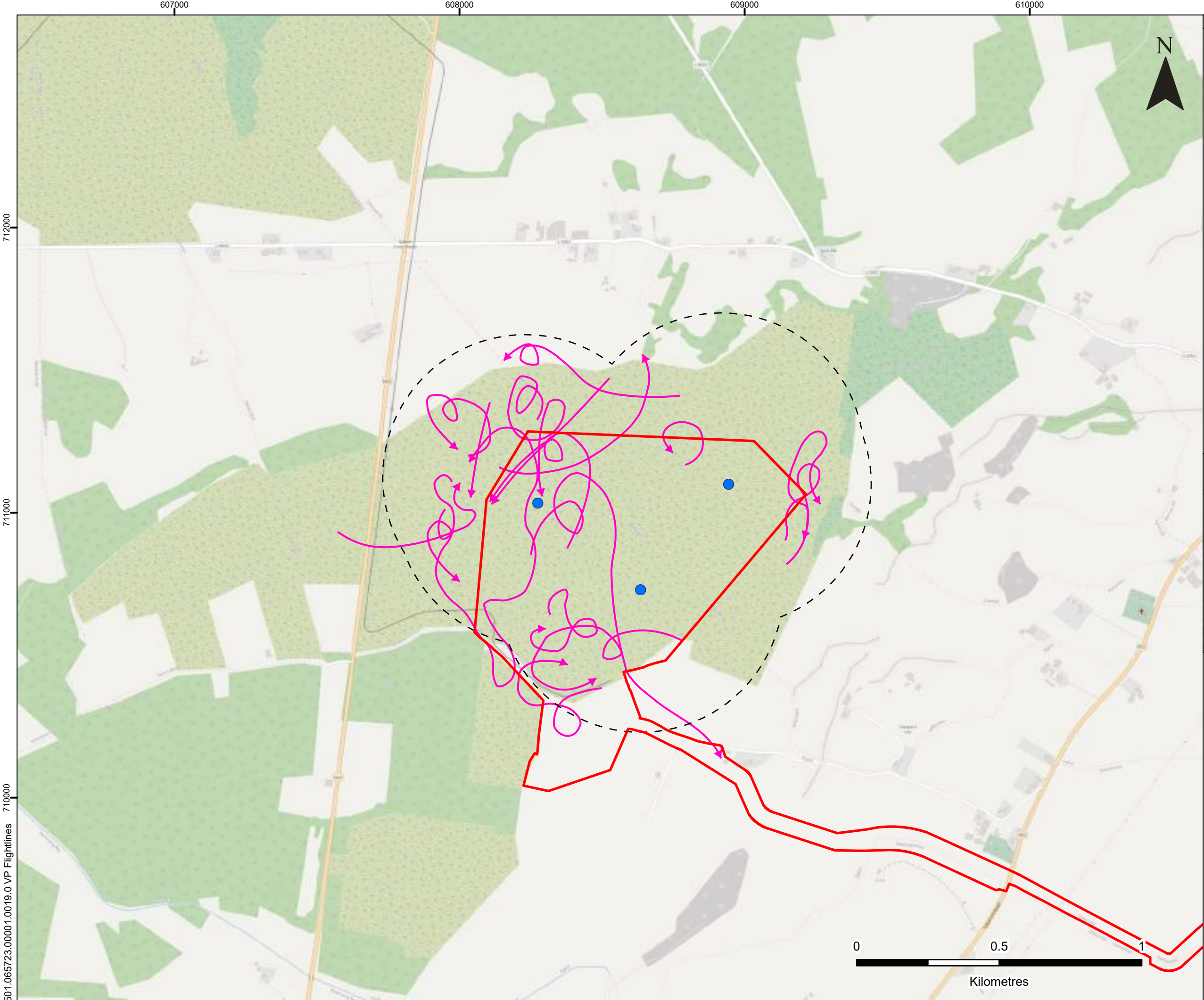
CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
KESTREL**

FIGURE 2.3

Scale	1:12,500 @ A3	Date	AUGUST 2026
-------	---------------	------	-------------





LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Lapwing



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BREEDING SEASON 2023

**VANTAGE POINT FLIGHTLINES
LAPWIND**

FIGURE 2.4

Scale	1:12,500 @ A3	Date	AUGUST 2026
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LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location

Species Flightline

- Mallard



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CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2023

VANTAGE POINT FLIGHTLINES
MALLARD

FIGURE 2.5

Scale 1:12,500 @ A3

Date AUGUST 2026

607000

608000

609000

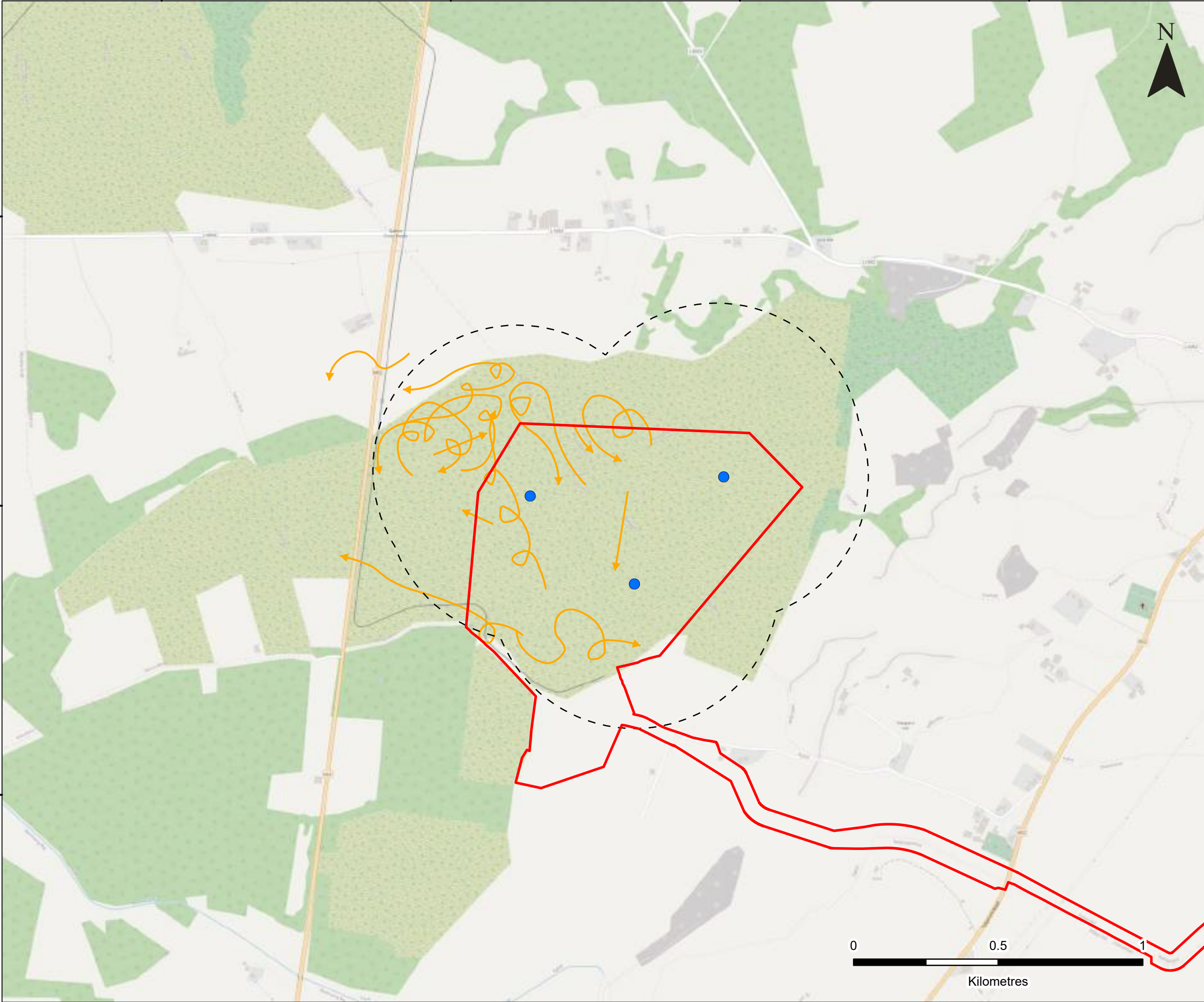
610000

712000

711000

710000

501.065723.00001.0019.0 VP Flightlines



LEGEND

- Site Boundary
- Site Infrastructure 500 m Buffer
- Turbine Location
- Species Flightline**
 - Snipe



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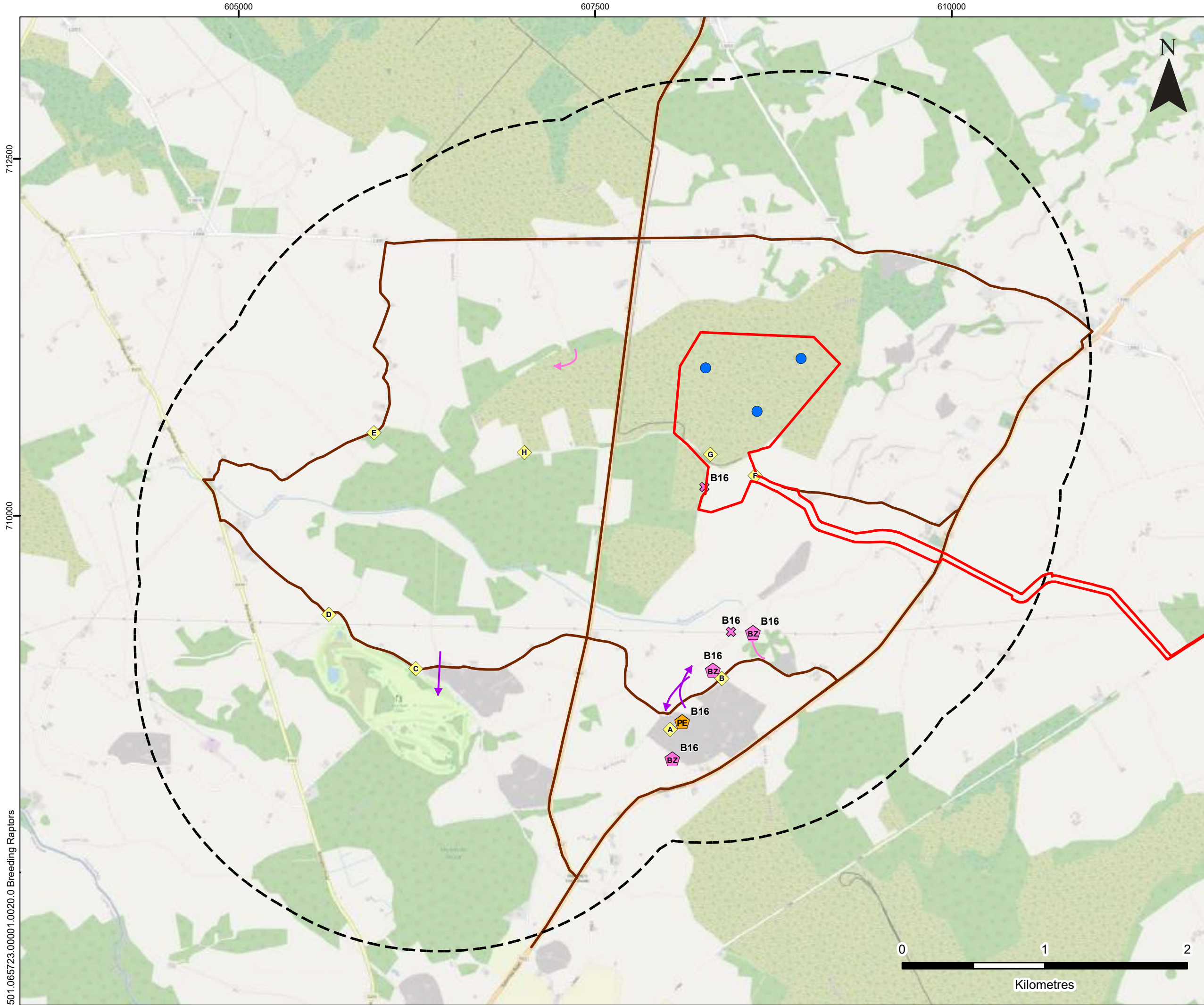
VANTAGE POINT FLIGHTLINES
SNIPE

FIGURE 2.6

Scale 1:12,500 @ A3

Date AUGUST 2026





LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 2 km Buffer
- Turbine Location
- Raptor Vantage Point (rVP)
- Driven Transect Route
- Raptor Record (Labelled with Behaviour Code)
 - BZ Buzzard
 - BZ Buzzard Breeding Territory
 - PE Peregrine
- Raptor Flightline
 - BZ Buzzard
 - Kestrel

Breeding Raptor Behaviour Codes: B16
- Present in Suitable Habitat

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CUSH WIND FARM

BIRD SURVEY REPORT
BREEDING SEASON 2023

BREEDING RAPTORS

FIGURE 3

Scale 1:25,000 @ A3

Date AUGUST 2026



LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 500 m Buffer
- Turbine Location
- Walked Transect Route

Wader Species Record (Labelled with Behaviour Code)

- Lapwing
- Ringed Plover
- Snipe

Breeding Wader Behaviour Codes:
B2 - Courtship or Display Behaviour Seen, Including Copulation
B16 - Present in Suitable Habitat

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CUSH WIND FARM

BIRD SURVEY REPORT
BREEDING SEASON 2023

BREEDING WADERS

FIGURE 4

Scale 1:12,500 @ A3

Date JULY 2026



LEGEND

- Site Boundary
- Site Infrastructure At Time Of Survey 500 m Buffer
- Turbine Location
- Kingfisher River Surveyed (Labelled with Section)



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BIRD SURVEY REPORT
BREEDING SEASON 2023

KINGFISHER SURVEY RESULTS

FIGURE 5

Scale	1:12,500 @ A3	Date	AUGUST 2026
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Appendix E Species Records

Bird Survey Report Non-Breeding Season 2023/24

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065092.00001

21 August 2026

The NBDC database was searched for records of bird species within the 10 km grid squares which overlap the Project Site (N00 and N01). All bird species are protected under the Wildlife Acts (1976, as amended) but for the purposes of this report, only records of species that are Red or Amber-listed in Birds of Conservation Concern in Ireland or listed under Annex I of the Birds Directive are included in the results. Only records within the last 10 years are considered within this report as older records are unlikely to be relevant. Details of the results are shown in Table E-1.

Table E-1: Species recorded within the 10 km grid squares N00 and N01 (Species Present During the Non-Breeding Season)

Species name	Season	Grid square	Last Record Year	Designation
Barn owl <i>Tyto alba</i>	Breeding	N01	2019	BoCCI4 Red
Black-headed gull	Breeding and wintering	N01	2022	BoCCI4 Amber
Common gull	Breeding and wintering	N00	2019	BoCCI4 Amber
Common kestrel	Breeding	N00, N01	2023	BoCCI4 Red
Common kingfisher <i>Alcedo atthis</i>	Breeding	N00, N01	2022	Annex I, BoCCI4 Amber
Common linnet <i>Linaria cannabina</i>	Breeding	N00, N01	2019	BoCCI4 Amber
Common pochard <i>Aythya ferrina</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Common redshank <i>Tringa totanus</i>	Breeding and wintering	N00	2019	BoCCI4 Red
Common snipe	Breeding and wintering	N01	2022	BoCCI4 Red
Common starling <i>Sturnus vulgaris</i>	Breeding	N00, N01	2019	BoCCI4 Amber
Dunlin <i>Calidris alpina</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Eurasian curlew	Breeding and wintering	N01	2019	BoCCI4 Red
Eurasian skylark <i>Alauda arvensis</i>	Breeding	N01	2019	BoCCI4 Amber
Eurasian teal	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
Eurasian wigeon	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
European golden plover	Breeding and wintering	N01	2019	Annex I, BoCCI4 Red
Gadwall <i>Mareca strepera</i>	Breeding and wintering	N00, N01	2019	BoCCI4 Amber
Hen harrier	Breeding	N01	2014	BoCCI4 Amber



Species name	Season	Grid square	Last Record Year	Designation
House sparrow <i>Passer domesticus</i>	Breeding	N00, N01	2022	BoCCI4 Amber
Little egret	Breeding and wintering	N00	2020	Annex I, BoCCI4 Green
Mallard	Breeding and wintering	N00, N01	2023	BoCCI4 Amber
Meadow pipit <i>Anthus pratensis</i>	Breeding	N00, N01	2019	BoCCI4 Red
Merlin <i>Falco columbarius</i>	Breeding	N01	2017	Annex I, BoCCI4 Amber
Mute swan	Breeding and wintering	N00, N01	2022	BoCCI4 Amber
Northern lapwing	Breeding and wintering	N00, N01	2022	BoCCI4 Red
Northern shoveler	Breeding and wintering	N00, N01	2019	BoCCI4 Red
Peregrine falcon	Breeding	N00, N01	2023	Annex I, BoCCI4 Green
Tufted duck	Breeding and wintering	N01	2018	BoCCI4 Amber
Yellowhammer <i>Emberiza citrinella</i>	Breeding	N00, N01	2021	BoCCI4 Red
Key	<p>Season – indicates which season was assessed for each species under the Birds of Conservation Concern in Ireland¹⁵;</p> <p>Annex I – the species is listed in Annex I of the EC Birds Directive; and</p> <p>BoCCI4 status (green, amber or red) – indicates the current Birds of Conservation Concern in Ireland status category.</p>			

¹⁵ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22





Making Sustainability Happen



Bird Survey Report Breeding Season 2024

Cush Wind Farm

Cush Wind Farm Ltd

Clondargan, Stradone, Co. Cavan
Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14
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SLR Project No.: 501.065415.00001

Client Reference No: NA

23 September 2024

Revision: 0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
00	23 September 2024	Hugo Brooks	Dr Jonathon Dunn	Dr Jonathon Dunn
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This document has been prepared by SLR Environmental Consulting (Ireland) Ltd (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Cush Wind Farm Ltd (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

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Appendices

Appendix A	Survey Dates, Times and Observers
Appendix B	Weather Data
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1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd (SLR) was commissioned by Cush Wind Farm Ltd to carry out a bird survey programme for an extension area, amenity trail and grid route (hereafter 'the Project') at a proposed wind farm at Cush, Co. Offaly during the breeding season of 2024. The purpose of this report is to describe these surveys and the resulting ornithological baseline.

1.1 Background to the Commission

No previous planning permission has been sought on the Project Site for the development of wind farms by Cush Wind Farm Ltd or any other party.

Bird surveys have been previously undertaken at the proposed wind farm development site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR for the breeding 2020, non-breeding 2020/21, breeding 2021, non-breeding 2021/22, breeding 2022, non-breeding 2022/23, breeding 2023 and non-breeding 2023/24 seasons.

Previous surveys have focused on a larger study area. Any reference to proposed turbines other than T9 to T11 refer to those part of a separate scheme.

1.2 Site Description

The Project Site is located in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946 (Appendix D Figure 1). The survey area of this suite of surveys targets an extension area of three turbines, linear grid route and amenity route. The habitats within the Project Site and are dominated by conifer plantations of varying age classes, cutaway bog and agricultural grasslands. A small section of the amenity route is within Lough Coura pNHA; however, this site is not designated for any bird species.

1.3 Terminology

For this report, "flight line" refers to the line drawn to record avian movement during a woodcock survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as "a flight".

1.4 Purpose of Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The assessment of impacts resulting from the proposed development and the development of mitigation measures, if required, are beyond the scope of this report and are covered in a separate Environmental Impact Assessment (EIA) report and Natura Impact Statement (NIS).

1.5 Relevant Legislation

Legislation relevant to this report includes the EC Birds Directives and the Wildlife Act (1976, as amended). Birds listed under Annex I of the Birds Directive are described in Section 5.0 and are afforded strict protection at the European and national level. All Irish birds are protected by the Wildlife Act.



2.0 Methodology

2.1 Scope of Work

The scope of survey work during the breeding season was based on knowledge of the Project Site acquired during the previous bird surveys, a desk-based review and access to lands within and surrounding the Project Site. It also considered current NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance¹. The details of the scope of work are provided in **Table 2-1**. Further details are provided in Section 2.3 including study areas and target species.

Table 2-1: Scope of Ornithological Survey Work April to July 2024

Survey Type	Summary Methodology
Breeding Raptor Surveys	Four breeding raptor surveys were carried out within the period of 29th April to 17th July to search for potential raptor nesting territories within a 2 km radius of the Project Site.
Breeding Wader Surveys	Three lowland wader surveys were carried out within the period of 30th April to 5th June to search for waders breeding in suitable habitat within a 500 m buffer of the Project Site.
Breeding Woodcock Surveys	Three breeding woodcock surveys per survey target area were carried out within the period of the 9 th of May to 18 th of June to search for breeding woodcock territories within suitable woodland areas within and nearby the Project Site.

NS guidance states that *“it is generally considered the passerine species are not significantly impacted by wind farms”*. It goes on to state that *“survey of woodland passerines, especially in commercial conifer forest is generally not required”*. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that passerines red-listed under the latest Birds of Conservation Concern in Ireland (BoCCI) scheme² should be considered as equivalent. No such species were returned during the desk-based review or data request. NS guidance also states that *“surveys of farmland passerines especially on more intensive arable habitat are generally not required”*. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

2.2 Desk-based Review

The desk review collated any available information to date on the breeding and non-breeding bird populations and movements around the Project Site.

The following reports resulting from previous breeding and non-breeding bird surveys were reviewed for any relevant information that could be used to inform the current bird surveys:

- SLR (2018) Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018;
- SLR (2020) Cush Wind Farm Breeding Bird Survey Report 2020;
- SLR (2022) Cush Wind Farm Winter Bird Survey Report 2020-2021;

¹ Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.

² Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. *Irish Birds* 43: 1–22



- SLR (2022) Cush Wind Farm Breeding and Winter Bird Survey Report 2021-2022;
- SLR (2022) Cush Wind Farm Breeding Bird Survey Report 2022;
- SLR (2023) Cush Wind Farm Non-Breeding Bird Survey Report 2022-2023;
- SLR (2023) Cush Wind Farm Breeding Bird Survey Report 2023; and
- SLR (2024) Cush Wind Farm Migration Survey Report 2024.

The websites of the National Parks and Wildlife Service (NPWS)³, the UK and Ireland Bird Atlas 2007-2011⁴ and the National Biodiversity Data Centre (NBDC)⁵ were also accessed for information on sites designated for nature conservation in the vicinity of the Project Site.

2.3 Field Surveys

2.3.1 Project Team: Evidence of Technical Competence and Experience

2.3.1.1 Jonathon Dunn (JD) – Project Manager and Lead Ornithologist

Jonathon is an Associate Ornithologist with SLR and holds a BA (Hons) in Natural Sciences from the University of Cambridge, an MSc in Ecology Evolution and Conservation from Imperial College London and a PhD in Avian Ecology from Newcastle University. He is a Full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). Jonathon is a highly skilled and experienced bird surveyor with eight years' post graduate experience as a professional consultant ecologist. Jonathon managed this project through liaison with the client, coordination of the survey team, supervision of the health and safety of the team, collating, quality controlling and assessing the survey data. He also undertook the technical and approval review for this report.

2.3.1.2 Darragh Nagle (DN) – Project Ecologist

Darragh is a Project Ecologist and graduated from University College Cork in 2020 with a BSc degree (Hons) in Ecology and Environmental Ecology. He is a qualifying member with CIEEM. Since joining SLR Darragh's field experience includes multiple diverse bird surveys on windfarm sites across Ireland with experience in vantage point, breeding wader, breeding raptor, feeding distribution, hen harrier roost *Circus cyaneus* and intertidal bird surveys. Darragh carried out breeding raptor and breeding wader surveys at the Project.

2.3.1.3 Adrian Allen

Adrian Allen is a sub-contractor with experience of carrying out a wide array of bird surveys for onshore wind farm projects including among others, vantage point, breeding wader, breeding raptor, and feeding distribution surveys. Adrian has a lifetime experience of birdwatching.

2.3.2 Breeding Raptor Surveys

The survey methodology for breeding raptors used a driven transect, with regular stops, to carry out watches of suitable habitat from appropriate viewpoints to identify potential nesting territories. A total of four unique stops were made along the transect around the targeted survey area, overlooking potentially suitable breeding habitat. The amenity route (within cutover bog) was walked to survey for evidence of merlin. The locations of these viewpoints

³ www.npws.ie (last accessed August 2024)

⁴ <https://app.bto.org/mapstore/StoreServlet> (last accessed August 2024)

⁵ <http://maps.biodiversityireland.ie/#/Map> (last accessed August 2024)



are presented in Appendix D Figure 2.1 together with the outline of the survey route and the results of the surveys. Suitable breeding habitat differs for each raptor species⁶.

Table 2-2 provides a summary of the potentially suitable raptor habitats within the 2 km buffer zone of the Site and the approximate locations of these in relation to the viewpoints used during the survey.

Breeding peregrine falcons have been previously observed at Loughnane Quarry. A raptor viewpoint was located at this location (rVP3) to survey for evidence of breeding of this species.

Potentially suitable barn owl breeding structures were surveyed during the 2023 breeding season, with no evidence of breeding found. Therefore, no structures were targeted this year.

Table 2-2: Potentially Suitable Habitats for Breeding Raptors within the Study Area

Raptor Viewpoint	Habitat Type Visible	Target Raptor Species Potentially Present
rVP1	Lowland cutover bog, conifer plantation (non-pre-thicket), treelines & broadleaf woodland	Common kestrel <i>Falco tinnunculus</i> , red kite <i>Milvus milvus</i> , common buzzard, <i>Buteo buteo</i> Eurasian sparrowhawk <i>Accipiter nisus</i> , hen harrier, merlin <i>Falco columbarius</i>
rVP2	Lowland cutover bog & conifer plantation (pre-thicket and non-pre-thicket)	Common kestrel, common buzzard, Eurasian sparrowhawk, hen harrier & merlin
rVP3	Edge of quarry, broadleaf woodland, conifer plantation (pre-thicket and non-pre-thicket) & treelines	Peregrine falcon <i>Falco peregrinus</i> , common kestrel, common buzzard, hen harrier, red kite, Eurasian sparrowhawk & merlin
rVP4	Edge of quarry, lowland cutover bog, conifer plantation (non-pre-thicket), broadleaf woodland & treelines	Peregrine falcon Common kestrel, common buzzard, Eurasian sparrowhawk, hen harrier, red kite, Eurasian sparrowhawk, merlin

Evidence of breeding was assessed using BTO criteria replicated in **Table 2-3** below and amended as required for any species-specific criteria (e.g. for hen harrier) as outlined in Hardey et al. (2013)⁶.

Table 2-3: Breeding Evidence criteria according to BTO

Non-breeding	
F	Flying over
M	Species observed but suspected to be still on migration
U	Species observed but suspected to be summering non-breeder
Possible breeder	
H	Species observed in breeding season in suitable nesting habitat
S	Singing male present (or breeding calls heard) in breeding season in suitable breeding habitat
Probable breeding	
P	Pair observed in suitable nesting habitat in breeding season

⁶ Hardey, J., Crick, H.Q.P., Wernham, C., Riley, H., Etheridge, B., Thompson, D. (2013). Raptors: A field guide for surveys and monitoring (3rd Edition). The Stationery Office Edinburgh.



Non-breeding	
T	Permanent territory presumed through registration of territorial behaviour (song etc) on at least two different days a week or more part at the same place or many individuals on one day
D	Courtship and display (judged to be in or near potential breeding habitat; be cautious with wildfowl)
N	Visiting probable nest site
A	Agitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby
I	Brood patch on adult examined in the hand, suggesting Incubation
B	Nest building or excavating nest-hole
Confirmed breeding	
DD	Distraction-display or injury feigning
UN	Used nest or eggshells found (occupied or laid within period of survey)
FL	Recently fledged young (nidicolous species) or downy young (nidifugous species). Careful consideration should be given to the likely provenance of any fledged juvenile capable of significant geographical movement. Evidence of dependency on adults (e.g. feeding) is helpful. Be cautious, even if the record comes from suitable habitat.
ON	Adults entering or leaving nest-site in circumstances indicating occupied nest (including high nests or nest holes, the contents of which cannot be seen) or adults seen incubating
FF	Adult carrying faecal sac or food for young
NE	Nest containing eggs
NY	Nest with young seen or heard

2.3.3 Breeding Wader Surveys

Lowland breeding wader surveys followed an adapted version of the methodology described in O'Brien & Smith⁷, as recommended by NS guidance. Lowland breeding wader surveys were conducted in the grasslands in the western section of the Project Site and the bog in the eastern section of the Project Site. The surveys involved a walked transect which covered all habitat potentially suitable for breeding waders within the Project Site and 500 m buffer, where accessible.

The location, movement and behaviour of all wader species were recorded onto field maps using standard BTO species codes. The following criteria was recorded for each species:

- Northern lapwing *Vanellus vanellus* – the total numbers of birds seen from the transect;
- Common snipe *Gallinago gallinago* – the number of drumming plus chipping birds heard or seen from the transect; and
- Other species – the number of pairs (where 'pairs' = (paired individuals/2), displaying birds, nests or broods and other single birds not in flocks).

⁷ O'Brien & K. W. Smith (1992) Changes in the status of waders breeding on wet lowland grasslands in England and Wales between 1982 and 1989, Bird Study, 39:3, 165-176



The breeding status of waders recorded during surveys was evaluated against the criteria set out in Gilbert et al. (2021)⁸ and BTO⁹ for wader surveys.

Birds were confirmed breeding if:

- Nests, eggs, or young were located;
- Adults repeatedly alarm called;
- Distraction displays were seen; and
- Territorial disputes were observed.

Birds were probably breeding if:

- They were observed displaying or singing on more than one visit;
- A pair was seen in suitable nesting habitat in the breeding season;
- Courtship was seen in or near suitable breeding habitat;
- They were observed visiting a probable nest site;
- Agitated behaviour or anxiety calls were observed; and
- A pair of birds was observed in suitable habitat for nesting.

Birds were possibly breeding if:

- They were observed displaying or singing on one visit in suitable breeding habitat; and
- A single bird was observed in the breeding season in suitable nesting habitat.

Other records were considered to be of non-breeding birds, failed breeders, birds loafing, feeding or on passage to other areas.

Please see Appendix D Figure 2 for an outline of the walked transect and Appendices A and B for metadata relating to these surveys.

2.3.4 Breeding Woodcock Surveys

Breeding woodcock *Scolopax rusticola* surveys followed an adapted version of the methodology described by the University College Cork (UCC) Woodcock Research Group¹⁰

Three survey visits were undertaken at least one week apart between 1st May and 30th June on dry and calm evenings following UCC methodology. Surveys commenced 15 mins before sunset and finished 60 mins after sunset, and a thermal imaging camera was used to aid detection of woodcock.

Transects were surveyed in areas with suitable breeding Eurasian woodcock habitat. These transects were along the amenity route, and in areas nearby the extension area and grid route.

Target notes were recorded on the number of woodcock heard or seen and habitat type. In addition, flight lines were recorded where possible and flight heights were assigned to 5 m flight height bands.

- 1 = < 5 m (below the likely rotor swept area);

⁸ Gilbert et al. (1998). Bird Monitoring Methods. RSPB, UK.

⁹ <https://www.bto.org/our-science/projects/birdatlas/methods/breeding-evidence> [Last Accessed 18/09/2024]

¹⁰ <https://www.ucc.ie/en/ornithology/projects/woodcock-phd/step2/> [last accessed 09/09/2024]



- 2 = 5 m to 10 m (below the likely rotor swept area);
- 3 = 10 m to 15 m (below the likely rotor swept area);
- 4 = 15 m to 20 m below the likely rotor swept area);
- 5 = 20 m to 25 m (below the likely rotor swept area);
- 6 = 25m to 30 m (potentially within the likely rotor swept area).

Other incidental species of note were also recorded.

Please see Appendix D Figure 4 for an outline of the walked transects and Appendix A and Appendix B for metadata relating to these surveys.

2.4 Survey Limitations

No significant limitations were present during surveys. Not all areas of potentially suitable raptor habitat within the 2 km search area could be viewed from public roads due to lack of access; however, the areas closest to the Project Site could be and so the areas potentially most likely to be affected by the Project could be surveyed.



3.0 Results

3.1 Desk-based review

3.1.1 Natura 2000 Sites

The amenity route, grid route and extension area are not within or immediately adjacent to any Special Protection Areas (SPAs). All SPAs within 20 km (area and their qualifying interest species) of the amenity route, grid route and extension area are presented in **Table 3-1** below.

Table 3-1: SPAs within 20 km of the Amenity Route, Grid Route and Extension Area and their Qualifying Interests

Site Name	Site Code	Distance / Direction from Amenity Route	Distance / Direction from Grid Route	Distance / Direction from Extension Area	Qualifying Interest Species Relevant to the Breeding Season
Dovegrove Callows SPA	004137	3.9 km southwest	1.0 km southwest	3.6 km southwest	N/A
All Saints Bog SPA	004103	5.1 km southwest	3.1 km northwest	5.1 km west	N/A
Middle Shannon Callows SPA	004096	5.3 km northwest	7.0 km northwest	7.2 km northwest	Corncrake <i>Crex crex</i> Northern lapwing
River Little Brosna Callows SPA	004086	6.1 km west	3.2 km west	5.9 km west	N/A
Slieve Bloom Mountains SPA	004160	12.4 km southeast	13.4 km southeast	13.4 km southeast	Hen harrier
River Suck Callows SPA	004097	15.3 km northwest	17.7 km northwest	17.2 km northwest	N/A
Mongan Bog SPA	004017	17.1 km northwest	>20 km	19.0 km northwest	Common snipe
Lough Derg (Shannon) SPA	004058	19.7 km southwest	16.7 km southwest	19.5 km southwest	Great cormorant <i>Phalacrocorax carbo</i> Tufted duck <i>Aythya fuligula</i> Common tern <i>Sterna hirundo</i>



3.1.1.1 Other Nature Conservation Sites

A small section of the amenity route is within Lough Coura pNHA, this site is not designated for any bird species.

All other NHAs and pNHAs (and their qualifying interest species) within 20 km of the amenity route, grid route and extension area are presented in **Table 3-2**.

Table 3-2: NHAs and pNHAs within 20 km of the Amenity Route and their Qualifying Interests (Sites Designated for Ornithological Qualifying Interests Only)¹¹

Site Name	Site Code	Distance/Direction from Amenity Route	Distance/Direction from Grid Route	Distance/Direction from Extension Area	Qualifying Interests Relevant to the Breeding Season
Woodville Woods pNHA	000927	2.2 km south	0.1 km southeast	0.9 km south	Common snipe
River Little Brosna Callows NHA	000564	6.1 km west	3.2 km west	6.1 km west	Peatlands [4] Birds [12] There are no QIs for the breeding season for the SPA of the same name, which is likely true for the NHA also.
Lough Nahinch (Tipperary) pNHA	000936	17.3 km southwest	15.1 km southwest	15.1 km southwest	Common redshank Common snipe Water rail <i>Rallus aquaticus</i>
Roscrea Bog pNHA	000583	18.82 km southeast	>20 km	>20 km	Common snipe Eurasian curlew
Pallas Lough pNHA	000916	19.1 km northeast	> 20 km	18.3 km northeast	Mallard <i>Anas platyrhynchos</i> Eurasian teal <i>Anas crecca</i> Eurasian wigeon <i>Mareca penelope</i> Western marsh harrier <i>Circus aeruginosus</i>

¹¹ Only pNHAs and NHAs that do not overlap with SPAs are shown.



Site Name	Site Code	Distance/Direction from Amenity Route	Distance/Direction from Grid Route	Distance/Direction from Extension Area	Qualifying Interests Relevant to the Breeding Season
Lough Nanag Esker pNHA	000910	> 20 km	19.98 km northwest	>20 km	Wildfowl (site synopsis does not include season of relevance)

3.2 Breeding Raptor Surveys

Two species of raptor were recorded during the four breeding raptor surveys. The following species accounts provide summary details of the target raptor species encountered during the 2024 surveys. The results of the breeding raptor survey, with the rVPs and species locations, can be found in Appendix D Figure 2.

3.2.1 Common buzzard

A total of six common buzzard observations were made across the four breeding raptor surveys with a peak count of one bird. Three of these observations were of a common buzzard within suitable breeding habitats. As per BTO breeding criteria (presented in **Table 2-3**), this suggests possibly breeding buzzards were present. Of these three observations, one was made within the extension area, another approximately 600 m southwest of the extension area, and another 500 m north of the amenity route.

3.2.2 Common kestrel

A single observation of common kestrel was made in each of the four breeding raptor surveys. All observations were made of a single bird displaying hunting behaviours. Three of these observations were of kestrels in suitable breeding habitat, which is evidence of possible breeding according to the BTO (see **Table 2-3**). These observations of possible breeding kestrel were made approximately 750 m north of the grid route and approximately 1 km southwest of the extension area.

3.2.3 Incidental recordings

3.2.3.1 Gulls

During the breeding raptor survey in June, aggressive behaviour of black-headed gulls *Larus ridibundus* (attacking surveyor) was recorded on the lake approximately 300 m north of the amenity route. Flocks of black-headed gulls were repeatedly recorded on this lake during breeding raptor surveys, with a peak count of 26 birds. According to BTO criteria (see **Table 2-3**), these behaviours suggest the probable breeding of black-headed gulls on this lake.

A flock of forty-six lesser black-backed gulls *Larus fuscus* were recorded resting on the lake north of amenity route during the breeding raptor survey in July. No evidence of breeding lesser black-backed gulls was observed.

3.2.3.2 Waders / Wildfowl

A single northern lapwing was recorded flying over the Project Site in April. No evidence of breeding was recorded for this species during the breeding raptor surveys.

Common snipe were observed on two occasions. In April, two birds were observed flying directly over the amenity route in a north-easterly direction. In June, a single common snipe



was recorded drumming immediately adjacent and flying over the amenity route. According to the criteria set out in section 2.3.3, this behaviour is evidence of possible breeding nearby to the amenity route.

A single Eurasian curlew was recorded flying south of the amenity route during the April breeding raptor survey. No evidence of breeding was observed.

A pair of great crested grebes *Podiceps cristatus* were recorded on the lake approximately 400 m north of the amenity route phase during the breeding raptor survey in May. According to BTO criteria (see **Table 2-3**), this pair in suitable breeding habitat is evidence of probable breeding. As this was the only observation of this species, confirmed breeding of this species is considered unlikely.

Mallards were recorded on two occasions. During the April survey, a pair of mallards (one male, one female) were observed flying over the amenity route. During the survey in May, breeding behaviours were observed. Seven mallards were recorded on the lake north of the amenity route, five of which were juveniles (with an adult male and adult female). This observation of downy young is evidence of confirmed breeding for this species according to BTO criteria (see **Table 2-3**).

There were no red listed passerines recorded during the breeding raptor surveys.

3.3 Breeding Wader

The following species accounts provide summary details of the target wader species encountered during the 2024 surveys. The results of the breeding wader survey, with the transect routes and species locations, can be found in Appendix D Figure 3.

3.3.1 Common snipe

Common snipe were recorded during the breeding wader surveys of April and May. During the survey in April, two separate observations were made of a common snipe in suitable breeding habitat, immediately adjacent to the amenity route. A further observation was made of a pair of common snipe in April in suitable breeding habitat in close proximity to the amenity route, within the survey buffer. This is evidence of probable breeding occurring according to the criteria set out in section 2.3.3. A single bird was observed flying directly over the amenity route during the survey in May.

3.3.2 Little egret *Egretta garzetta*

Little egrets were observed in May and June. Of these observations one individual was recorded foraging approximately 300 m northeast of the amenity route. This observation meets the criteria of a possible breeder according to the criteria set out in section 2.3.3.

3.3.3 Northern lapwing

Three northern lapwings were recorded during the breeding wader survey of April. Three birds were observed foraging in suitable breeding habitat within the extension area, east of the amenity route. Northern lapwing have been observed to be probably breeding in this area during the breeding season of 2022 and 2023. This is evidence of probable breeding occurring within the extension area according to the criteria set out in section 2.3.3.

3.3.4 Incidental Recordings

A common buzzard was recorded flying over in April.

Black-headed gulls were recorded during each of the breeding wader surveys. A peak count of thirty black-headed gulls were observed in May in the lake north-east of the amenity route. This is assumed to be the probable breeding colony reported in section 3.2.3.1.



Evidence of breeding mallards was recorded during the breeding wader survey in May. A flock of eleven mallards, consisting of five adults (three males, two females) and six juveniles were recorded approximately 250 m the grid route. According to BTO criteria (outlined in **Table 2-3**), this observation of downy young is evidence of confirmed breeding. Other observations of mallard were made which did not indicate any breeding behaviours.

A single great white egret *Ardea alba* was recorded foraging on the lake north-east of the amenity route. There was no evidence of breeding observed.

3.3.4.1 Amber / Red-listed² Passerines

There were no red-listed passerines recorded during the breeding wader surveys.

The following amber-listed species were recorded: barn swallow *Hirundo rustica*, house martin *Delichon urbicum*, linnet *Linaria cannabina*, and willow warbler *Phylloscopus trochilus*.

Barn swallows were recorded one occasion, during the breeding wader survey in April. A flock of over twenty birds were observed within the 500 m extension area buffer. No evidence of breeding was found for this species.

Flocks of house martins ranging from over twenty to over thirty were observed flying near the prospective location of turbine T10 during two breeding wader surveys. Suitable house martin nesting habitat is present in buildings approximately 900 m north of turbine T10.

Willow warblers were recorded during each of the breeding wader surveys. This species was recorded in the same area (along amenity route), in suitable nesting habitat during the breeding wader survey of April and May. These observations were of three to four birds. According to the BTO criteria outlined in **Table 2-3**; this suggests possible breeding.

Three linnets were recorded nearby suitable breeding habitat during the breeding wader survey of April within the extension area, nearby to T10. According to BTO criteria (see **Table 2-3**) this is evidence of probable breeding.

3.4 Breeding Woodcock Surveys

3.4.1 Eurasian Woodcock

A total of 58 Eurasian woodcock observations were recorded across all the breeding woodcock surveys. Of these observations, 43 were roding flight lines (all consisting of a single male). Other observations included ten recordings of calling Eurasian woodcocks, two flight lines consisting of two males interacting in the air, and three non-roding flight lines.

Details of recorded Eurasian woodcock flightlines are presented in Appendix C and Appendix D and a summary of Eurasian woodcock flight activity is displayed below in **Table 3-3**.

Displaying or 'roding' Eurasian woodcocks were observed at each of the targeted transect areas. Roding flightlines were most frequently recorded at transect B, with 25 of the 43 (58.14%) recorded roding flight lines recorded over the bog woodland in this area (approximately 450 m north of the grid route and over 2 km from the extension area). The highest number of roding flight lines recorded during a single survey was also made the transect B, with a total of 10 roding flight lines. The abundance and frequency of breeding behaviours observed in this area, suggests a breeding territory is present.

The frequency of and abundance of roding flightlines recorded over the conifer plantation during the A transect suggests a probable breeding territory to be present here. Most of these flight lines were within 500 m of the extension area buffer.



A possible breeding territory could also be present in the conifer plantation which was surveyed during transect C. Roding flightlines were recorded during consecutive surveys, all within the amenity route buffer.

The total flight time of all the Eurasian woodcock flight lines was 960 seconds, and 31.25% of this flight time was at potential collision risk heights. This data can be used for collision risk modelling if required.

See Appendix D Figure 4 for the locations of all Eurasian woodcock flight lines.

Table 3-3: Summary of the Breeding Woodcock Surveys

Transect Route	Number of Roding Flight Lines*			Total No. of Roding Flight Lines	Total No. of all Flight Lines	Time at risk height**(s)
	Survey 1	Survey 2	Survey 3			
A	4	3	1	8	9	30
B	10	8	7	25	28	105
C	6	2	0	8	9	165
Total				41	46	300
* all roding flight lines were of an single male bird						
** precautionary risk height assumed to be between 28 – 200 m						

3.4.2 Incidental Species

Further evidence of breeding black-headed gulls on the lake north of amenity route was recorded during a breeding woodcock survey in May. Approximately 80 black-headed gulls were observed on the lake, within the 500 m amenity route buffer. This is assumed to be the same colony reported in sections 3.2.3.1 and 3.3.4.

Common snipe were recorded in multiple breeding woodcock surveys, across all transect routes. In May, an individual snipe was heard drumming within the extension area, approximately 500 m southwest of T10. According to the criteria set out in section 2.3.3 this is evidence of possible breeding occurring within the extension area. Another individual was heard drumming in June, outside of the 500 m extension area buffer.

Two recordings of snipe were made at the lake north of amenity route. One of a drumming individual and another individual chirping. Both observations were within the 500 m amenity route buffer. This is further evidence of probable evidence within the same area reported in section 3.3.1 .

A single observation of a Eurasian whimbrel *Numenius phaeopus* on migration was made in May, flying north of the amenity route; no evidence of breeding was observed.

A great white egret was recorded flying south over the amenity route in June, no breeding behaviours were recorded



4.0 Summary and Conclusions

The following ornithological surveys were carried out on the Project Site during the 2024 breeding season:

- Breeding raptor surveys;
- Breeding wader surveys; and
- Breeding woodcock surveys.

Breeding raptor surveys recorded two target species:

- Common buzzard; and
- Common kestrel.

Evidence of possible breeding for both common buzzard and common kestrel was observed. However, these species are unlikely to present a constraint to the Project as no confirmed evidence of breeding was found within the Project Site or buffer areas. All recordings of breeding behaviours for common buzzard and common kestrel were outside of the recommended disturbance free buffer of 200 m for these species¹².

Breeding wader surveys recorded three target species:

- Common snipe;
- Little egret; and
- Northern lapwing.

Observations of common snipe were made in suitable breeding habitat were made across the survey period and different survey types, providing evidence of probable breeding within the amenity route buffer and possible breeding within the extension area. Considering this, common snipe could present a constraint to the Project if any nests are nearby the amenity route or within the extension area at the time of construction. Although there is no published disturbance-free buffer for snipe during the breeding season, a 500 m separation distance is recommended, as the maximum buffer required for other wader species is 500 m¹².

A possible breeding little egret was observed in suitable breeding habitat within 500 m of the amenity, which could present a constraint to the Project if any nests are found in this area at the time of construction.

Three northern lapwings were observed in suitable breeding habitat east of the amenity route, within the extension area. This is evidence of probable breeding within the Project Site and if any nests are present, could represent a constraint to the Project at the time of construction.

A Eurasian curlew was recorded during a breeding raptor survey in April, but no confirmed breeding was observed.

Evidence of confirmed breeding Eurasian woodcock territories were observed within 500 m of all survey transects. Although there is no published disturbance-free buffer for woodcock during the breeding season, a 500 m separation distance is recommended, as the maximum buffer required for other wader species is 500 m¹². As most roding flight lines were recorded within this 500 m buffer, these breeding woodcock territories could present a constraint to the Project if any nests are present at the time of construction. The buffer would only need to be implemented until the chicks have fledged.

¹² Goodship, N.M. and Furness, R.W. 2022. Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species. A report from MacArthur Green to NatureScot.



Collision risk for Eurasian woodcock must also be considered as 31.25% of their flight activity was recorded within potential collision risk heights.

Incidental recordings of note are discussed below.

Probable breeding black-headed gulls were recorded on the lake north of the amenity route (within the 500 m buffer), across all types of surveys. A peak flock count of approximately 80 birds was recorded during a breeding woodcock survey. Considering the proximity of this probable breeding colony to the amenity trail, this species could present a constraint to the Project if present at the time of construction.

Evidence of breeding mallard ducks was observed during both breeding wader and breeding raptor surveys. During a breeding wader survey, a flock consisting of five adults and six juveniles were recorded approximately 250 m of the proposed grid route. During a breeding raptor survey, a flock of seven mallards were observed on the lake north of the amenity route, five of which were juveniles. These observations indicate that confirmed breeding is occurring nearby to the amenity route and grid route and could present a constraint to the Project if any nests are present at the time of construction.

Evidence of probable breeding willow warbler was observed along the amenity route. Similarly, linnets also displayed evidence of probable breeding within the extension area, nearby to T10. These species could present a constraint to the Project. While NS guidance generally accepts that passerines do not present major constraints to wind farm developments, it would be prudent to undertake nest checks for these species prior to construction to avoid destruction of nests until breeding has finished.



5.0 Legal and Conservation Status of Target Species Recorded

Table 5-1 summarises the legal and conservation status of the target species recorded during the range of ornithology surveys mentioned above.

Table 5-1: Legal and Conservation Status of Recorded Species

Species (BTO Code)	Legal & Conservation Status in Ireland
Barn swallow (SL)	BoCCI4 Amber
Black-headed gull (BH)	BoCCI4 Amber
Common buzzard (BZ)	BoCCI4 Green
Common kestrel (K.)	BoCCI4 Red
Common snipe (SN)	BoCCI4 Red
Eurasian curlew (CU)	BoCCI4 Red
Eurasian whimbrel (WM)	BoCCI4 Green
Great crested grebe (GG)	BoCCI4 Amber
Great white egret (HW)	Annex I; Not categorised in BoCCI4
House martin (HM)	BoCCI4 Amber
Lesser black-backed gull (LB)	BoCCI4 Amber
Little egret (ET)	Annex I; BoCCI4 Green
Mallard (MA)	BoCCI4 Amber
Northern lapwing (L.)	BoCCI4 Red
Willow warbler (WW)	BoCCI4 Amber
Key: Annex I – the species is listed in Annex I of the EC Birds Directive ¹³ ; and BoCCI4 ² status (green, amber or red) – indicates the current Birds of Conservation Concern in Ireland status category	

¹³ Annex I of the Birds Directive (Directive 2009/147/EC)





Appendix A Survey Dates, Times and Observers¹⁴

Bird Survey Report Breeding Season 2024

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

23 September 2024

¹⁴ A list of surveyor initials is provided in section 2.3.1

Table A-1: Details of Breeding Raptor Surveys

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
29/04/2024	DN	12:45	17:00	04:15
23/05/2024	DN	10:45	15:00	04:15
07/06/2024	DN	08:40	13:20	04:40
17/07/2024	DN	11:00	16:00	05:00
Total Hours				18:10

Table A-2: Details of Breeding Wader Surveys

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
30/04/2024 (dawn)	DN	05:20	08:12	02:52
30/04/2024 (dusk)	DN	18:35	21:30	02:55
22/05/2024 (dawn)	DN	04:35	07:35	03:00
22/05/2024 (dusk)	DN	19:22	22:03	02:41
05/06/2024 (dusk)	DN	19:45	22:45	03:00
06/06/2024 (dawn)	DN	04:20	07:20	03:00
Total Hours				17:28

Table A-3: Details of Breeding Woodcock Surveys Transect A

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
13/05/2024	AA	21:06	22:21	01:15
12/06/2024	AA	21:43	22:58	01:15
21/06/2024	AA	21:47	23:02	01:15
Total Hours				03:45

Table A-4: Details of Breeding Woodcock Surveys Transect B

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
09/05/2024	AA	21:00	22:15	01:15
05/06/2024	AA	21:37	22:52	01:15
18/06/2024	AA	21:46	23:01	01:15
Total Hours				03:45

Table A-5: Details of Breeding Woodcock Surveys Transect C

Date	Surveyor	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
08/05/2024	AA	20:45	22:10	01:15
04/06/2024	AA	21:36	22:51	01:15
19/06/2024	AA	21:46	23:01	01:15
Total Hours				03:45





Appendix B Weather Data¹⁵

Bird Survey Report Breeding Season 2024

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

23 September 2024

¹⁵ Key: Rain: None = 0, light showers/snow = 2, heavy showers = 3, heavy rain/snow = 4; cloud cover: expressed in oktas (n/8); height of cloud above average height of viewshed: <150 m = 0, 150-500 m = 1, >500 m = 2; visibility: poor (<1 km) = 0, moderate (1-3 km) = 1 and good (>3 km) = 2; snow: none = 0, on site = 1, on higher ground = 2; frost: none = 0, ground = 1 and all day = 2.

Table B-1: Weather Data Collected During Breeding Raptor Surveys

Date	Survey Start	Survey End	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
29/04/2024	12:45	17:00	1	5	W	0	6	2	2	0	0	9
29/04/2024	12:45	17:00	2	5	W	0	5	2	2	0	0	13
29/04/2024	12:45	17:00	3	4	W	0	6	2	2	0	0	13
29/04/2024	12:45	17:00	4	4	W	0	6	2	2	0	0	13
23/05/2024	10:45	15:00	1	4	NW	0	7	2	2	0	0	11
23/05/2024	10:45	15:00	2	3	NW	0	8	2	2	0	0	12
23/05/2024	10:45	15:00	3	3	NW	0	8	2	2	0	0	12
23/05/2024	10:45	15:00	4	3	NW	0	8	2	2	0	0	12
07/06/2024	08:40	13:20	1	3	W	0	7	2	2	0	0	13
07/06/2024	08:40	13:20	2	3	W	0	8	2	2	0	0	13
07/06/2024	08:40	13:20	3	3	W	1	8	2	2	0	0	13
07/06/2024	08:40	13:20	4	3	W	0	8	2	2	0	0	14
07/06/2024	08:40	13:20	5	3	W	0	8	2	2	0	0	14
17/07/2024	11:00	16:00	1	3	SW	1	8	2	2	0	0	16
17/07/2024	11:00	16:00	2	3	SW	1	7	2	2	0	0	17
17/07/2024	11:00	16:00	3	3	SW	0	7	2	2	0	0	17
17/07/2024	11:00	16:00	4	3	SW	1	8	2	2	0	0	17
17/07/2024	11:00	16:00	5	3	SW	1	8	2	2	0	0	17



Table B-2: Weather Data Collected During Breeding Wader Surveys

Date	Survey Start	Survey End	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
30/04/2024	05:20	08:12	1	2	W	0	6	2	2	0	0	8
30/04/2024	05:20	08:12	2	2	W	0	7	2	2	0	0	9
30/04/2024	05:20	08:12	3	3	W	0	6	2	2	0	0	9
30/04/2024	18:35	21:30	1	2	W	0	3	2	2	0	0	10
30/04/2024	18:35	21:30	2	3	W	0	4	2	2	0	0	11
30/04/2024	18:35	21:30	3	2	W	0	3	2	2	0	0	11
22/05/2024	04:35	07:35	1	3	NW	1	8	2	2	0	0	8
22/05/2024	04:35	07:35	2	3	NW	0	8	2	2	0	0	8
22/05/2024	04:35	07:35	3	3	NW	0	8	2	2	0	0	9
22/05/2024	19:22	22:03	1	3	NW	0	7	2	2	0	0	11
22/05/2024	19:22	22:03	2	3	NW	2	8	2	2	0	0	12
22/05/2024	19:22	22:03	3	3	NW	1	8	2	2	0	0	12
05/06/2024	19:45	22:45	1	2	W	0	7	2	2	0	0	12
05/06/2024	19:45	22:45	2	2	W	0	6	2	2	0	0	11
05/06/2024	19:45	22:45	3	2	W	0	6	2	2	0	0	11
06/06/2024	04:20	07:20	4	2	W	0	4	2	2	0	0	8
06/06/2024	04:20	07:20	5	2	W	0	5	2	2	0	0	9
06/06/2024	04:20	07:20	6	2	W	0	5	2	2	0	0	9



Table B-3: Weather Data Collected During Breeding Woodcock Surveys Transect A

Date	Survey Start	Survey End	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
13/05/2024	21:06	22:21	1	2	SE	0	3	2	2	0	0	13
13/05/2024	21:06	22:21	2	2	SE	0	4	2	2	0	0	11
12/06/2024	21:43	22:58	1	2	S	0	7	2	2	0	0	15
12/06/2024	21:43	22:58	2	2	S	0	7	2	2	0	0	13
21/06/2024	21:47	23:02	1	3	W	0	1	2	2	0	0	12
21/06/2024	21:47	23:02	2	2	W	0	3	2	2	0	0	10

Table B-4: Weather Data Collected During Breeding Woodcock Surveys Transect B

Date	Survey Start	Survey End	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
09/05/2024	21:00	22:15	1	2	S	0	8	2	2	0	0	16
09/05/2024	21:00	22:15	2	2	S	0	8	2	2	0	0	15
05/06/2024	21:37	22:52	1	2	W	0	7	2	2	0	0	11
05/06/2024	21:37	22:52	2	1	W	0	8	2	2	0	0	10
18/06/2024	21:46	23:01	1	3	N	0	7	2	2	0	0	13
18/06/2024	21:46	23:01	2	3	N	0	7	2	2	0	0	13



Table B-5: Weather Data Collected During Breeding Woodcock Surveys Transect C

Date	Survey Start	Survey End	Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
08/05/2024	20:45	22:10	1	2	S	0	5	2	2	0	0	16
08/05/2024	20:45	22:10	2	2	S	0	5	2	2	0	0	15
04/06/2024	21:36	22:51	1	3	NW	0	3	2	2	0	0	10
04/06/2024	21:36	22:51	2	0	NW	0	2	2	2	0	0	7
19/06/2024	21:46	23:01	1	2	W	0	2	2	2	0	0	14
19/06/2024	21:46	23:01	2	2	W	0	2	2	2	0	0	12





Appendix C Breeding Woodcock Survey Results¹⁶

Bird Survey Report Breeding Season 2024

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

23 September 2024

¹⁶ Species BTO codes are given in Section 5.0; age: U = unidentified, Ad = adult and Juv = juvenile; sex: U = unidentified, M = male, F = female, F / I = female or immature; observation type: 1 = roding flight line, 2 = non roding flight line, 3 = heard only, 4 = two males interacting

Table C-1: Results of Breeding Woodcock surveys undertaken at Transect A

Date	Flight ID	BTO Code	No. Birds	Age	Sex	Obs. Time	Obs. Type	Flight Time (s)
13/05/2024	1	WK	1	U	M	21:30	3	-
13/05/2024	2	WK	1	U	M	21:44	3	-
13/05/2024	3	WK	1	U	M	21:48	1	15
13/05/2024	4	WK	1	U	M	21:53	1	30
13/05/2024	5	WK	1	U	M	21:55	1	30
13/05/2024	6	WK	1	U	M	21:55	1	30
13/05/2024	7	SN	1	U	M	22:14	3	-
12/06/2024	1	WK	2	U	M	22:02	4	45
12/06/2024	2	WK	1	U	M	22:40	1	15
12/06/2024	3	WK	1	U	M	22:53	1	15
12/06/2024	4	SN	1	U	M	22:55	3	-
12/06/2024	5	WK	1	U	M	22:55	1	30
21/06/2024	1	WK	1	U	M	22:37	1	45
21/06/2024	2	WK	1	U	M	22:50	3	-

Table C-2: Results of Breeding Woodcock surveys undertaken at Transect B

Date	Flight ID	BTO Code	No. Birds	Age	Sex	Obs. Time	Obs. Type	Flight Time (s)
09/05/2024	1	WK	1	U	M	21:08	3	-
09/05/2024	2	WK	1	U	M	21:13	1	15
09/05/2024	3	WK	1	U	M	21:13	1	15
09/05/2024	4	WK	1	U	M	21:14	1	15
09/05/2024	5	WK	1	U	M	21:17	1	15
09/05/2024	6	WK	1	U	M	21:23	1	15
09/05/2024	7	WK	1	U	M	21:16	1	15
09/05/2024	8	WK	2	U	M	21:32	4	30
09/05/2024	9	WK	1	U	M	21:39	1	15
09/05/2024	10	WK	1	U	M	21:42	1	15
09/05/2024	11	WK	1	U	M	21:48	1	15
09/05/2024	12	WK	1	U	M	21:52	1	15
09/05/2024	13	WK	1	U	M	22:00	3	-
09/05/2024	14	SN	1	U	U	22:14	3	-
05/06/2024	1	WK	1	U	M	21:52	1	15
05/06/2024	2	WK	1	U	M	21:52	1	15
05/06/2024	3	WK	2	U	M	22:00	2	15



Date	Flight ID	BTO Code	No. Birds	Age	Sex	Obs. Time	Obs. Type	Flight Time (s)
05/06/2024	4	WK	1	U	M	22:06	3	-
05/06/2024	5	WK	1	U	M	22:09	1	15
05/06/2024	6	WK	1	U	M	22:10	1	15
05/06/2024	7	WK	1	U	M	22:12	1	15
05/06/2024	8	WK	1	U	M	22:13	3	-
05/06/2024	9	WK	1	U	M	22:22	1	30
05/06/2024	10	WK	1	U	M	22:31	1	15
05/06/2024	11	WK	1	U	M	22:39	3	-
05/06/2024	12	WK	1	U	M	22:45	1	15
18/06/2024	1	WK	1	U	M	22:02	3	-
18/06/2024	2	WK	1	U	M	22:04	1	15
18/06/2024	3	WK	1	U	U	22:07	2	15
18/06/2024	4	WK	1	U	M	22:19	1	15
18/06/2024	5	WK	1	U	M	22:23	1	15
18/06/2024	6	WK	1	U	M	22:26	1	15
18/06/2024	7	WK	1	U	M	22:31	1	15
18/06/2024	8	WK	1	U	M	22:38	1	15
18/06/2024	9	WK	1	U	M	22:47	3	-
18/06/2024	10	WK	1	U	M	22:54	1	15

Table C-3: Results of Breeding Woodcock surveys undertaken at Transect C

Date	Flight ID	BTO Code	No. Birds	Age	Sex	Obs. Time	Obs. Type	Flight Time (s)
08/05/2024	1	WM	1	U	U	21:04	2	50
08/05/2024	2	WK	1	U	M	21:24	1	45
08/05/2024	3	WK	1	U	M	21:26	1	30
08/05/2024	4	WK	1	U	M	21:29	1	30
08/05/2024	5	WK	1	U	M	21:32	1	45
08/05/2024	6	WK	1	U	M	21:34	1	30
08/05/2024	7	WK	1	U	M	21:44	3	-
08/05/2024	8	WK	1	U	M	21:46	1	30
08/05/2024	9	WK	1	U	M	21:55	3	-
08/05/2024	10	WK	1	U	M	21:58	2	15
04/06/2024	1	SN	1	U	U	21:52	2	60
04/06/2024	2	HW	1	U	U	21:55	2	75
04/06/2024	3	WK	1	U	M	22:15	1	45



Date	Flight ID	BTO Code	No. Birds	Age	Sex	Obs. Time	Obs. Type	Flight Time (s)
04/06/2024	4	WK	1	U	M	22:17	1	45
19/06/2024	1	SN	1	U	M	22:54	3	-
19/06/2024	2	SN	1	U	M	23:01	3	-





Appendix D Figures

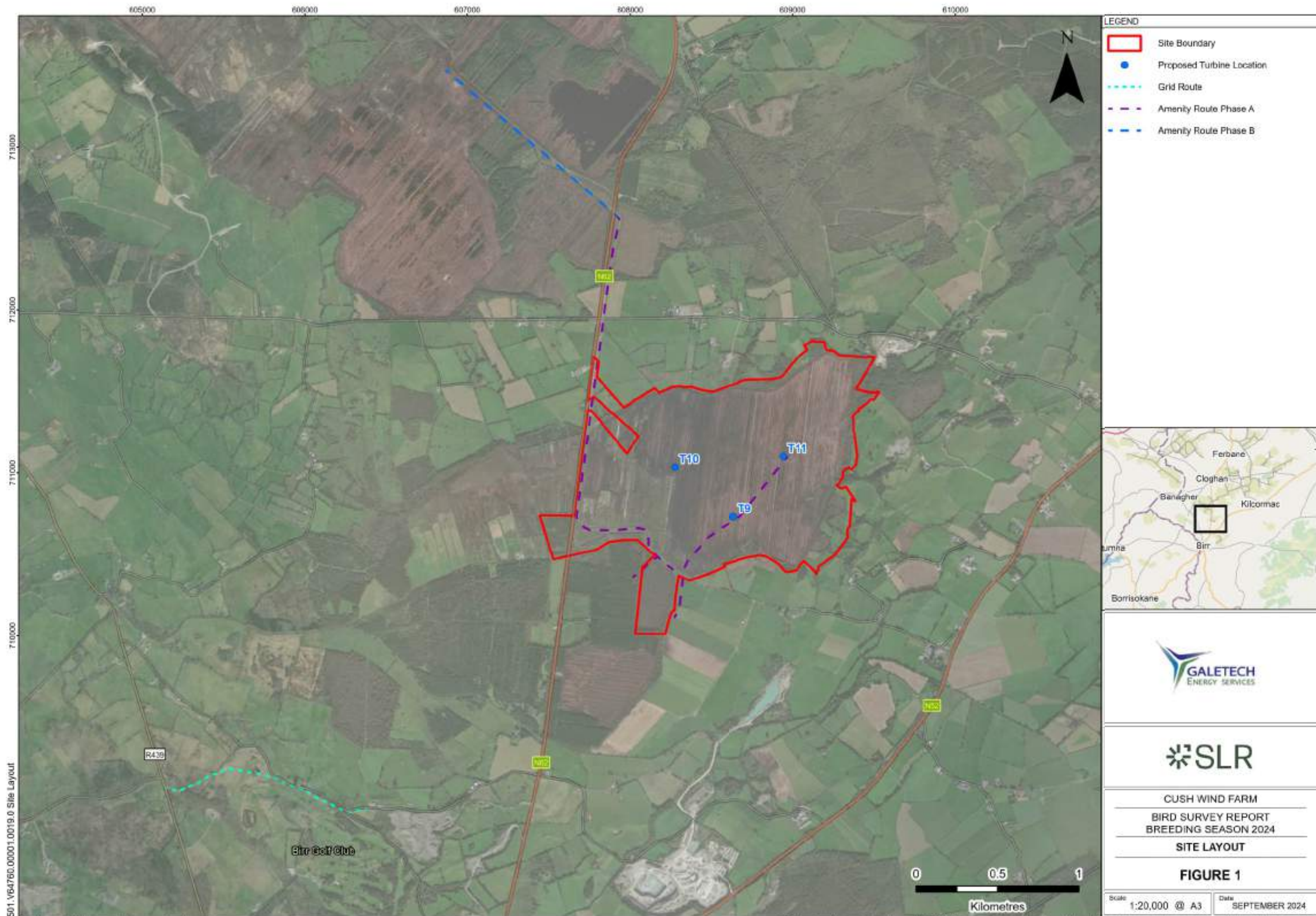
Bird Survey Report Breeding Season 2024

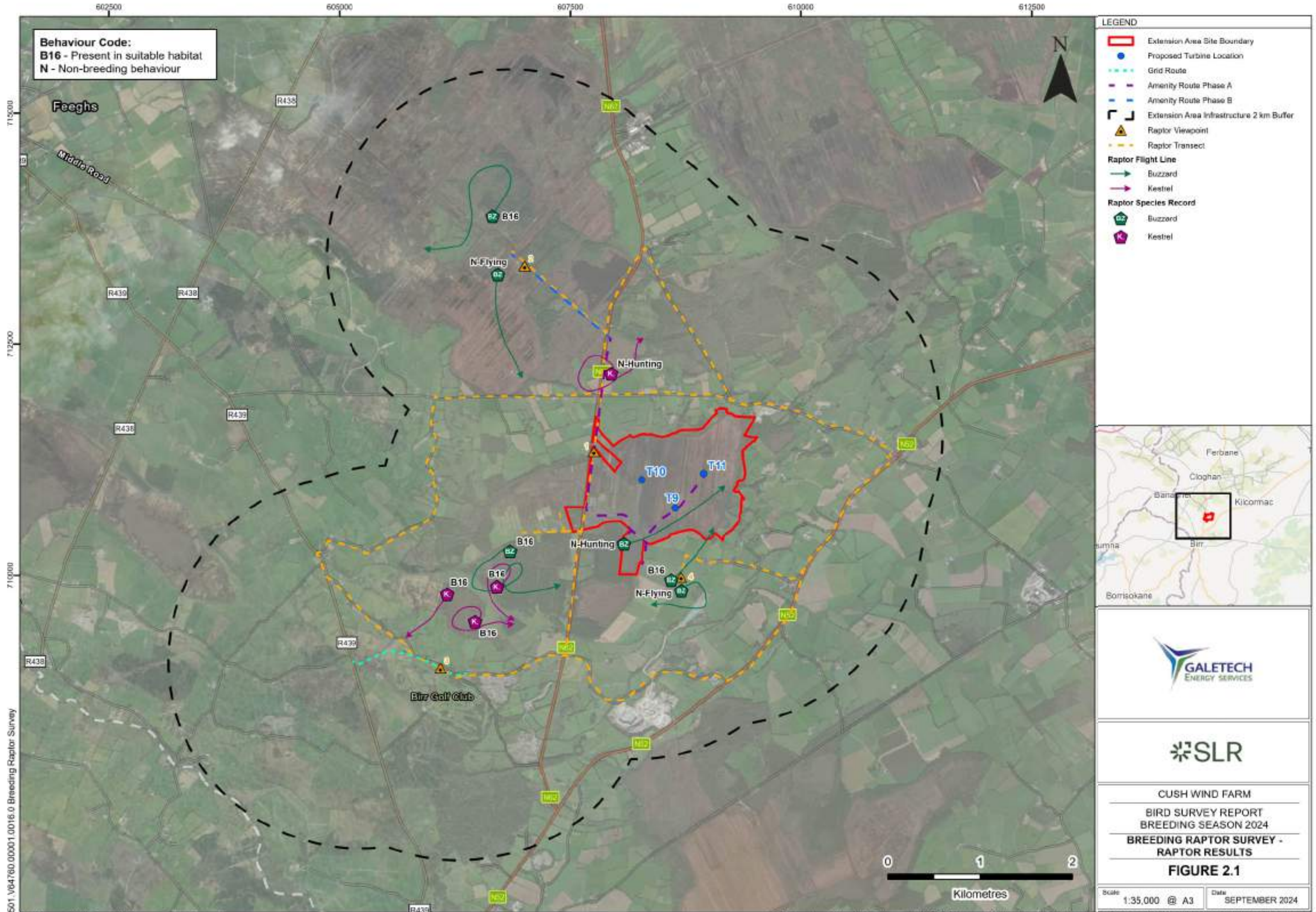
Cush Wind Farm

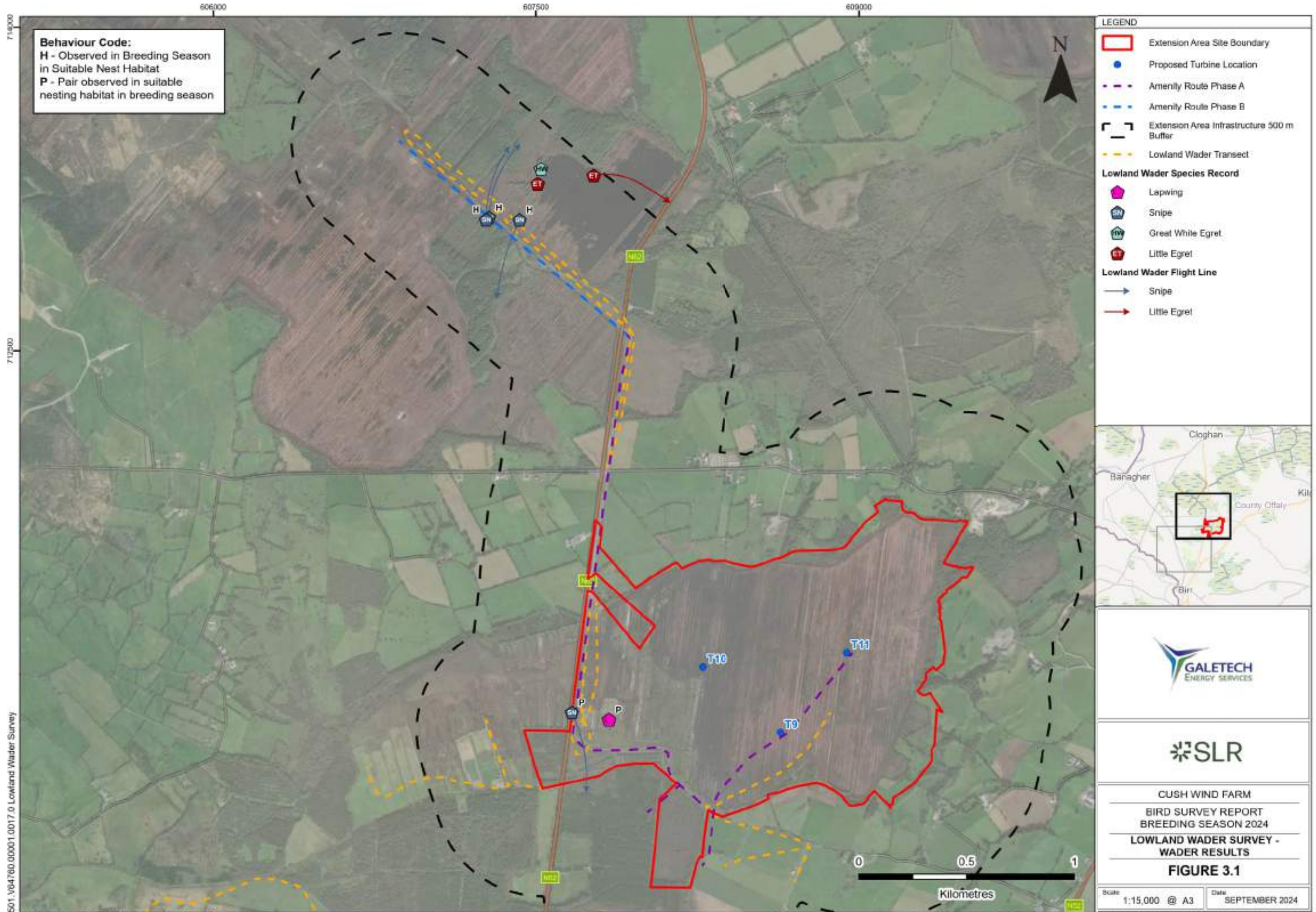
Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

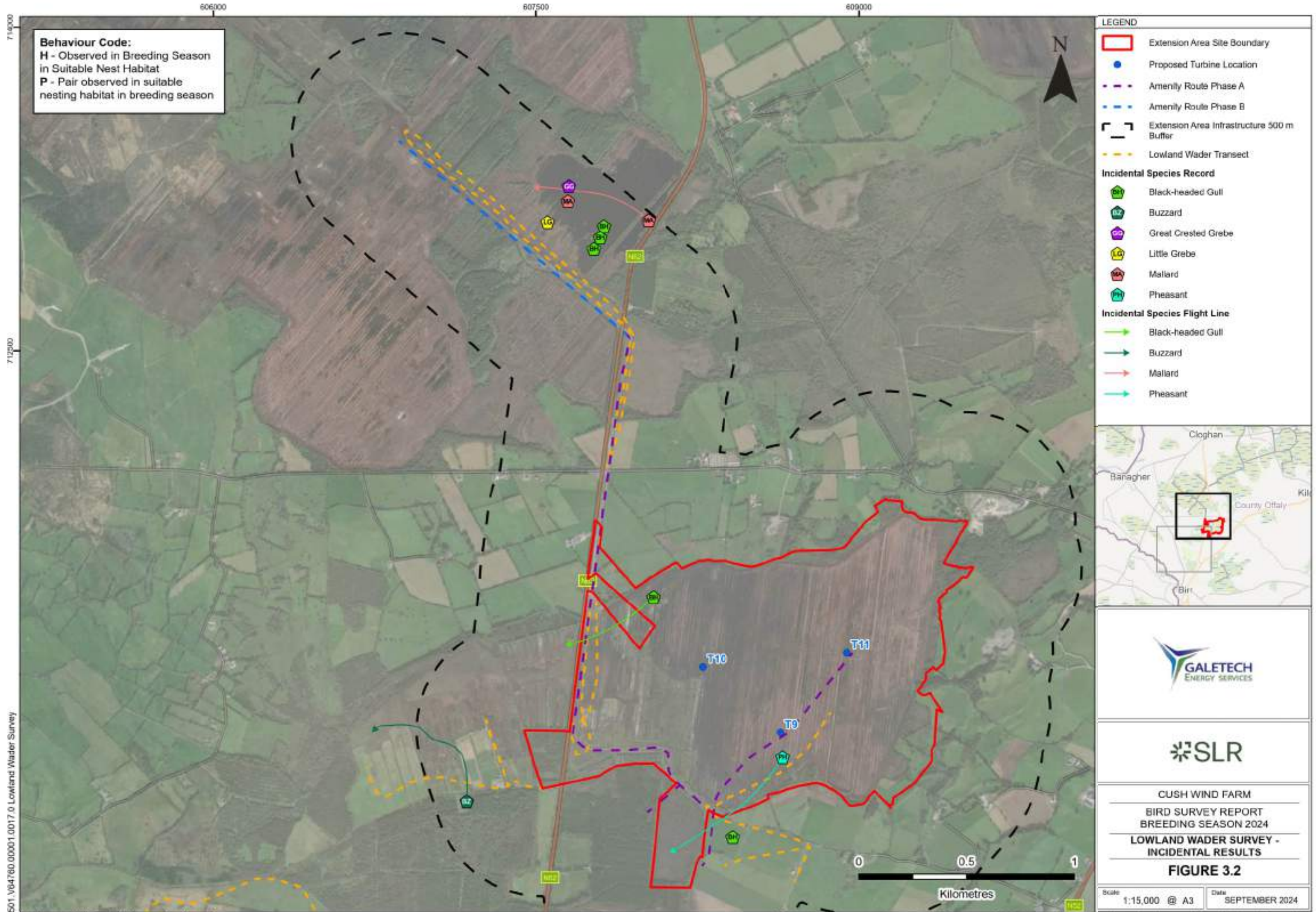
23 September 2024



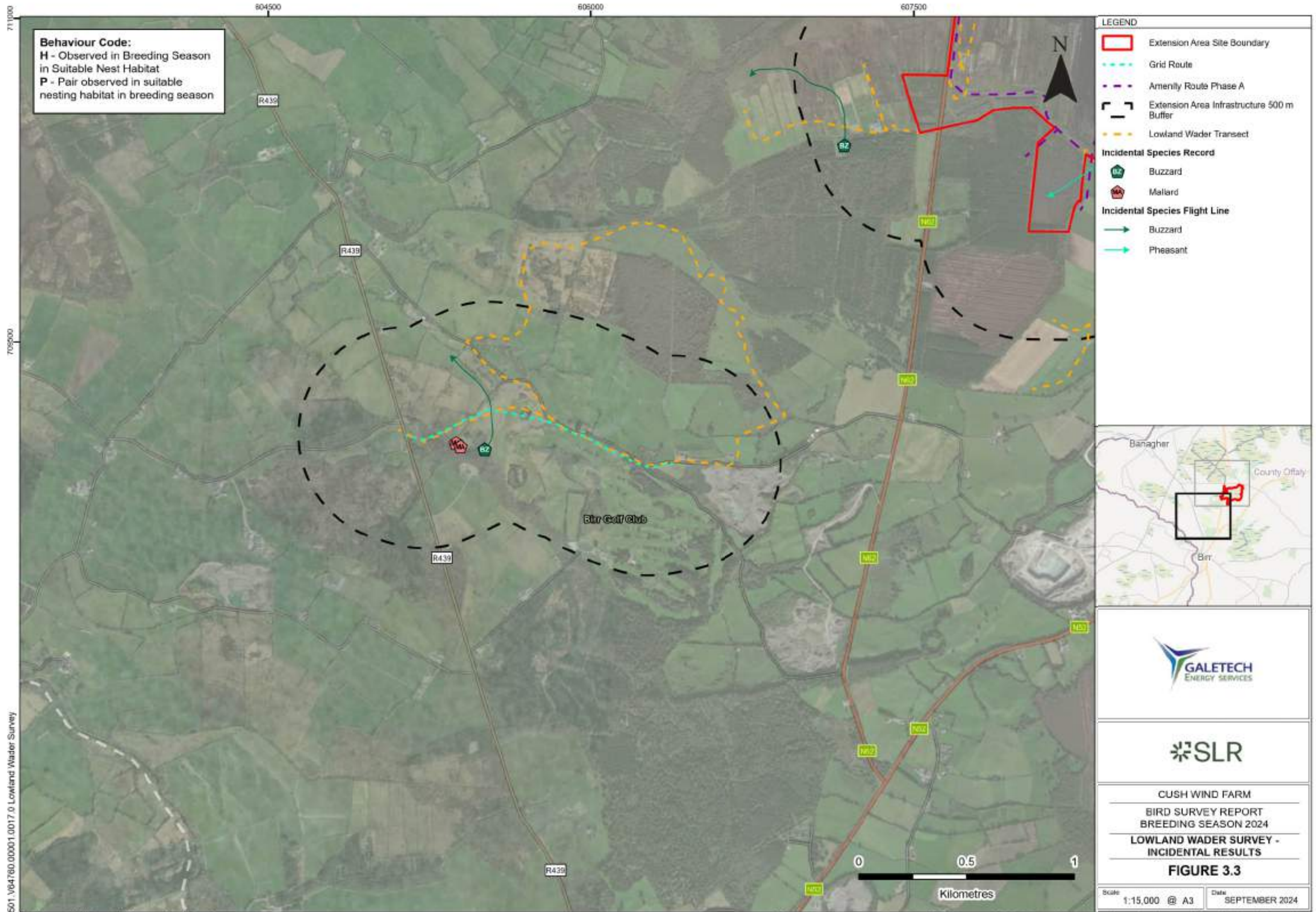




501_V04760.00001.0017.0 Lowland Wader Survey



501_V04760.00001.0017.0 Lowland Wader Survey



Behaviour Code:
H - Observed in Breeding Season in Suitable Nest Habitat
P - Pair observed in suitable nesting habitat in breeding season

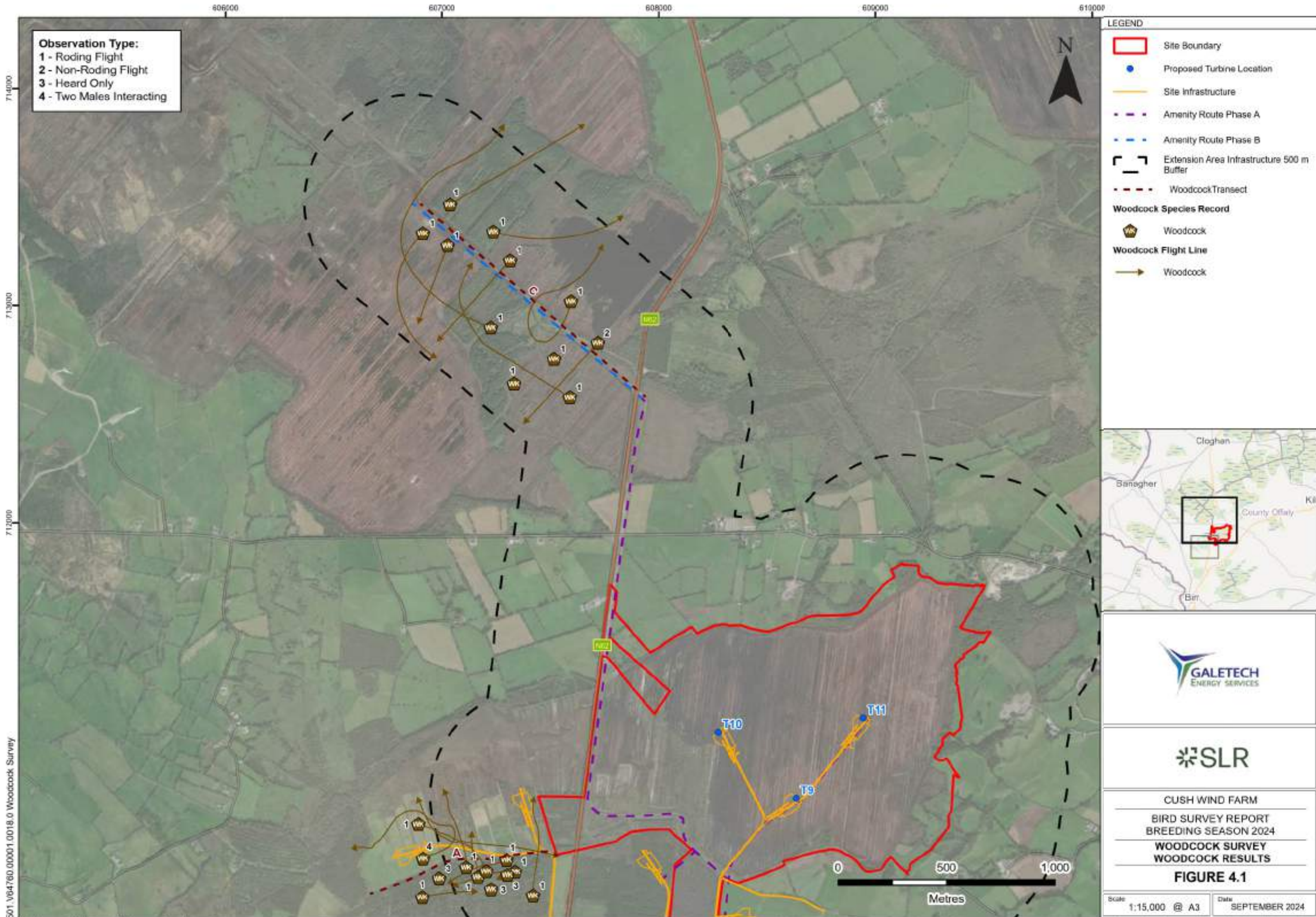
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- Extension Area Site Boundary
 - Grid Route
 - Amenity Route Phase A
 - Extension Area Infrastructure 500 m Buffer
 - Lowland Wader Transect
 - Incidental Species Record**
 - Buzzard
 - Mallard
 - Incidental Species Flight Line**
 - Buzzard
 - Pheasant

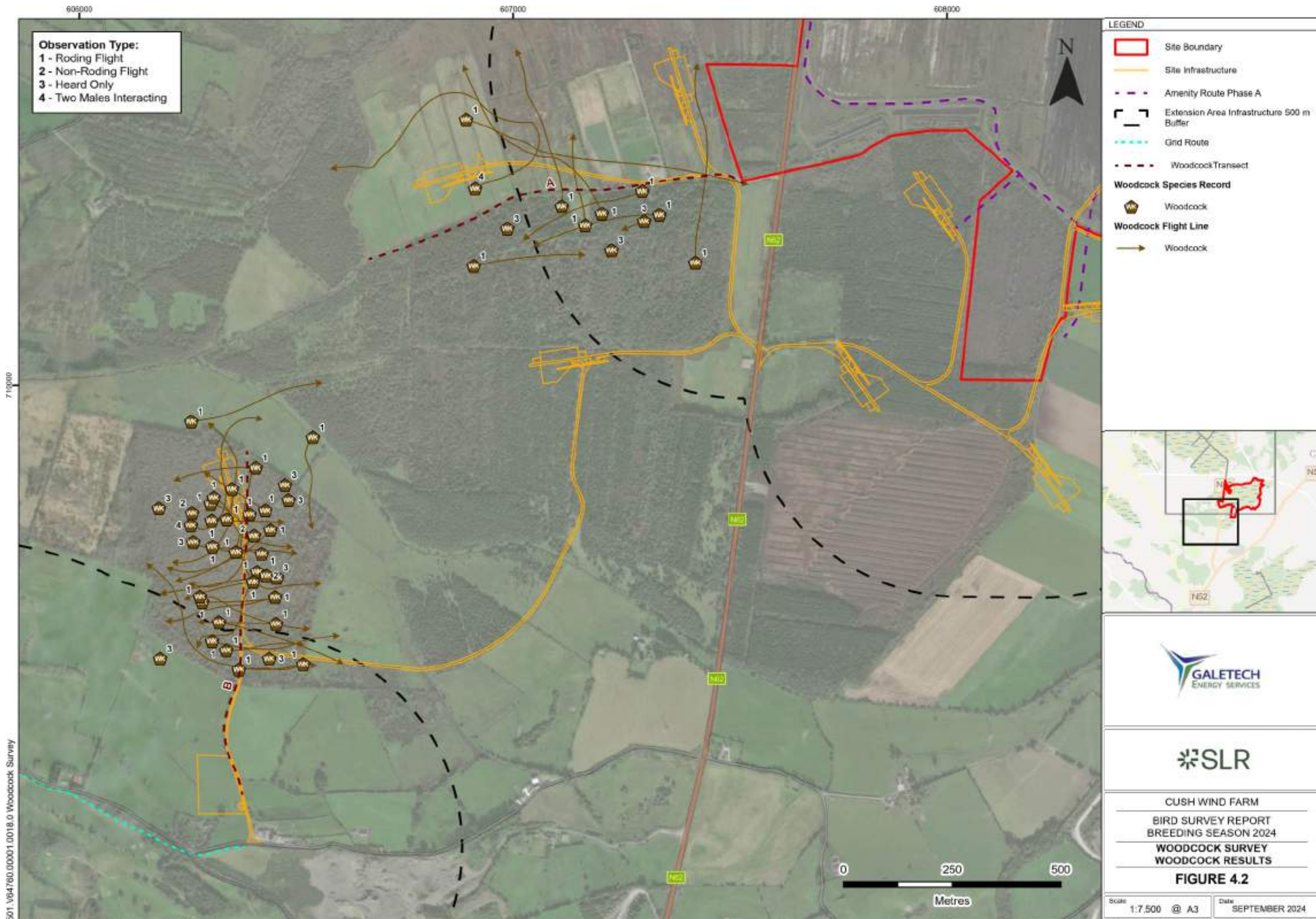


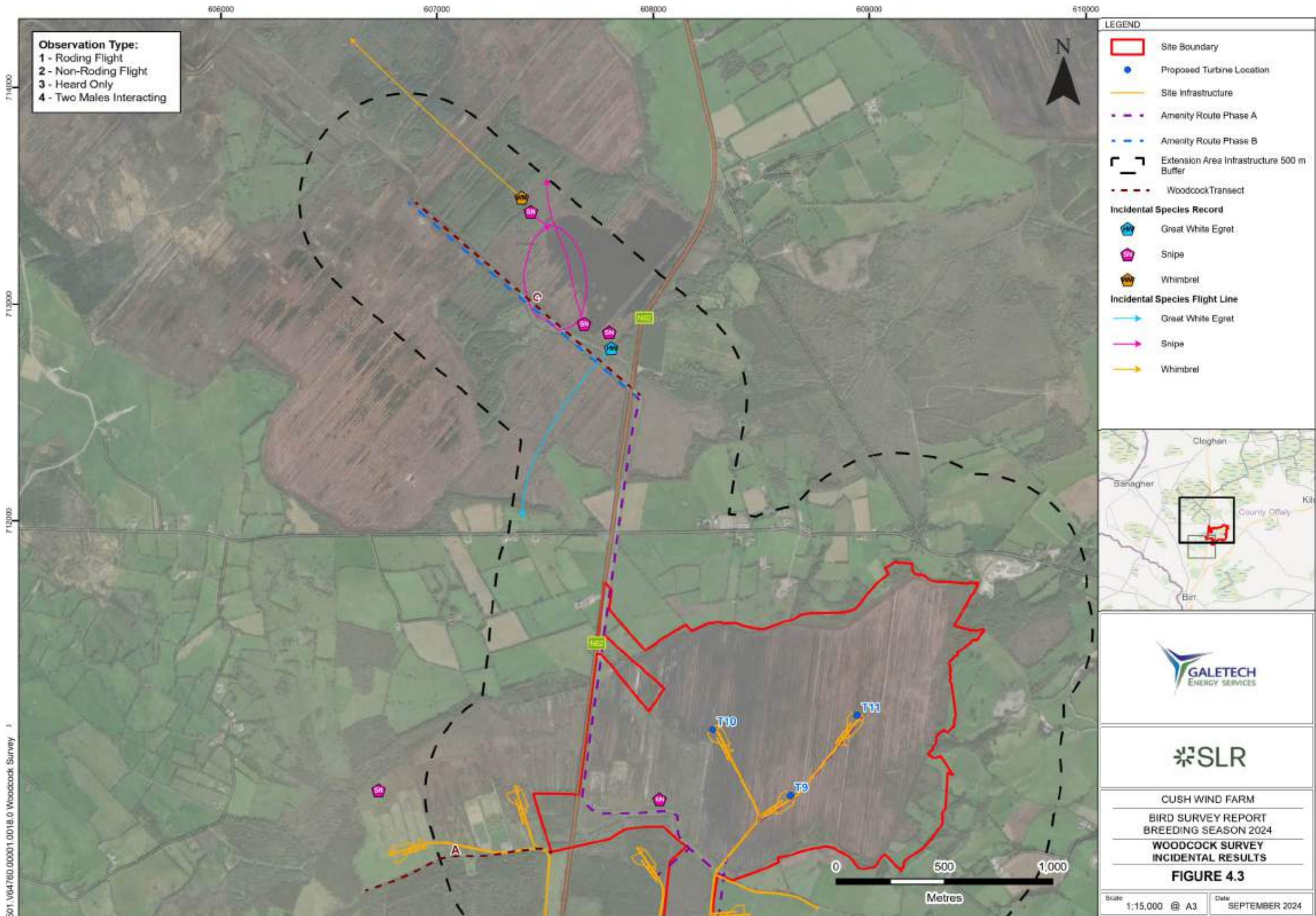
CUSH WIND FARM
BIRD SURVEY REPORT
BREEDING SEASON 2024
LOWLAND WADER SURVEY -
INCIDENTAL RESULTS

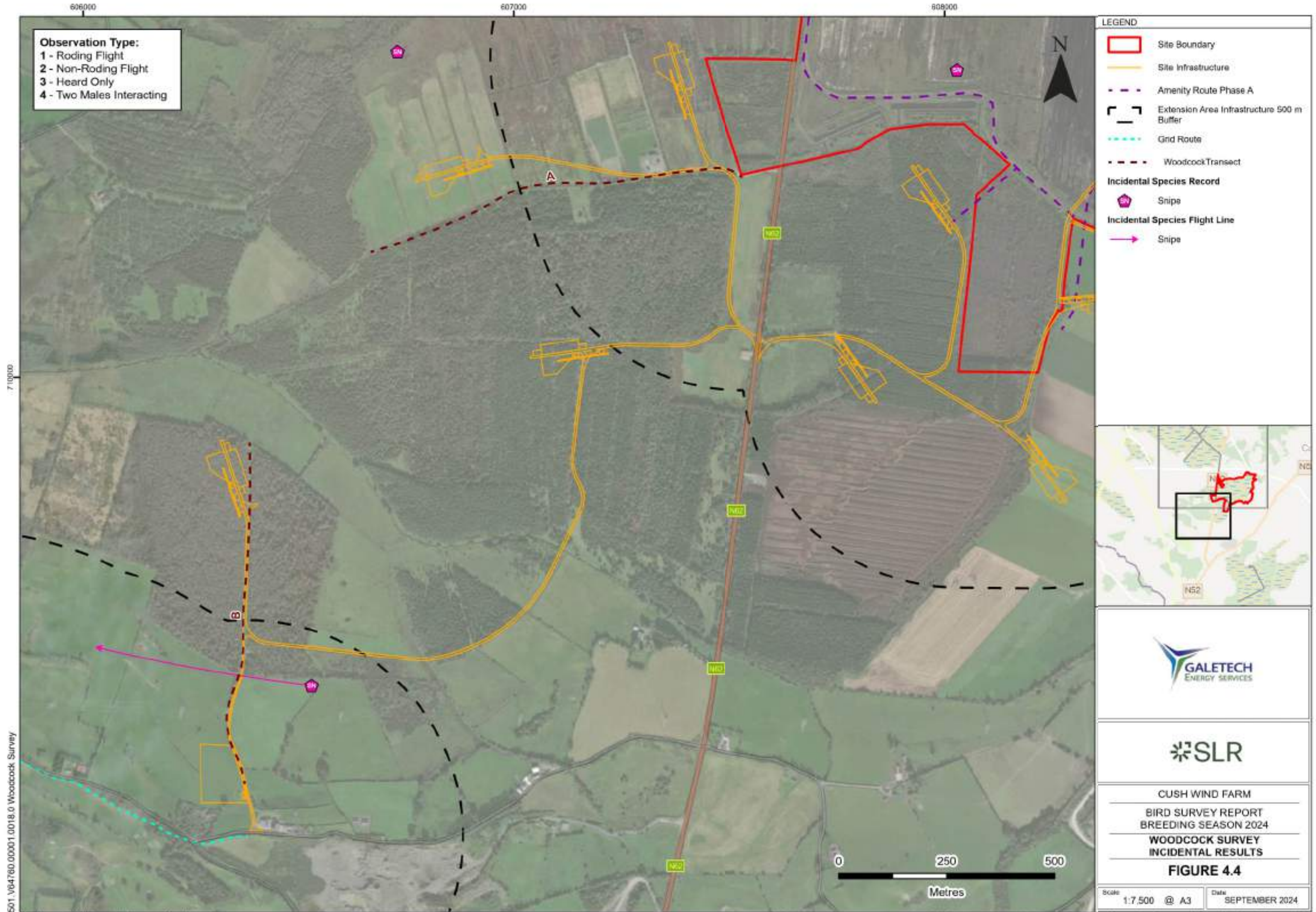
FIGURE 3.3

Scale: 1:15,000 @ A3 Date: SEPTEMBER 2024









501_V04760.00001.0018.0 Woodcock Survey





Baseline Ornithology Report – Non Breeding Bird Surveys 2024/25

Cush Wind Farm Phase 2

Cush Wind Farm Ltd

Clondargan, Stradone, Co. Cavan

Prepared by:

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SLR Project No.: 501.065415.00001

Client Reference No: N/A

13 August 2025

Revision: 0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	13 August 2025	Derbhla Moore	Dr Jonathon Dunn	Dr Jonathon Dunn
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

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Executive Summary

The proposed development comprises an extension to Cush Wind Farm, located in the townland of Cush, approximately 4 km north of Birr, Co. Offaly. The project includes three turbines, a grid connection route, and an amenity trail, with part of the trail overlapping Lough Coura pNHA. The site is primarily made up of conifer plantations, cutaway bog, and agricultural grassland.

The purpose of this report is to describe the baseline ornithological conditions recorded during the non-breeding season of 2024/25. The suite of surveys undertaken followed best-practice guidance as set out by NatureScot (2025), and included swan and goose feeding distribution surveys, nocturnal wader surveys, and nocturnal migration watch surveys during autumn and spring. The focus was on species of conservation concern and qualifying interests of nearby Special Protection Areas (SPAs).

Survey results showed generally low levels of target species activity across all methods. Feeding distribution surveys recorded low numbers of whooper swan (peak count of three birds) within the site on a single occasion and mute swan (peak count of two birds) at lands approximately 1.2 km from the site on two occasions. Northern lapwing and black-headed gull were occasionally recorded at the lake at Clooneen north of the amenity trail in small numbers, and northern lapwing were recorded once in small numbers to the southeast of the project site. Small numbers of northern lapwing and common snipe were occasionally recorded during nocturnal wader surveys in the same location. Only low numbers of mallard and snipe were recorded during migration watch surveys but there was no evidence of any bird species undergoing migration.

Overall, the results do not indicate any major constraints to the project. No further surveys or analysis are recommended currently.



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Appendix B Survey Metadata

B.1 Survey Dates, Times and Surveyors

B.2 Survey Weather

Appendix C Bird species names



Acronyms and Abbreviations

AA	Appropriate Assessment
BoCCI	Birds of Conservation Concern Ireland
CIEEM	Chartered Institute of Ecology and Environmental Management
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
GIS	Geospatial Information Systems
IOC	International Ornithology Committee
NBDC	National Biodiversity Data Centre
NHA	Natural Heritage Area
NS	NatureScot
NPWS	National Parks and Wildlife Service
pNHA	proposed Natural Heritage Area
The Project	Cush Wind Farm Phase 2
The Project Site	The application site
RVP	Raptor Vantage Point
SNH	Scottish Natural Heritage
SPA	Special Protection Area
VP	Vantage Point
ZTV	Zones of Theoretical Visibility



1.0 Introduction

1.1 Purpose of this report

SLR Environmental Consulting (Ireland) Ltd (SLR) was commissioned by Cush Wind Farm Ltd to carry out baseline bird surveys during the 2024/25 bird non-breeding season at a proposed wind farm (hereafter ‘the Project’) at Cush Phase 2, Co. Offaly. This report documents the methods and results of those surveys. The assessment of impacts resulting from the Project and the identification of mitigation measures are beyond the scope of this report and will be covered in a separate Environmental Impact Assessment (EIA) report in due course.

1.2 Project and Site description

The Project is located in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946, and the developable area (hereafter ‘the Site’) is illustrated in Figure 1, Appendix A. The Project comprises three wind turbines with a tip height of 200m, rotor diameter of 172 m and hub height of 114 m, an underground electricity cable and an amenity trail.

The habitats within the Project Site and are dominated by conifer plantations, cutaway bog and agricultural grasslands.

1.3 Evidence of technical competence and experience

Surveys were undertaken by Darragh Nagle (DN) Qualifying member of CIEEM, a Project Ecologist at SLR with over three years of ecological consulting experience, Faolán Linnane (FL) Qualifying member of CIEEM, a Senior Ecologist at SLR with five years of ecological consulting experience and Jake Matthews (JM) Associate member of CIEEM, a Senior Ecologist at SLR with over five years of ecological consulting experience. The report was authored by Derbhla Moore (DM) Qualifying member of CIEEM, a Graduate Ecologist at SLR with six months of ecological consulting experience. Technical review was conducted by Jonathon Dunn (JD) MCIEEM, an Associate Ornithologist at SLR with over ten years of ecological consulting experience.

1.4 Nomenclature

The nomenclature throughout this report follows The IOC (International Ornithological Committee; now renamed as International Ornithologist’s Union) World Bird List (version 15.1¹). A full list of the species is referred to in this report, including scientific names, is provided in Appendix C.

1.5 Terminology

For this report “flight line” refers to the line drawn to record avian movement. A single flight line may be used to indicate the collective movement of a flock of birds. Each bird moving within the same flight line is referred to as a “flight”. The cumulative number of flights reflects occupancy of the study area by a particular species and not abundance.

¹ Gill, F, D Donsker, and P Rasmussen (Eds). 2024. IOC World Bird List (v 15.1). Doi 10.14344/IOC.ML.14.2. <http://www.worldbirdnames.org/>



1.6 Relevant legislation

Legislation relevant to this report includes the European Council (EC) directive 2009/147/EC ('the Birds Directive') and the Wildlife Act (1976, as amended). Birds listed under Annex I of the Birds Directive are afforded strict protection at the European and national level. All Irish birds are protected by the Wildlife Act.



2.0 Methodology

2.1 Scope of Work

The scope of survey work during the non-breeding season was based on knowledge of the Project Site acquired during the scoping survey, a desk-based review and access to lands within and surrounding the Project Site. It also considered current NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance².

NS guidance states that *“it is generally considered the passerine species are not significantly impacted by wind farms”*. It goes on to state that *“survey of woodland passerines, especially in commercial conifer forest is generally not required”*. The only exception is if the desk study identifies that the Project Site is in a key area for a Schedule 1 woodland passerine species. As Schedule 1 refers to UK legislation, it is prudent to assume that woodland passerines red-listed under the latest Birds of Conservation Concern in Ireland (BoCCI)³ scheme should be considered as equivalent. No such species were returned during the desk-based review or data request

NS guidance also states that *“surveys of farmland passerines especially on more intensive arable habitat are generally not required”*. Based on the above, while not the targets, any red-listed passerines were recorded as incidental species during other surveys.

2.2 Desk study

2.2.1 Designated sites

A search was undertaken using the NPWS⁴ website for Special Protection Areas (SPA), Natural Heritage Areas (NHA), proposed NHAs (pNHA) and Ramsar sites, with cited ornithological features within 20 km⁵ of the Site.

2.2.2 Bird records

Data searches were undertaken for records of protected and conservation priority species, which are those listed on:

- Annex I of the Birds directive; and
- BoCCI red and amber list

Searches were undertaken with the following organisations:

- National Biodiversity Data Centre (NPWS)⁶, for records from within 2 km of the Site;
- British Trust for Ornithology (BTO) Bird Track⁷, for details on migration of birds within the same country as the Project;

² NatureScot. 2025. Recommended bird survey methods to inform impact assessment of onshore wind farms: version 2. NatureScot, Inverness.

³ Gilbert, G., Stanbury, A. and Lewis, L. (2021). Birds of Conservation Concern in Ireland 2020–2026. Irish Birds 43: 1–22

⁴ [Maps and Data | National Parks & Wildlife Service](#) Accessed on 07/04/2025.

⁵ A 20 km search radius was used as this represents the maximum core foraging distance used by qualifying interest species of SPAs in the UK and Ireland.

⁶ <http://maps.biodiversityireland.ie/#/Map> Accessed on 07/04/2025.

⁷ <https://app.bto.org/birdtrack/login/login.jsp> Accessed on 07/04/2025.



- UK and Ireland Bird Atlas 2007-2011⁸;
- BirdWatch Ireland⁹, for Irish Wetland Bird Survey (I-WeBS) data from count sectors within 2 km of the Site

2.3 Field survey

2.3.1 Swan and goose feeding distribution surveys

NS² recommends that for whooper swan, Greenland white-fronted goose and other geese species, feeding distribution surveys should be undertaken in areas of suitable habitat when the survey area lies within the core foraging distance of SPAs or other major roosts for these species, unless it can be established from existing data that the area is not utilised for feeding. As there are SPAs within 20 km of the Project Site designated for whooper swan and Greenland white-fronted goose (Table 3-1) and there are habitats nearby the Project that could potentially support foraging swans and geese, feeding distribution surveys were undertaken.

A buffer of at least 500 m around the Project Site was used for these surveys, which were undertaken by driven transects twice per month, stopping on a regular basis to check all fields within the Project Site and 500 m buffer for goose and swan feeding activity. Dovegrove Callows SPA, which is located 1 km southwest of the grid route, was visited during the surveys.

The survey area is shown in Appendix A, Figure 2.1, survey dates, times and observers are provided in Appendix B.1 and details of the weather conditions during surveys are provided in Appendix B.2.

2.3.2 Nocturnal wader surveys

NS guidance² states that *“night vision/infra-red equipment and survey on moonlit nights can establish presence of nocturnal species or presence and direction of feeding/migration movements both by calls any by sight (although we accept following birds beyond short distances is almost impossible, and that for most species nocturnal activity is likely to be underestimated in any attempted survey).”*

On this basis and due to the proximity of the Middle Shannon Callow SPA and River Little Brosna Callows SPA which both include northern lapwing and European golden plover as qualifying interests, nocturnal wader surveys were conducted. The habitats present at and nearby the Project Site were also noted as suitable for European golden plover (and potentially other wader species; see Gillings *et al.*, 2007¹⁰ for further details of winter habitat use), which often forages at night.

The primary targets of surveys were European golden plover, although northern lapwing *Vanellus vanellus*, which utilises similar habitats to European golden plover, was also targeted and all other nocturnal species detected were also recorded.

Two transect routes within the Project Site that were representative of potentially suitable winter habitats for European golden plover and northern lapwing were identified.

⁸ <https://app.bto.org/mapstore/StoreServlet> Accessed on 14/04/2025.

⁹ I-WeBS Coverage Accessed on 29/04/2025.

¹⁰ Gillings, S., Fuller, R.J. and Sutherland, W.J. (2007). Winter field use and habitat selection by Eurasian Golden Plovers *Pluvialis apricaria* and Northern Lapwings *Vanellus vanellus* on arable farmland. *Ibis*. 149: 509 – 520.



Surveys were undertaken using a Zeiss DTI 6/20 thermal monocular. This enables birds to be readily detected by their body heat at up to c. 1 km range. Where birds were detected, images were recorded as videos.

The transects were walked once per month, from October 2024 to March 2025 inclusive, after dark using the thermal monocular to detect and identify the presence of target species. Birds were also detected and identified by sound, as appropriate. Surveys were conducted in pairs for health and safety reasons.

The survey area is shown in Appendix A, Figure 3.1, survey dates, times and observers are provided in Appendix B.1 and details of the weather conditions during surveys are provided in Appendix B.2.

2.3.3 Nocturnal migration surveys

Surveys for nocturnal migrants should be considered where a high level of migration movement is considered likely or known to occur.

There is no requirement in NS guidance² to conduct nocturnal vantage point surveys for migratory birds; however, it does state that: *“For species which are active at dawn and dusk or at night, other methods of recording or assessing activity needs to be employed. Night vision/infra-red equipment and survey on moonlit nights can establish presence of nocturnal species or presence and direction of feeding/migration movements both by calls any by sight (although we accept following birds beyond short distances is almost impossible, and that for most species nocturnal activity is likely to be underestimated in any attempted survey)”*.

The desk study records returned records of several species that are known to migrate at night, and there are SPAs nearby whereby SCI species could overfly the Project Site during migration. Therefore, on this basis, nocturnal migration surveys were conducted during the autumn and spring migration periods, which are defined below.

The survey method was the same as that for the diurnal flight activity surveys described in the previously issued, Bird Survey Report Non-Breeding Season 2023/25, section 2.3 with some minor differences.

A Zeiss DTI 6/20 Thermal Monocular was used to search for migration birds during periods of darkness. This enables birds to be readily detected by their body heat at up to c. 1 km range. Where birds were detected, images were recorded as videos.

The autumn migration period is September to November, and the spring migration period is March to mid-May according to NS guidance². BTO BirdTrack records were used to determine peak migration periods for primary target species likely to overfly the Project Site, which were subsequently used to determine the optimal period to conduct migration watch surveys. The optimal migration periods for the Project Site were mid-September to late November for autumn migration, and late February to mid-March for spring migration. The target species that were considered likely to be on migration within the vicinity of the Project Site included:

- Wildfowl: Greenland white-fronted goose, whooper swan, northern shoveler, Eurasian wigeon, mallard, Eurasian teal, tufted duck, common goldeneye, Eurasian coot; and
- Waders: northern lapwing, European golden plover.

As migration activity is often weather-related, weather conditions were closely monitored during each migration period to time surveys with periods of colder or warmer weather.

There is no prescribed level of survey effort for nocturnal migration surveys; however, to maximise the chances of detecting migration, two one-hour surveys pre-dawn and two one-



hour surveys post-dusk were conducted at VP3. The surveys were spread over multiple dates per migration period.

A total of 4 hours were conducted at VP3 and summarised in the table below.

The survey area is shown in Figure 4.1 in Appendix A. Survey dates, times, and corresponding weather conditions are provided in Appendix B.

Table 2-1: Summary of migration surveys undertaken during the autumn and spring migration periods

VP No.	Co-ordinates (x,y; ITM)	Hours of Survey (hh:mm)				
		Autumn Migration Period		Spring Migration Period		Total per VP
		Dawn	Dusk	Dawn	Dusk	
3	607816.3573, 711308.9654	01:00	01:00	01:00	01:00	04:00

2.4 Limitations

Feeding distribution, nocturnal golden plover, and migration vantage point surveys were all conducted under optimal weather conditions. Of the 60 total hours of non-breeding bird survey effort, only one hour (1.6%) was recorded under “poor visibility” (<1 km), and one hour (1.6%) under “moderate visibility” (1–3 km). This means that 96.8% of survey effort was carried out during periods of good visibility (>3 km).

Access to the substation area southwest of the Project boundary was restricted. Surveyors were unable to walk this section and instead observed the area from public roads and adjacent agricultural fields.

Visibility during feeding distribution surveys to Dovegrove Callows SPA, located west of the Project Site, was constrained due to lack of access to private lands. While every attempt was made to view the SPA from public roads, it was not possible to view all the lands within.

The first feeding distribution survey in October was affected by disturbance from construction vehicle activity along the amenity trail to the north of the Project boundary.



3.0 Results

3.1 Desk study

3.1.1 Designated sites

3.1.1.1 SPAs

Table 3-1 documents SPAs identified within 20 km of the Project Site and shows special conservation interest (SCI) species for which the site was designated, ROMS, and other important species listed on the standard data form, along with any SCI habitats. To provide focus, only species relevant to the current non-breeding season are shown.

Table 3-1: Details of designated ornithological sites within 20 km of the Project

Site Name and Code	Distance and Direction from Site at Closest Point (km)	Special Conservation Interest Species Relevant to the Non-Breeding Season	Regularly Occurring Migratory Species	Other Important Species	Special Conservation Interest Habitats
Dovegrove Callows SPA 004137	3.6 km southwest	<ul style="list-style-type: none"> Greenland white-fronted goose 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
All Saints Bog SPA 004103	5.1 km southwest	<ul style="list-style-type: none"> Greenland white-fronted goose 	<ul style="list-style-type: none"> Greenland white-fronted goose 	<ul style="list-style-type: none"> Merlin 	<ul style="list-style-type: none"> N/A
Middle Shannon Callows SPA 004096	7.2 km northwest	<ul style="list-style-type: none"> Northern lapwing Whooper swan Eurasian wigeon European golden plover Black-tailed godwit Black-headed gull 	<ul style="list-style-type: none"> Eurasian teal Tufted duck Greenland white-fronted goose Dunlin Eurasian curlew Redshank 	<ul style="list-style-type: none"> Hen harrier Mute swan Skylark 	<ul style="list-style-type: none"> Wetlands
River Little Brosna Callows SPA 004086	5.8 km west	<ul style="list-style-type: none"> Whooper swan Eurasian wigeon Eurasian teal Northern pintail Northern shoveler 	<ul style="list-style-type: none"> Mallard Common pochard Dunlin Eurasian curlew 	<ul style="list-style-type: none"> Mute Swan 	<ul style="list-style-type: none"> Wetlands



Site Name and Code	Distance and Direction from Site at Closest Point (km)	Special Conservation Interest Species Relevant to the Non-Breeding Season	Regularly Occurring Migratory Species	Other Important Species	Special Conservation Interest Habitats
		<ul style="list-style-type: none"> European golden plover Northern lapwing Black-tailed godwit Black-headed gull Greenland white-fronted goose 			
Slieve Bloom Mountains SPA 004160	11.8 km southeast	<ul style="list-style-type: none"> Hen harrier 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Merlin Peregrine falcon 	<ul style="list-style-type: none"> N/A
River Suck Callows SPA 004097	17.2 km northwest	<ul style="list-style-type: none"> Greenland white-fronted goose Whooper swan Eurasian wigeon Northern lapwing European golden plover 	<ul style="list-style-type: none"> Northern pintail Eurasian teal Black-headed gull Eurasian curlew Black-tailed godwit Mallard 	<ul style="list-style-type: none"> Mute swan 	<ul style="list-style-type: none"> N/A
Mongan Bog SPA 004017	19.1 km northwest	<ul style="list-style-type: none"> Greenland white-fronted goose 	<ul style="list-style-type: none"> Common snipe Eurasian curlew 	<ul style="list-style-type: none"> Red grouse 	<ul style="list-style-type: none"> N/A
Lough Derg (Shannon) SPA 004058	19.5 km southwest	<ul style="list-style-type: none"> Great cormorant Tufted duck Common goldeneye 	<ul style="list-style-type: none"> Eurasian teal Eurasian wigeon Mallard Greenland white-fronted goose Common pochard Whooper swan Eurasian coot Black-headed gull 	<ul style="list-style-type: none"> Mute swan Little grebe 	<ul style="list-style-type: none"> N/A



3.1.1.2 Other nature conservation sites

A small section of the amenity route is within Lough Coura pNHA, which is not designated for any bird species.

There are three NHAs located within 20 km of the amenity route, grid route and extension area with site synopses that mention birds. Two NHAs (River Little Brosna Callows NHA and Suck River Callows NHA) are also SPAs, and the bird species for which they are designated are detailed above in Table 3-1. Details of the remaining NHA are presented in Table 3-2.

There are five pNHAs 20 km of the amenity route, grid route and extension area with site synopses that mention birds. Details of these pNHAs are presented in Table 3-2.

Table 3-2: Details of other nature conservation sites relevant to ornithology within 20 km of the Project

Site Name and Code	Distance/Direction from the Site at Closest Point (km)	Species of Interest
NHAs		
Arragh More Bog NHA 000640	14.1 km southwest	<ul style="list-style-type: none"> Hen harrier
pNHAs		
Woodville Woods pNHA 000927	2.2 km south	<ul style="list-style-type: none"> Common snipe
Lough Nahinch (Tipperary) pNHA 000936	17.3 km southwest	<ul style="list-style-type: none"> Common snipe
Roscrea Bog pNHA 000583	18.8 km southeast	<ul style="list-style-type: none"> Common snipe Eurasian curlew Reed bunting
Pallas Lough pNHA 000916	19.1 km northeast	<ul style="list-style-type: none"> Western marsh harrier
Lough Nanag Esker pNHA 000910	> 20 km	<ul style="list-style-type: none"> Wildfowl (site synopsis does not include season of relevance)
Nature Reserves / Ramsar Site		
Slieve Bloom	14 km southeast	<ul style="list-style-type: none"> Hen harrier Red grouse



Site Name and Code	Distance/Direction from the Site at Closest Point (km)	Species of Interest
Mountains Nature Reserve / Ramsar Site		<ul style="list-style-type: none"> • Skylark • Snow bunting • Merlin • Peregrine Falcon • Common snipe • European golden plover • Northern lapwing • Eurasian curlew

3.1.2 Bird Records

The results from the desk study are listed below in Table 3-3.

Table 3-3: Relevant bird species records from the desk study

Location	Species	Source	Dataset	Date of Last Record
N01R	Black-headed gull	NBDC	Birds of Ireland	2010
N00U, N01Q, N01V, N01R	Common buzzard	NBDC	Birds of Ireland	2021
N01R	Common ringed plover	NBDC	Birds of Ireland	2010
N01R	Common snipe	NBDC	Birds of Ireland	2009
N01R	Eurasian curlew	NBDC	Birds of Ireland	2009
N01R	Great crested grebe	NBDC	Birds of Ireland	2010
N01R	Grey heron	NBDC	Birds of Ireland	2009
N00U	Grey wagtail	NBDC	Birds of Ireland	BoCCI4 Red
N01R	House martin	NBDC	Birds of Ireland	2009
N01R	Little grebe	NBDC	Bird Atlas 2007 – 2011	2011
N01R	Mallard	NBDC	Birds of Ireland	2009
N01R	Meadow pipit	NBDC	Birds of Ireland	2009
N01V, N01R	Northern lapwing	NBDC	Birds of Ireland	2022
N00U, N01R	Northern raven	NBDC	Birds of Ireland	2019
N01R	Peregrine falcon	NBDC	Birds of Ireland	2009
N01V	Yellowhammer	NBDC	Birds of Ireland	2021

The absence of records of species from the NBDC database does not necessarily imply that a species does not occur within the search area, rather that it has not formally been recorded as present.

There are no I-WeBS count sites within 2 km of the Project Site.



3.2 Field survey

3.2.1 Swan and goose feeding distribution surveys

The results of the feeding distribution surveys are shown in Figure 2.2 – 2.8 in Appendix A.

3.2.1.1 Target species

All records of target species are summarised in Table 3-4.

Across all feeding distribution surveys, whooper swan were sporadically recorded through the non-breeding season and were sighted on just 1/12 visits to the Site. Three birds were recorded resting on flooded bogland within the north of the Project Site boundary, approximately 200 m east from the N62 roadside.

Mute swan were recorded on 2/12 survey visits. Four mute swans, including one cygnet were recorded resting on the lake at Clooneen, north of the Project Site.

No Greenland white-fronted geese were recorded at Dovegrove Callows SPA notwithstanding the lack of accessibility to the SPA lands.

Table 3-4: Target species summary for swan and goose feeding distribution surveys

Month	Visit	Peak Count	
		Whooper swan	Mute swan
October	1	0	0
	2	0	0
November	1	0	0
	2	3	0
December	1	0	0
	2	0	0
January	1	0	0
	2	0	0
February	1	0	2 (1 juvenile)
	2	0	2
March	1	0	0
	2	0	0
Peak Count		3	2

3.2.1.2 Incidentals

Incidental species of note recorded during these surveys included the following:

- Raptors: common buzzard (peak count of two birds), common kestrel (peak count of one bird), Eurasian sparrowhawk (peak count of one bird);



- Gulls: lesser black-backed gull (peak count of 21 birds), black headed gull (peak count of eight birds);
- Waders: common snipe (peak count of one bird), northern lapwing (peak count of 27 birds);
- Wildfowl: great white egret (peak count of one bird), mallard (peak count of 22 birds), grey heron (peak count of one bird), little grebe (peak count of one bird), great crested grebe (peak count of one bird), teal (peak count of 35 birds); and
- Passerines: northern raven (peak count of one bird).

Of these incidental species recorded, northern lapwing are qualifying interests of nearby Middle Shannon Callows SPA and so additional discussion is provided below.

Black-headed gull

Black-headed gull were recorded on 2/12 survey visits, both in March. A peak count of eight birds was recorded at the lake at Clooneen, c.1 km from the Project Site. Both observations were made in the same location.

Northern Lapwing

Lapwing were recorded on 3/12 survey visits. A large group (peak count of 27 birds) was recorded in October at rest on the water in the lake at Clooneen, c.1 km from the Project Site. The other recordings sighted smaller groups at the same location, and a small group of five birds on the edge of the Project Site to the east on a single occasion.

3.2.2 Nocturnal wader surveys

3.2.2.1 Target species

Across the six nocturnal wader surveys, northern lapwing (peak count of 13 birds) was recorded on two occasions, foraging in the south-east of the Project Site. Common snipe was recorded in small numbers (peak count of two birds) during four of the six survey visits, foraging within the south-east of the Project Site. No observations of European golden plover were recorded. Survey results are shown in Figure 3.2 – 3.3, Appendix A.

3.2.2.2 Incidental records

Incidental species of note recorded during these surveys included:

- Lesser black-backed gull (peak count of >50 birds) flying north-west from the lake at Clooneen, 1 km from the Project Site;
- Mallard – two birds flying from agricultural fields within the 500 m buffer of amenity trail, 1.2 km north of the Project Site; and
- Mute swan – five birds recorded at rest on the lake at Clooneen, 1.2 km from the Project Site.



3.2.3 Nocturnal migration surveys

3.2.3.1 Autumn migration surveys

Target species

Across the autumn migration watch surveys, target species recorded included: mallard (peak count of one bird) heard not seen in the northern area of the Project Site boundary. Common snipe (peak of count one bird) was recorded flushing from vegetation in the north of the Project Site. These observations were not considered to be migrants as flight lines were either unrecorded or short flights within the Project Site boundary. Survey results are shown in Figure 4.2 – 4.3, Appendix A

Incidental records

Incidental species of note recorded during these surveys included:

- Raptor: barn owl (peak count of one bird) – heard not seen.

3.2.3.2 Spring migration period

Target species

Across the spring migration watch surveys, target species recorded included: common snipe (peak count of one bird) and mallard (peak count of two birds). These observations were not considered to be migrants because only very low and short flights were recorded within the Project Site boundary. Survey results are shown in Figure 4.2 – 4.3, Appendix A.

Incidental records

No incidental species of note were recorded during these surveys.



4.0 Summary

4.1 Legal and conservation status of target species recorded

Table 4-1 provides a summary of the target species recorded during the baseline surveys, their activity within the survey area, as well as their legal and conservation status.

Table 4-1: Summary of target species results and legal/conservation status

Target Species	Legal and Conservation Status ¹¹	Qualifying or Listed Species for Nearby Nature Conservation Site	Relevant Population Estimates and Trends	Summary of Observations within the Survey Area
Whooper swan	Annex I; BoCCI4 amber	<ul style="list-style-type: none"> Blackwater Callows SPA 	ROI winter population 11,852 individuals ¹² ; increasing	Small number of whooper swan recorded within 1 km of the Site boundary on a single occasion across all surveys (peak count three birds).
Mute swan	BoCCI4 amber	<ul style="list-style-type: none"> River Little Brosna Callows SPA Middle Shannon Callows SPA Lough Derg (Shannon) SPA River Suck Callows SPA 	ROI winter population 7,032 individuals; increasing ¹³	Small numbers of mute swan recorded in February on the lake at Clooneen (peak count two birds) c. 1.2 km from the Project Site. One juvenile recorded.

¹¹ Gilbert, G., Stanbury, A. & Lewis, L., 2021. *Birds of Conservation Concern in Ireland 4: 2020–2026*. Belfast: RSPB Northern Ireland & BirdWatch Ireland.

¹² Burke, B., McElwaine, J.G., Fitzgerald, N., Kelly, S.B.A., McCulloch, N., Walsh, A.J. and Lewis, L.J. (2021). Population size, breeding success and habitat use of Whooper Swan *Cygnus cygnus* and Bewick's Swan *Cygnus columbianus bewickii* in Ireland: results of the 2020 International Swan Census. *Irish Birds*, 43, pp.57–70.

¹³ Lewis, L.J., Burke, B., Fitzgerald, N., Tierney, T.D. and Kelly, S. (2019). *Irish Wetland Bird Survey: Waterbird Status and Distribution 2009/10–2015/16*. Irish Wildlife Manuals No. 106. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin



Target Species	Legal and Conservation Status ¹¹	Qualifying or Listed Species for Nearby Nature Conservation Site	Relevant Population Estimates and Trends	Summary of Observations within the Survey Area
Northern lapwing	BoCCI4 red	<ul style="list-style-type: none"> Middle Shannon Callows SPA River Little Brosna Callows SPA River Suck Callows SPA 	ROI winter population 69,823 individuals, declining ¹³	Northern lapwing were recorded in medium-sized groups (peak count 27 birds) throughout the survey at rest on the lake at Clooneen, 1.2 km from Project Site, and a small flock of five birds on the eastern edge of the Project Site on a single occasion.
Mallard	BoCCI4 green	<ul style="list-style-type: none"> River Little Brosna Callows and Lough Derg (Shannon) SPA 	ROI winter population 18,810 individuals ¹³ , stable ¹⁴	Flocks of mallard (peak count 22 birds) were recorded foraging on lake at Clooneen approx. 1.2 km from the Project Site during diurnal feeding distribution surveys. Small numbers recorded during nocturnal wader survey (peak count two birds) flying north of amenity trail and single bird record heard during nocturnal migration survey (not thought to be on migration).
Common snipe	BoCCI4 amber	<ul style="list-style-type: none"> Mongan Bog SPA Woodville Woods pNHA Lough Nahinch (Tipperary) pNHA Slievebloom Nature Reserve 	ROI winter population 883 individuals, declining ¹³	Small numbers of snipe recorded (peak count two birds) consistently (4/6 months) during nocturnal wader surveys within 500 m survey buffer to southeast of Site. Peak count of one bird recorded near amenity trail on one occasion. Single birds were also recorded to the east of the N62 during migration surveys (not thought to be on migration).
Barn owl	BoCCI4 red	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI breeding population 562-702 pairs ¹⁴ , declining ¹¹	One barn owl was heard during the autumn nocturnal migration survey.

¹⁴ European Environment Agency (EEA), 2020, Article 12 web tool on population status and trends of birds under Article 12 of the Birds Directive. [online] Available at: <https://nature-art12.eionet.europa.eu/>



Target Species	Legal and Conservation Status ¹¹	Qualifying or Listed Species for Nearby Nature Conservation Site	Relevant Population Estimates and Trends	Summary of Observations within the Survey Area
Common buzzard	BoCCI4 green	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI breeding population 1,938 pairs, increasing ¹⁴	Small numbers of buzzard flightlines (peak count two birds) were recorded as incidental targets north and south of Project Site during 4/12 of the swan and goose feeding distribution surveys.
Eurasian sparrowhawk	BoCCI4 amber	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI breeding population 11,859 individuals ¹⁴ , stable but declining ¹¹	One Eurasian sparrowhawk was recorded in flight over the amenity trail approx.1.2 km from the Project Site, during a swan and goose feeding distribution survey in February 2025.
Common kestrel	BoCCI4 amber	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI breeding population 13,500 individuals, declining ¹⁴	Kestrel (peak count one bird) was recorded in the survey area as incidental target during 1/12 of the swan and goose feeding distribution surveys near the amenity trail.
Lesser black backed gull	BoCCI4 amber	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI winter population 11,842 individuals ¹³ , increasing ¹⁴	Small flocks of lesser black backed gull (peak count six birds) were recorded as incidental targets during 1/12 of the swan and goose feeding distribution surveys near the amenity trail and so the southeast of the Site.
Black headed gull	BoCCI4 red	<ul style="list-style-type: none"> Middle Shannon Callows SPA River Little Brosna Callows SPA 	ROI winter population 48,821 individuals ¹³ , declining ¹¹	Small flocks of black headed gull (peak count eight birds) were recorded as incidental targets in the survey area during 2/12 of the swan and goose feeding distribution surveys near the lake at Clooneen.
Great white egret	No BoCCI4 status (non-regularly occurring)	<ul style="list-style-type: none"> None within 20 km of Project Site 	Non-regularly occurring; ROI winter population peak count 2011/12 – 2015/16 of one bird, no population trends available	A single great white egret was recorded as an incidental target on the lake at Clooneen, 1.2 km from the Project Site during a November swan and goose feeding distribution survey.
Little grebe	BoCCI4 amber	<ul style="list-style-type: none"> Lough Derg (Shannon) SPA 	ROI winter population 1,594 individuals, increasing ¹⁴	Small numbers of little grebe (peak count two birds) were recorded throughout the non-breeding season across 6/12 swan and goose feeding distributions. All



Target Species	Legal and Conservation Status ¹¹	Qualifying or Listed Species for Nearby Nature Conservation Site	Relevant Population Estimates and Trends	Summary of Observations within the Survey Area
				records were of the birds on the lake at Clooneen, 1.2 km from the Project Site.
Great crested grebe	BoCCI4 amber	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI winter population 1,734 individuals, decreasing ¹⁴	Great crested grebe (peak count one bird) were recorded on 2/12 swan and goose feeding distribution surveys. Both sightings recorded the birds on the lake at Clooneen, 1.2 km from the Project Site.
Eurasian teal	BoCCI4 amber	<ul style="list-style-type: none"> Middle Shannon Callows SPA Lough Derg (Shannon) SPA 	ROI winter population 27,644 individuals, increasing ¹³	A flock of teal (peak count of 35 birds) were recorded on 1/12 swan and goose feeding distribution in February. The birds were seen at rest on the water at Clooneen, 1.2 km from the Project Site.
Grey heron	BoCCI4 green	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI winter population 1,943 individuals, stable ¹³	Small numbers of grey heron (peak count one bird) were recorded in the survey area during 2/12 swan and goose feeding distribution surveys. Recordings were located at the lake at Clooneen. One bird was on passage and the others were foraging in the water, 1.2 km from the Project Site.
Northern raven	BoCCI4 green	<ul style="list-style-type: none"> None within 20 km of Project Site 	ROI breeding population 55,878 pairs, stable ¹⁴	Raven were recorded in small numbers (peak count one bird) on passage both south and north of the Project Site during 2/12 swan and goose feeding distribution surveys.



5.0 Discussion and Recommendations

The nocturnal migration surveys recorded small numbers of target species including mallard (peak count of two birds) and common snipe (peak count of one bird). Common snipe were flushed from grasslands, taking short flight lines within the Project Site boundary. A mallard flight line was recorded with the flight line ending within the Project Site boundary. Based on the height and lengths of the flight lines observed, the target species recorded during nocturnal migration surveys are not considered to be migrants and therefore, nocturnal collision risk is unlikely to represent a major constraint to the Project.

Small numbers of whooper swan (peak count of three birds) and mute swan (peak count of two birds) were recorded sporadically throughout the non-breeding season.

Whooper swans were recorded at rest on flooded bogland within the Project Site on a single occasion. As low numbers of swans were recorded very infrequently, there is no good evidence to suggest that the habitats within the Project Site are used consistently or are of great importance to both mute or whooper swan.

In relation to SCI bird species associated with nearby SPAs, a small number of northern lapwing (peak count of five birds) were recorded foraging within improved agricultural grasslands where flooding was located to the southeast of the Site boundary, predominantly outside the 500 m survey buffer during diurnal feeding distribution surveys. A peak count of 27 lapwing were also recorded at rest within the lake at Clooneen c. 1 km north of the Site on a single occasion; with smaller groups recorded on two other occasions at the same location. A small number of black-headed gull (peak count eight birds) were recorded at the lake at Clooneen c. 1 km north of the Site on two occasions. Based on the inconsistency of the sightings and the overall low number of recorded gulls, waders and wildfowl, the surrounding habitats to the Project Site do not appear to be consistently used by these bird groups and therefore are unlikely to represent a major constraint to the Project.

The nocturnal wader surveys recorded small numbers of target species. Northern lapwing (peak count of 13 birds) and common snipe (peak count of one bird) were both recorded in the southeast of the 500 m survey buffer. Of these, lapwing were only recorded on two occasions, whereas snipe were recorded on four occasions. Incidental recordings were made of lesser black backed gulls (peak count of >50 birds), mallard (peak count of two birds) and mute swan (peak count of five birds) but these were again either within the 500 m survey buffer or outside it. The inconsistency of observations plus the low number of waders recorded during the nocturnal surveys suggests it is unlikely that nocturnal foraging of waders or wildfowl represents a major constraint to the Project.

Overall, the results do not indicate any major constraints to the Project and there are no recommendations for additional surveys or analysis currently.





Appendix A Figures

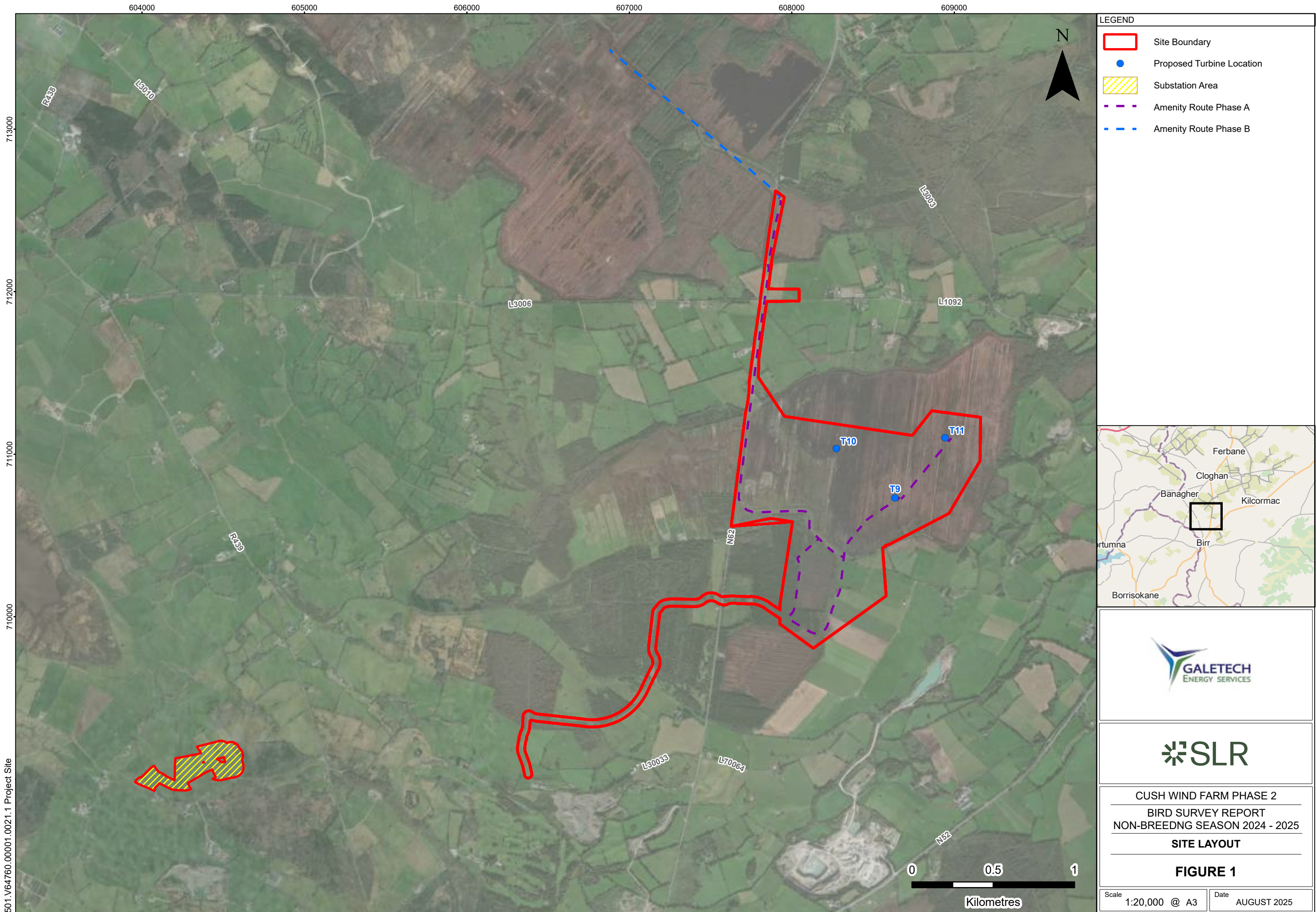
Baseline Ornithology Report – Non Breeding Bird Surveys 2024/25

Cush Wind Farm Phase 2

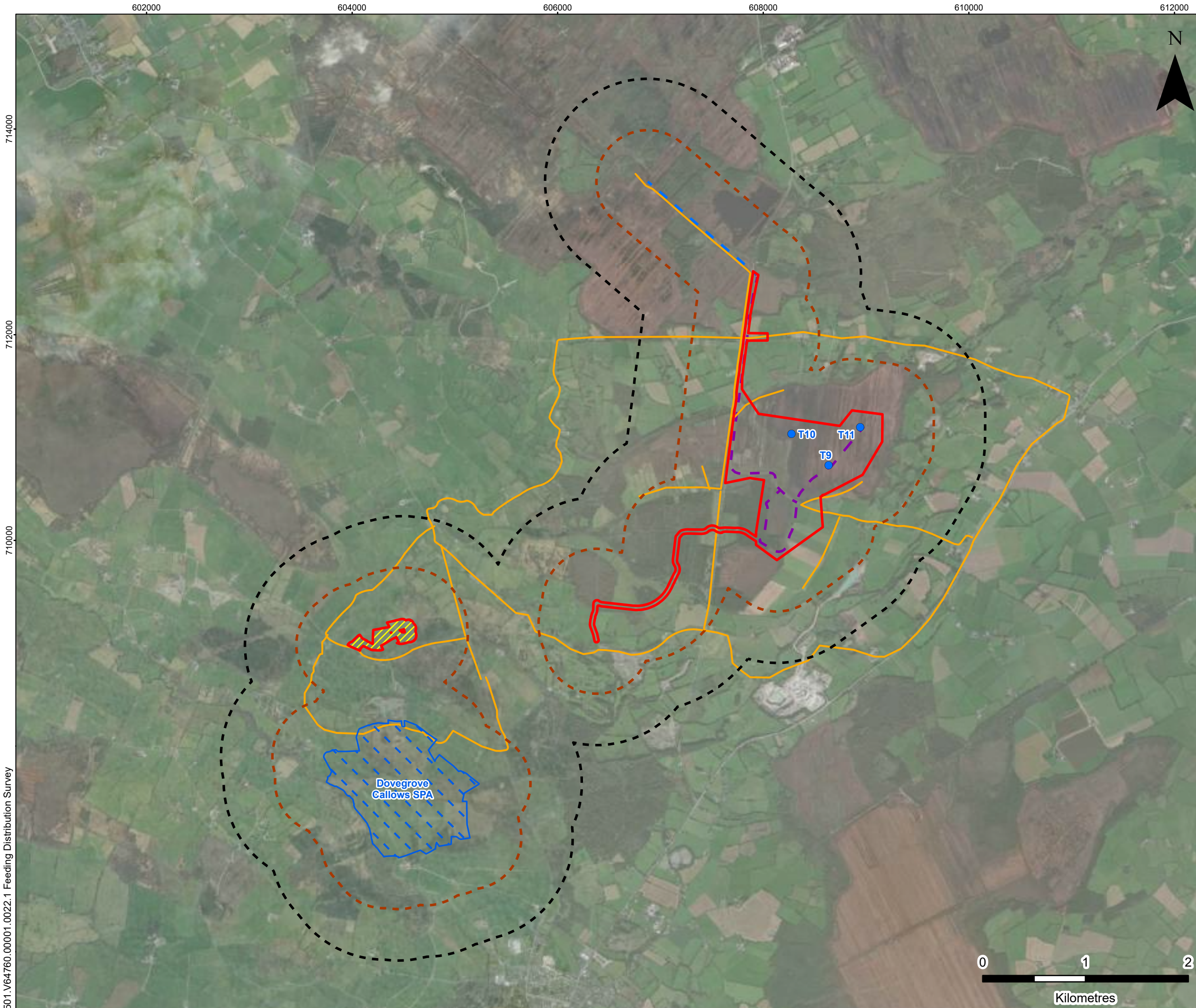
Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

13 August 2025



501.V64760.00001.0021.1 Project Site



- LEGEND
- Site Boundary
 - Proposed Turbine Location
 - Substation Area
 - Amenity Route Phase A
 - Amenity Route Phase B
 - Dovegrove Callows Special Protection Area (SPA)
 - Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
 - Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer
 - Transect Route



CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT
BREEDING SEASON 2024

FEEDING DISTRIBUTION:
SURVEY AREA

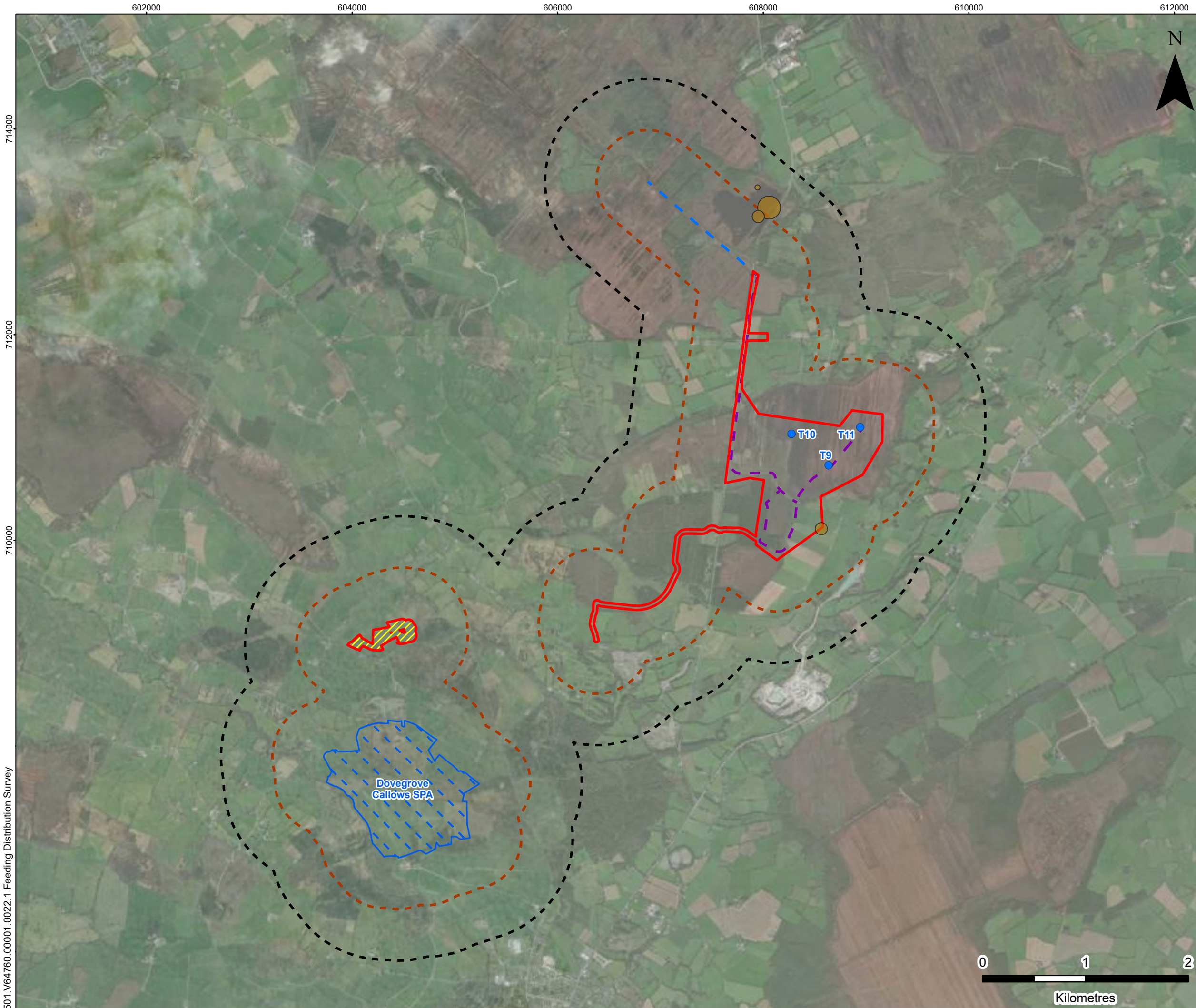
FIGURE 2.1

Scale 1:35,000 @ A3

Date AUGUST 2025

0 1 2
Kilometres

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer

Species

- Lapwing

Number of Birds

- < 2
- 5 - 10
- 21 - 35

CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT
BREEDING SEASON 2024

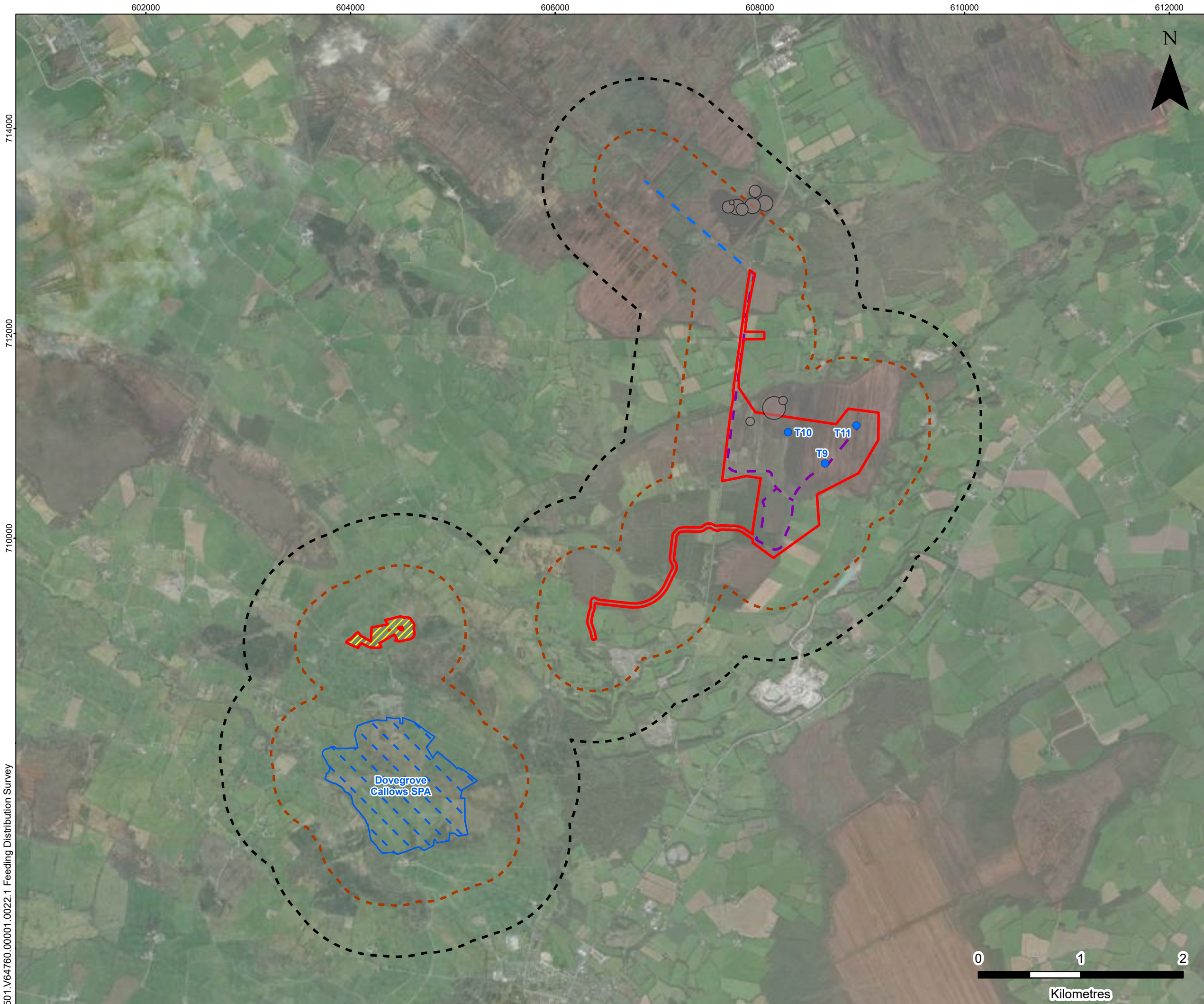
**FEEDING DISTRIBUTION:
LAPWING**

FIGURE 2.2

Scale1:35,000 @ A3

DateAUGUST 2025

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer

Species

- Mallard

Number of Birds

- < 2
- 2 - 4
- 5 - 10
- 11 - 20
- 21 - 35

CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT
BREEDING SEASON 2024

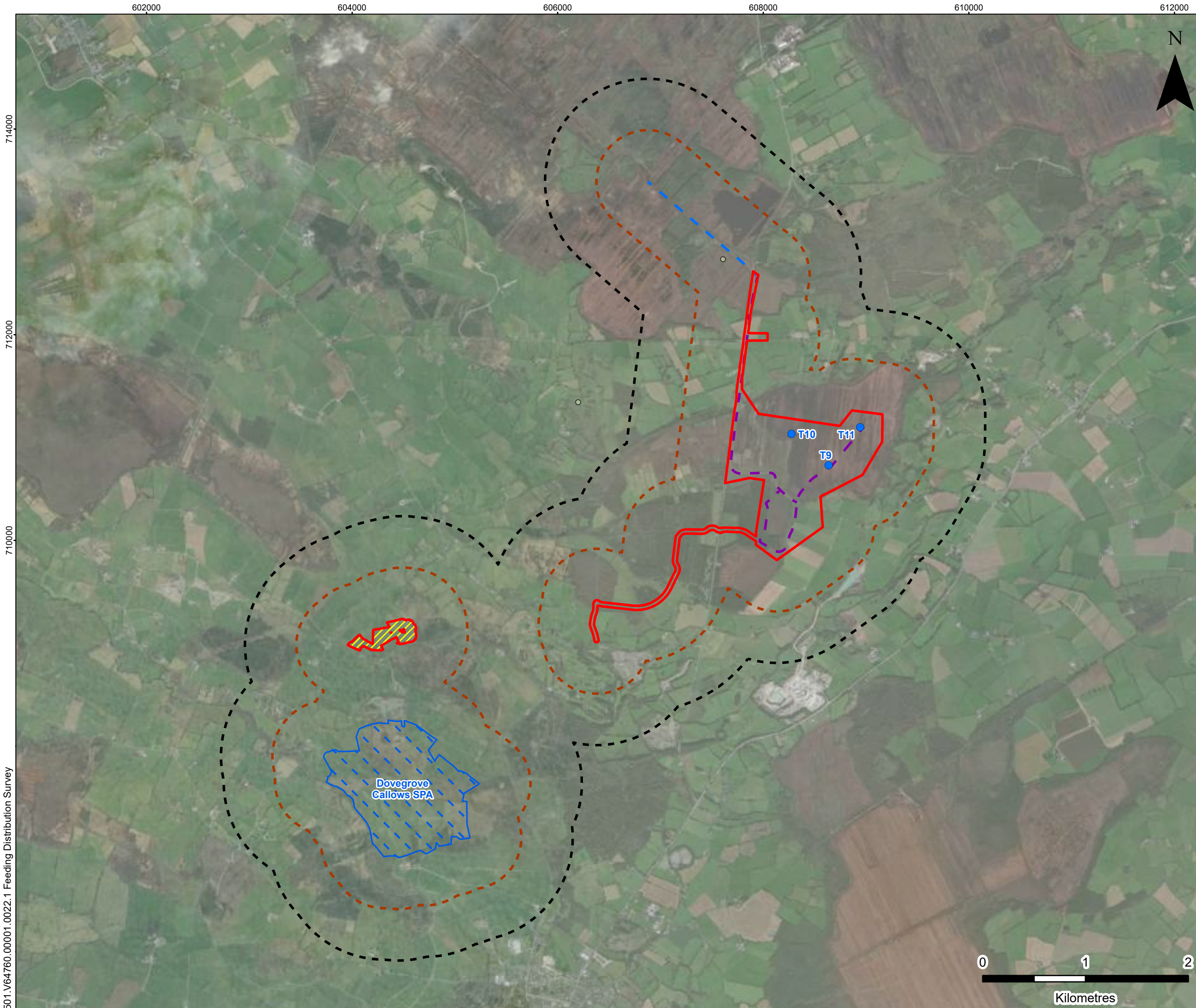
**FEEDING DISTRIBUTION:
MALLARD**

FIGURE 2.3

Scale1:35,000 @ A3

DateAUGUST 2025

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

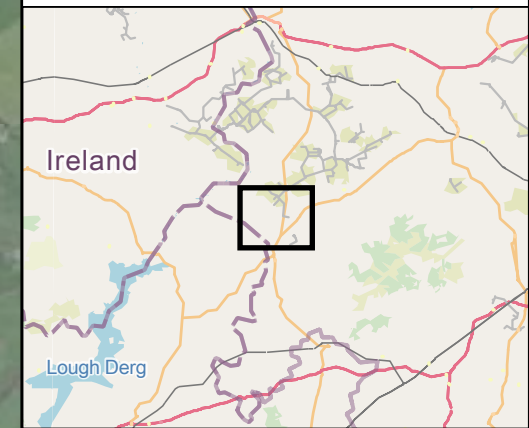
- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer

Species

- Snipe

Number of Birds

- < 2



CUSH WIND FARM PHASE 2

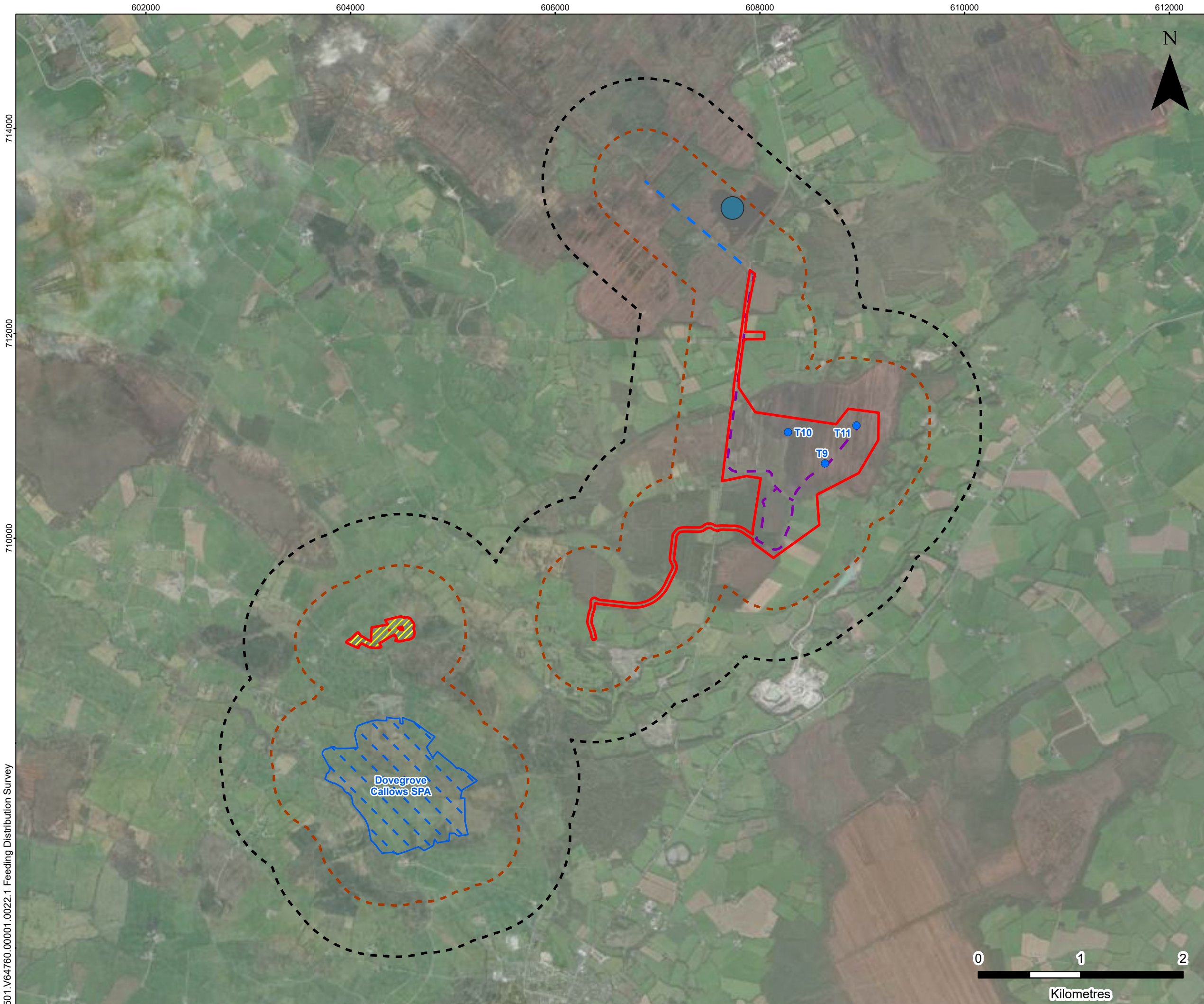
BIRD SURVEY REPORT
BREEDING SEASON 2024

**FEEDING DISTRIBUTION:
SNIPE**

FIGURE 2.5

Scale 1:35,000 @ A3 Date AUGUST 2025

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer

Species

- Teal

Number of Birds

- 21 - 35



CUSH WIND FARM PHASE 2

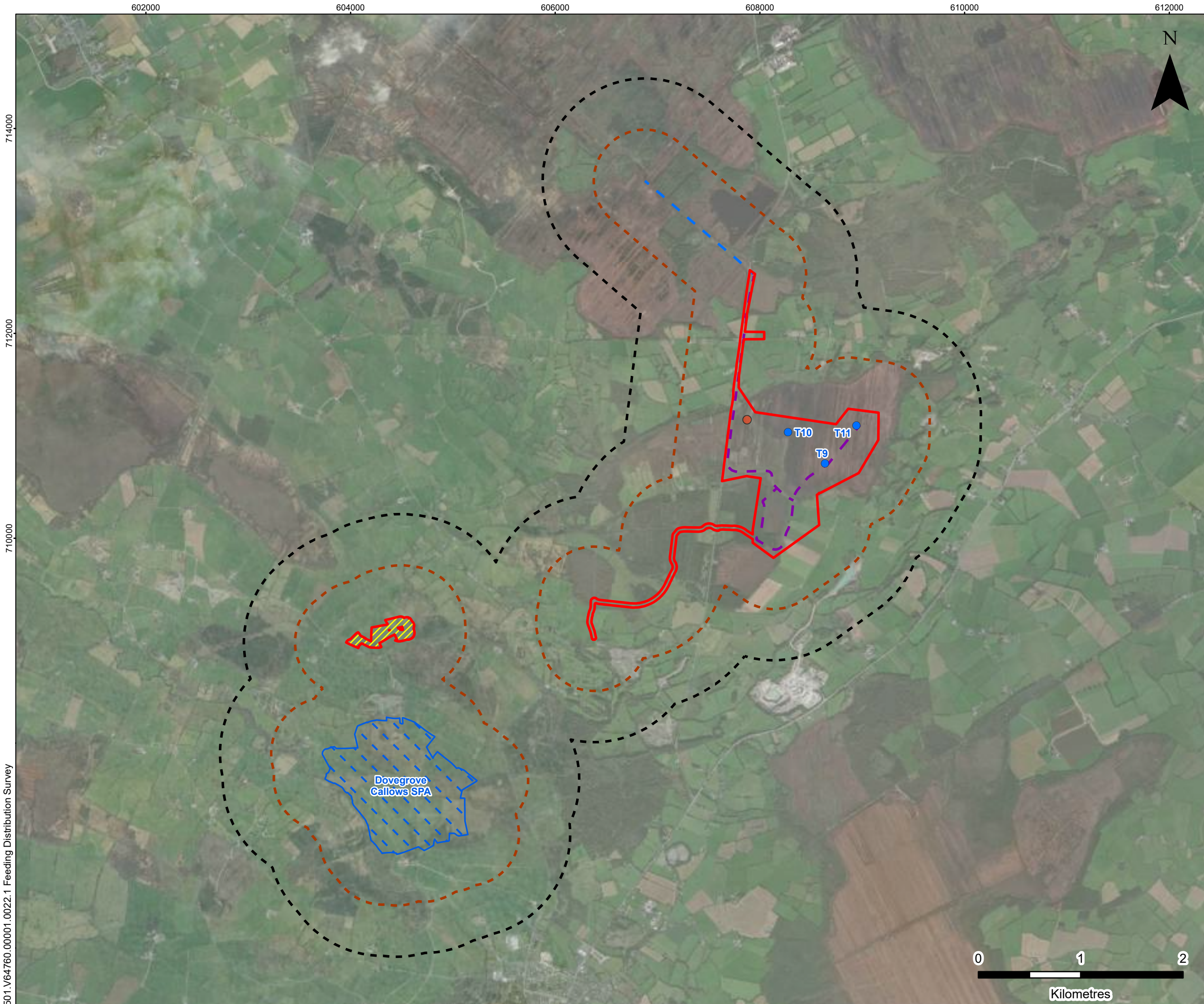
BIRD SURVEY REPORT
BREEDING SEASON 2024

**FEEDING DISTRIBUTION:
TEAL**

FIGURE 2.6

Scale 1:35,000 @ A3 Date AUGUST 2025

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrow Callows SPA 1 km Buffer

Species

- Whooper Swan

Number of Birds

- 2 - 4



CUSH WIND FARM PHASE 2

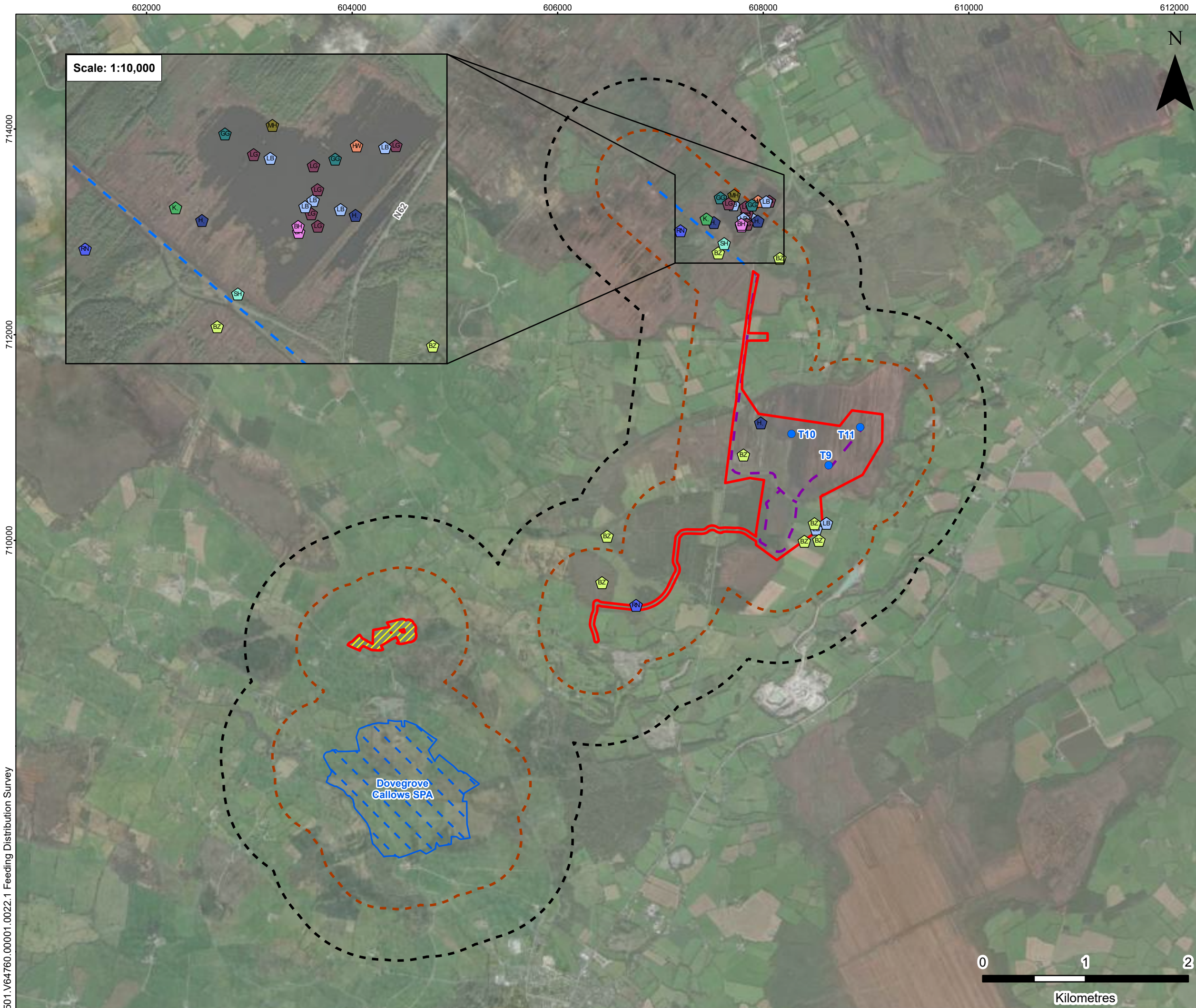
BIRD SURVEY REPORT
BREEDING SEASON 2024

**FEEDING DISTRIBUTION:
WHOOPER SWAN**

FIGURE 2.7

Scale 1:35,000 @ A3 Date AUGUST 2025

501.V64760.00001.0022.1 Feeding Distribution Survey



LEGEND

- Site Boundary
- Proposed Turbine Location
- Substation Area
- Amenity Route Phase A
- Amenity Route Phase B
- Dovegrove Callows Special Protection Area (SPA)
- Site Boundary, Amenity Routes and Dovegrove Callows SPA 500 m Buffer
- Site Boundary, Amenity Routes and Dovegrove Callows SPA 1 km Buffer

Incidental Species

- Black-headed Gull
- Buzzard
- Great Crested Grebe
- Great White Egret
- Grey Heron
- Kestrel
- Lesser Black-backed Gull
- Little Grebe
- Moorhen
- Raven
- Sparrowhawk

Ireland

Lough Derg

CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT

BREEDING SEASON 2024

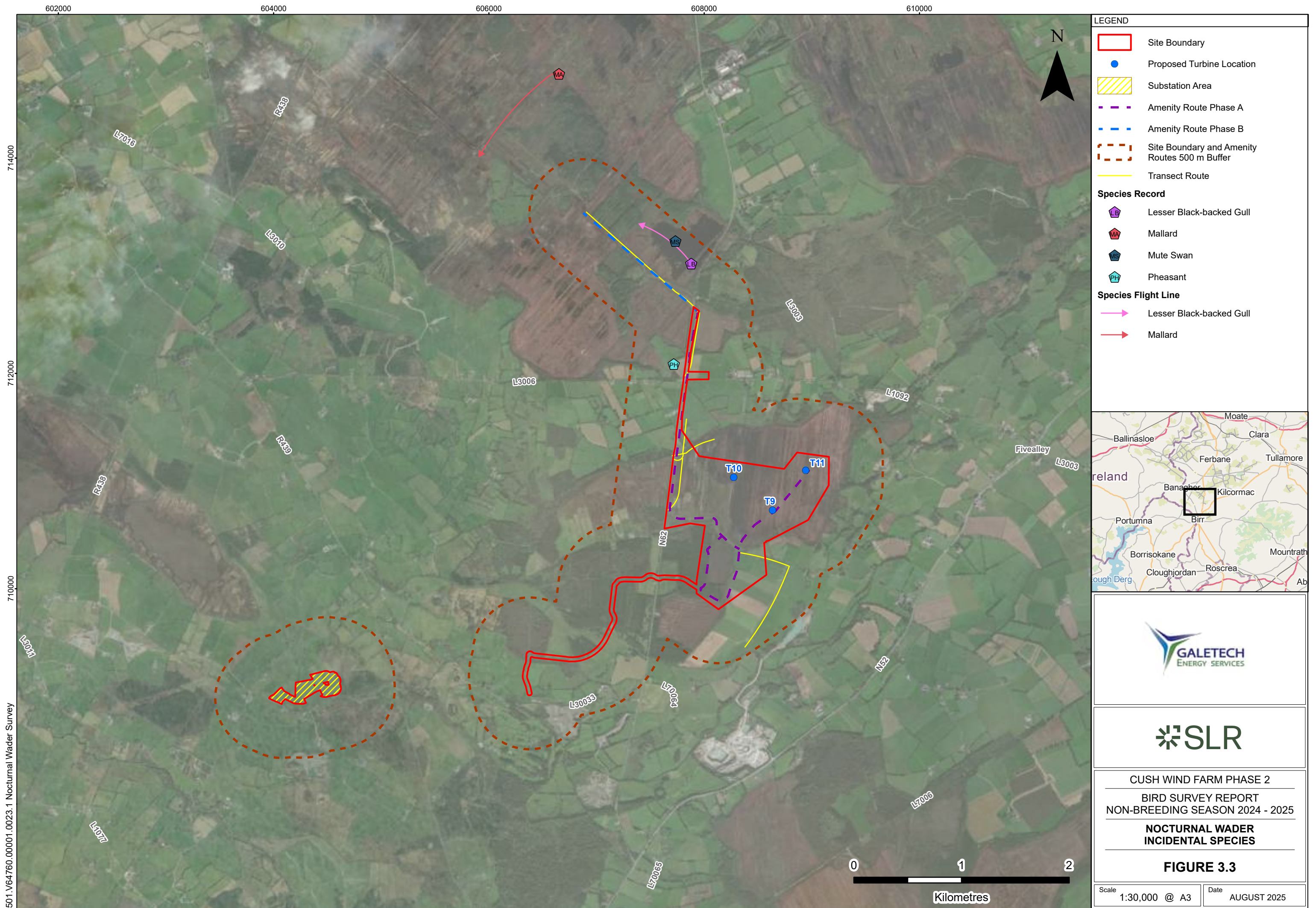
FEEDING DISTRIBUTION:

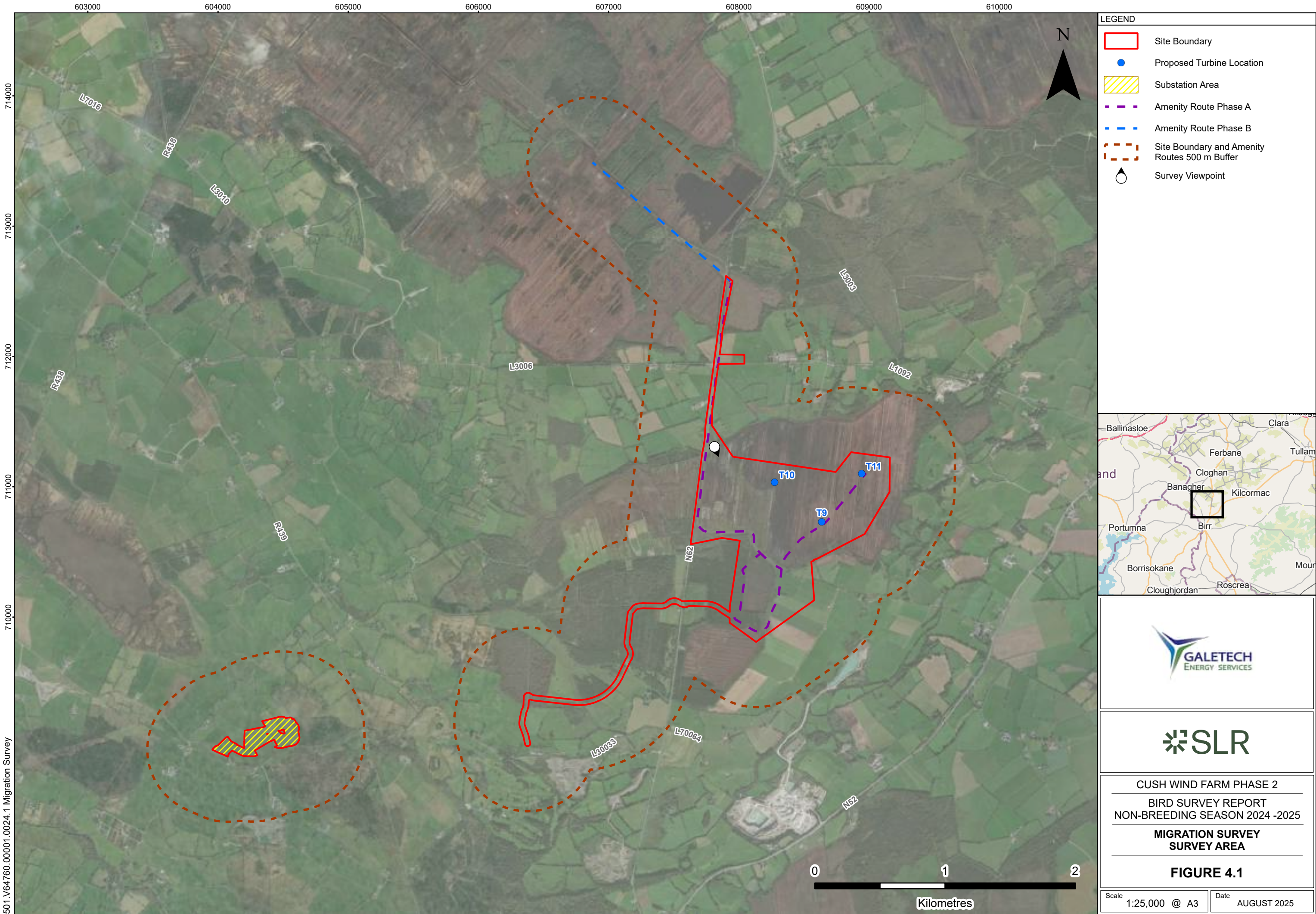
INCIDENTAL SPECIES

FIGURE 2.8

Scale 1:35,000 @ A3

Date AUGUST 2025





LEGEND

-  Site Boundary
-  Proposed Turbine Location
-  Substation Area
-  Amenity Route Phase A
-  Amenity Route Phase B
-  Site Boundary and Amenity Routes 500 m Buffer
-  Survey Viewpoint



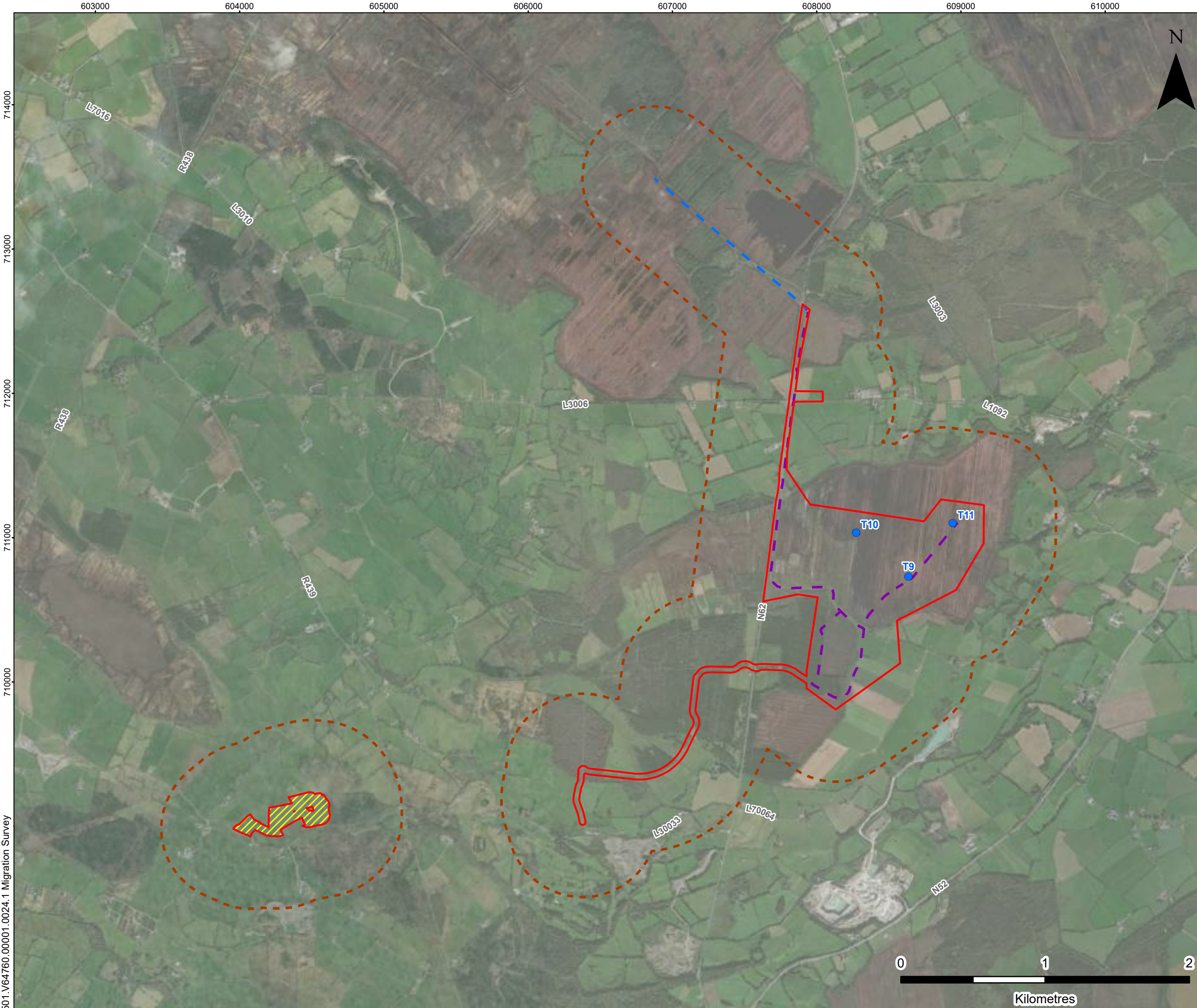
CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT
NON-BREEDING SEASON 2024 -2025

**MIGRATION SURVEY
SURVEY AREA**

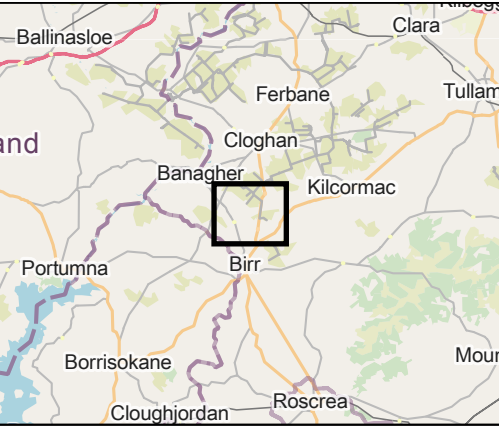
FIGURE 4.1

Scale 1:25,000 @ A3 Date AUGUST 2025



- LEGEND
- Site Boundary
 - Proposed Turbine Location
 - Substation Area
 - Amenity Route Phase A
 - Amenity Route Phase B
 - Site Boundary and Amenity Routes 500 m Buffer

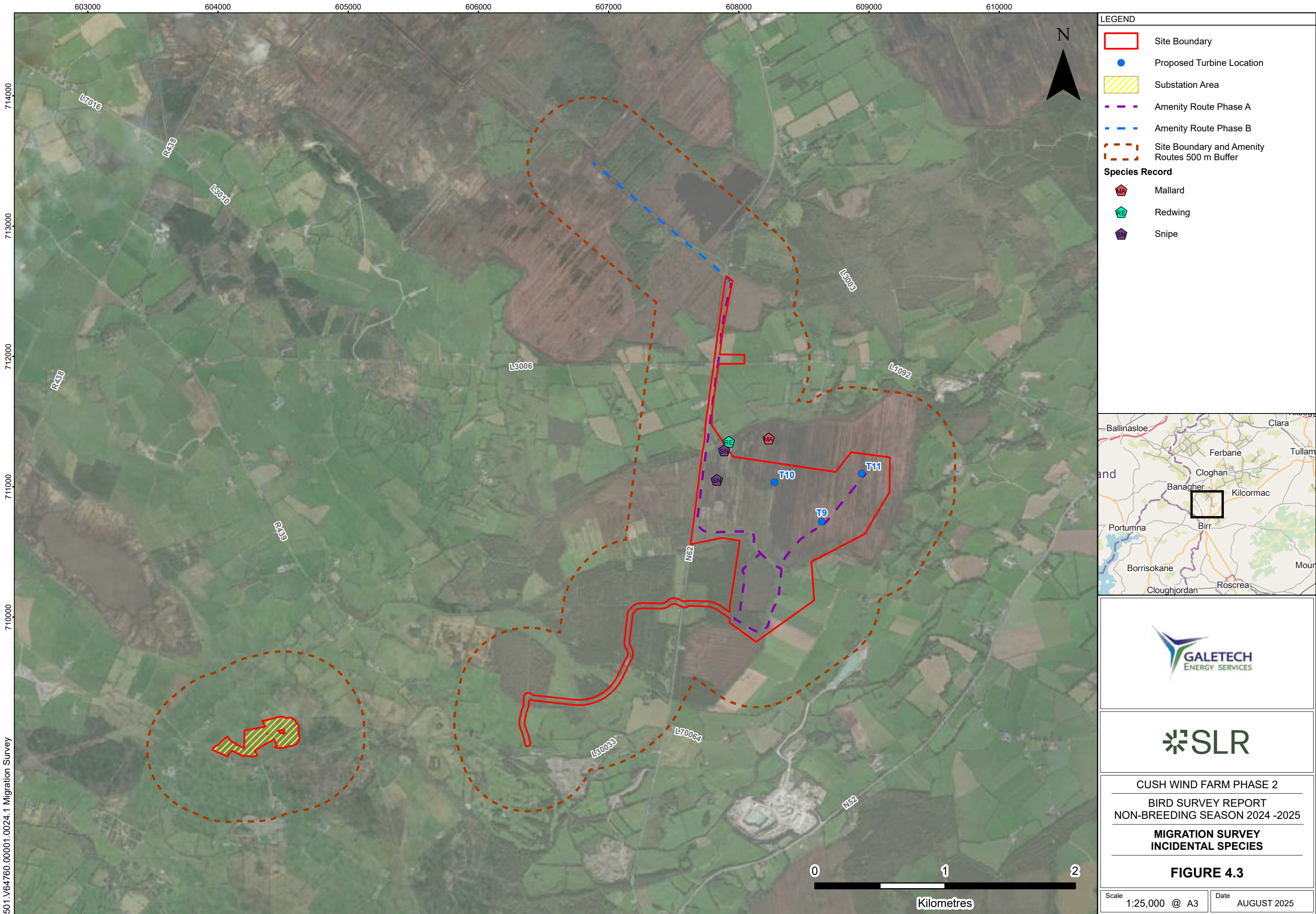
Note
No Target Species Recorded

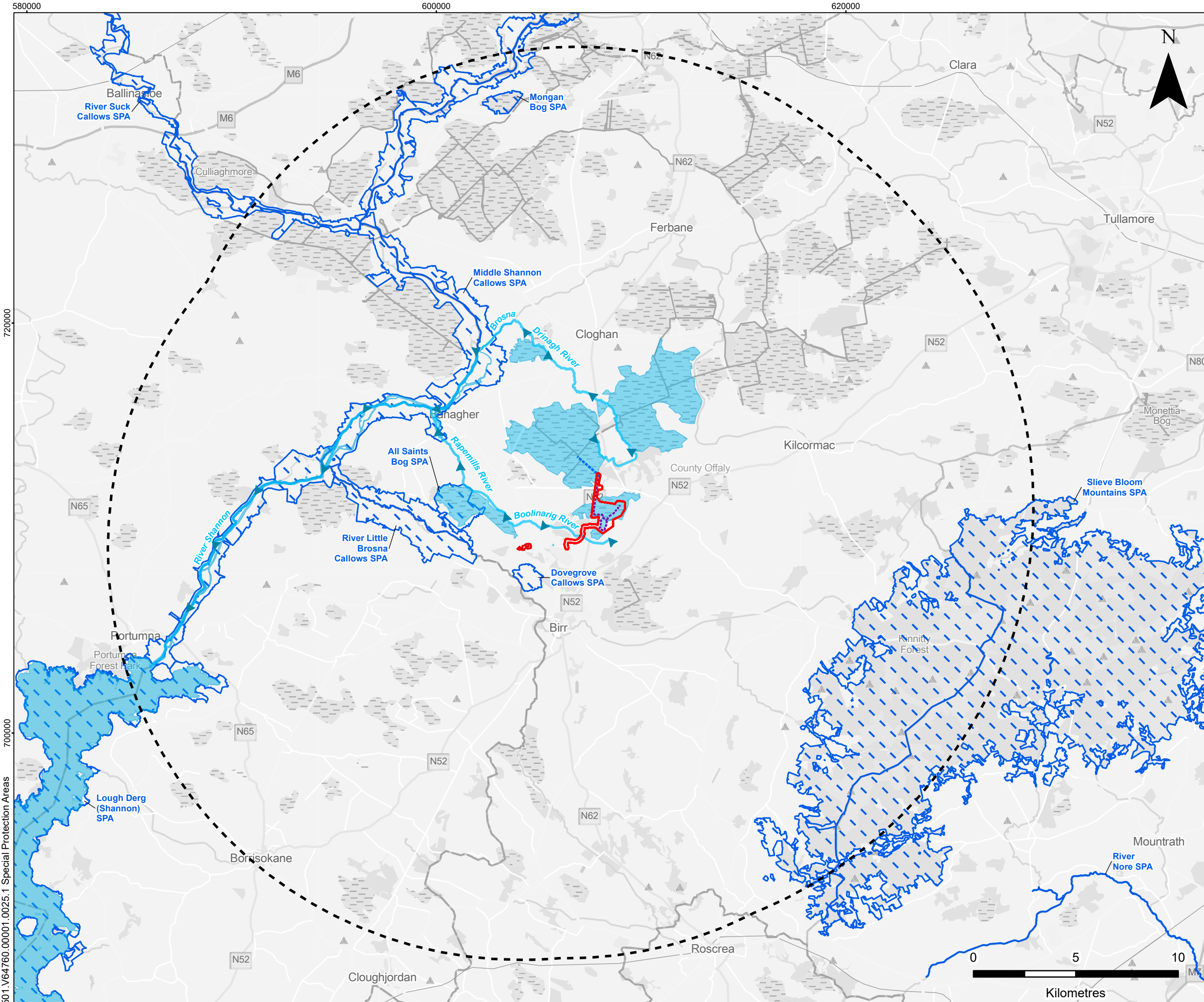


CUSH WIND FARM PHASE 2
BIRD SURVEY REPORT
NON-BREEDING SEASON 2024 -2025
MIGRATION SURVEY
TARGET SPECIES

FIGURE 4.2

Scale 1:25,000 @ A3 Date AUGUST 2025





LEGEND

Site Boundary

Amenity Route Phase A

Hydrological Connection



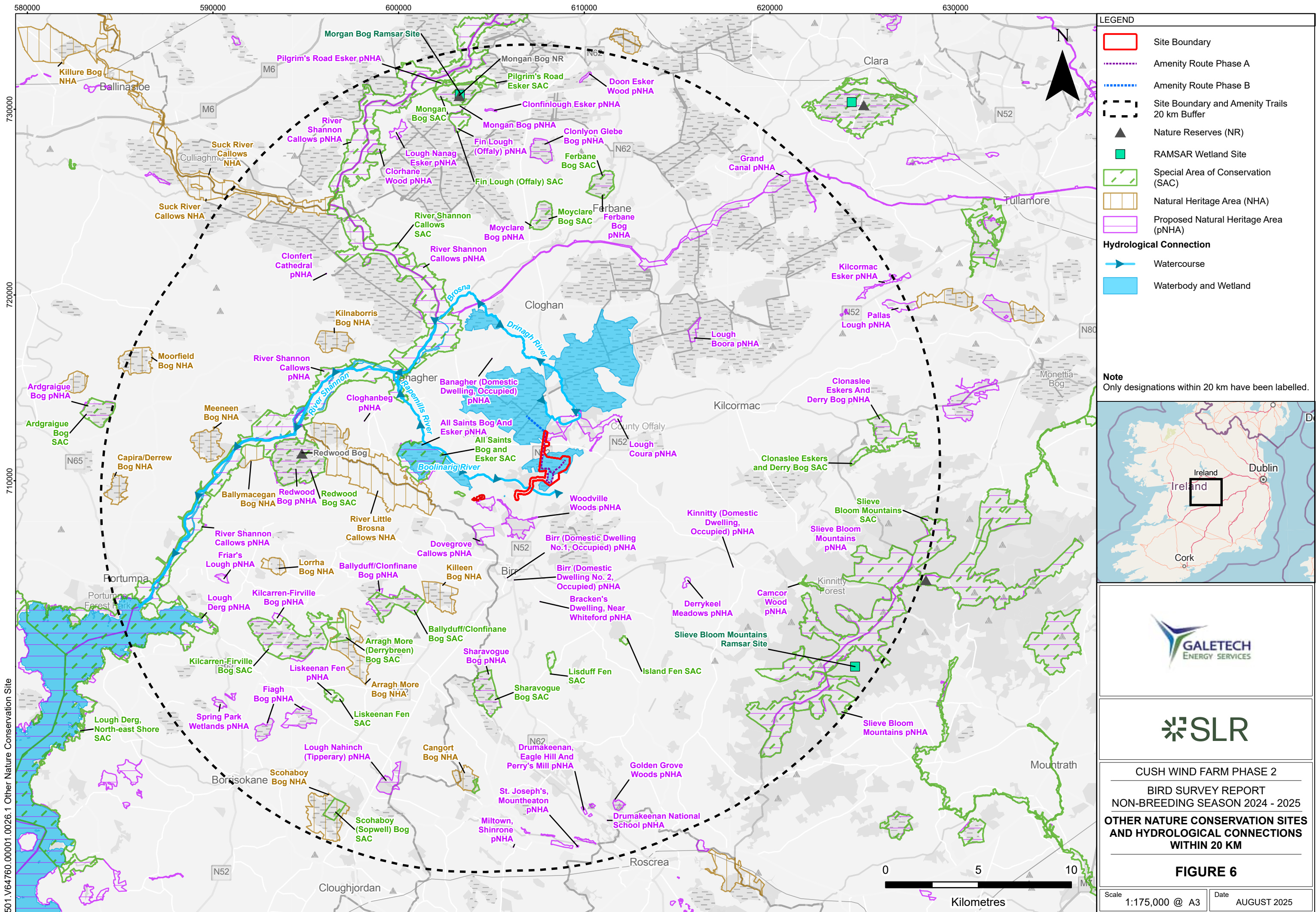
CUSH WIND FARM PHASE 2

BIRD SURVEY REPORT
NON-BREEDING SEASON 2024 - 2025

**SPECIAL PROTECTION AREAS AND
HYDROLOGICAL CONNECTIONS
WITHIN 20 KM**

FIGURE 5

Scale1:175,000 @ A3DateAUGUST 2025





Appendix B Survey Metadata

Baseline Ornithology Report – Non Breeding Bird Surveys 2024/25

Cush Wind Farm Phase 2

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

13 August 2025

B.1 Survey Dates, Times and Surveyors

Surveyor initials are given in section 1.3.

Table B-1.1: Details of feeding distribution surveys

Date	Surveyor Initials	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Duration (hh:mm)
04/10/2024	DN	09:14	12:30	03:06
18/10/2024	DN	10:10	14:10	04:00
06/11/2024	DN	09:05	12:40	03:35
25/11/2024	DN	12:45	16:15	03:30
05/12/2024	DN	12:50	16:05	03:15
19/12/2024	DN	09:00	13:10	04:10
14/01/2025	DN	13:35	16:35	03:00
27/01/2025	DN	11:10	14:10	03:00
11/02/2025	DN	13:20	17:20	04:00
21/02/2025	DN	08:30	12:30	04:00
03/03/2025	DN	15:30	18:30	03:00
19/03/2025	DN	07:15	11:15	04:00
Total hours (hh:mm)				42:36

Table B-1.2: Details of nocturnal wader surveys

Date	Surveyor Initials	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Duration (hh:mm)
04/10/2024	DN/JM	18:00	20:49	02:49
18/10/2024	DN/FL	17:37	20:00	02:23
06/11/2024	DN/FL	17:15	19:50	02:35
25/11/2024	DN/FL	18:30	20:30	02:00
05/12/2024	DN/FL	18:30	20:30	02:00
19/12/2024	DN/DM	19:30	21:30	02:00
Total hours (hh:mm)				13:37



Table B-1.3: Details of nocturnal migration surveys undertaken from VP3

Date	Surveyor Initials	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Duration (hh:mm)
11/11/2024	DN	17:25	18:25	01:00
12/11/2024	DN	06:15	07:15	01:00
03/03/2024	DN	18:55	19:55	01:00
20/03/2025	DN	05:20	06:20	01:00
Total hours (hh:mm)				04:00



B.2 Survey Weather

Weather keys are as follows:

- Wind speed: 0 = calm, 1 = light air, 2 = light breeze, 3 = gentle breeze, 4 = moderate breeze, 5 = fresh breeze, 6 = strong breeze, 7 = moderate gale, 8 = gale;
- Rain: 0 = none, 1 = drizzle, 2 = light showers/snow, 3 = heavy showers/snow, 4 = heavy rain/snow;
- Cloud height (height of clouds above average height of viewshed): 0 = <150 m, 2 = 150-500 m, 3 = >500 m;
- Visibility: 0 = <1km (poor), 1 = 1-3 km (moderate), 3 = >3 km (good);
- Snow (lying): 0 = none, 1 = on site, 2 = on higher ground; and
- Frost: 0 = none, 1 = on ground in morning, 2 = on ground all day.



Table B-2.1: Weather data collected during feeding distribution surveys

Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
04/10/2024	09:14	12:20	1	4	N	1	8	2	2	0	0	13
04/10/2024	09:14	12:20	2	5	N	1	8	2	2	0	0	14
04/10/2024	09:14	12:20	3	4	N	1	8	2	2	0	0	14
04/10/2024	09:14	12:20	4	4	N	1	8	2	2	0	0	14
18/10/2024	10:10	14:10	1	6	N	0	8	2	2	0	0	16
18/10/2024	10:10	14:10	2	5	N	0	8	2	2	0	0	16
18/10/2024	10:10	14:10	3	5	N	0	8	2	2	0	0	16
18/10/2024	10:10	14:10	4	5	N	0	8	2	2	0	0	16
06/11/2024	09:05	12:40	1	3	NW	0	6	2	2	0	0	15
06/11/2024	09:05	12:40	2	4	NW	0	4	2	2	0	0	15
06/11/2024	09:05	12:40	3	4	NW	0	4	2	2	0	0	17
06/11/2024	09:05	12:40	4	4	NW	0	4	2	2	0	0	17
25/11/2024	12:45	16:15	1	3	N	0	4	2	2	0	1	2
25/11/2024	12:45	16:15	2	3	N	0	4	2	2	0	1	3
25/11/2024	12:45	16:15	3	3	N	1	4	2	2	0	1	4
05/12/2024	12:50	16:05	1	4	N	0	5	2	2	0	0	6



Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
05/12/2024	12:50	16:05	2	6	N	3	8	2	2	0	0	6
05/12/2024	12:50	16:05	3	4	N	1	3	2	2	0	0	6
05/12/2024	12:50	16:05	4	6	N	2	8	2	2	0	0	6
05/12/2024	17:15	19:50	1	2	N	2	6	2	2	0	0	6
05/12/2024	17:15	19:50	2	2	N	0	3	2	2	0	0	5
05/12/2024	17:15	19:50	3	2	N	0	2	2	2	0	0	5
19/12/2024	09:00	13:10	1	3	N	0	5	2	2	0	0	4
19/12/2024	09:00	13:10	2	3	NE	0	6	2	2	0	0	5
19/12/2024	09:00	13:10	3	3	NE	0	5	2	2	0	0	6
19/12/2024	09:00	13:10	4	3	NE	0	5	2	2	0	0	6
14/01/2025	13:35	16:35	1	3	SW	0	5	2	2	0	0	10
14/01/2025	13:35	16:35	2	3	SW	0	5	2	2	0	0	10
14/01/2025	13:35	16:35	3	3	SW	0	5	2	2	0	0	9
27/01/2025	11:10	14:10	1	2	S	0	4	2	2	0	0	9
27/01/2025	11:10	14:10	2	2	S	0	4	2	2	0	0	9
27/01/2025	11:10	14:10	3	2	S	0	4	2	2	0	0	9
27/01/2025	18:30	20:30	1	2	S	0	4	2	2	0	0	8
27/01/2025	18:30	20:30	2	2	S	0	4	2	2	0	0	8
11/02/2025	13:20	17:20	1	2	W	0	8	2	2	0	0	5



Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
11/02/2025	13:20	17:20	2	2	W	1	8	2	2	0	0	5
11/02/2025	13:20	17:20	3	2	W	0	8	2	2	0	0	5
11/02/2025	13:20	17:20	4	2	W	0	8	2	2	0	0	5
11/02/2025	18:30	20:30	1	3	SW	0	7	2	2	0	0	4
11/02/2025	18:30	20:30	2	3	SW	0	7	2	2	0	0	4
21/02/2025	08:30	12:30	1	3	NE	2	8	2	2	0	0	9
21/02/2025	08:30	12:30	2	4	NE	2	8	2	2	0	0	10
21/02/2025	08:30	12:30	3	3	NE	1	7	2	2	0	0	10
21/02/2025	08:30	12:30	4	3	NE	1	8	2	2	0	0	10
03/03/2025	15:30	18:30	1	2	SW	0	5	2	2	0	0	9
03/03/2025	15:30	18:30	2	2	SW	0	5	2	2	0	0	9
03/03/2025	15:30	18:30	3	2	SW	0	4	2	2	0	0	9
19/03/2025	18:55	19:55	1	2	SW	0	4	2	2	0	0	9
19/03/2025	07:15	11:15	1	2	SW	0	3	2	2	0	0	12
19/03/2025	07:15	11:15	2	2	SW	0	3	2	2	0	0	12



Table B-2.2: Weather data collected during nocturnal wader surveys

Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
29/10/2024	18:00	20:49	1	2	NE	0	7	2	2	0	0	11
29/10/2024	18:00	20:49	2	2	NE	0	6	2	2	0	0	11
29/10/2024	18:00	20:49	3	2	NE	0	6	2	2	0	0	10
05/11/2024	17:37	20:00	1	1	NW	0	5	2	2	0	0	14
05/11/2024	17:37	20:00	2	1	NW	0	6	2	2	0	0	14
05/11/2024	17:37	20:00	3	1	NW	0	4	2	2	0	0	13
05/12/2024	12:50	16:05	1	4	N	0	5	2	2	0	0	6
05/12/2024	12:50	16:05	2	6	N	3	8	2	2	0	0	6
05/12/2024	12:50	16:05	3	4	N	1	3	2	2	0	0	6
05/12/2024	12:50	16:05	4	6	N	2	8	2	2	0	0	6
05/12/2024	17:15	19:50	1	2	N	2	6	2	2	0	0	6
05/12/2024	17:15	19:50	2	2	N	0	3	2	2	0	0	5
05/12/2024	17:15	19:50	3	2	N	0	2	2	2	0	0	5
27/01/2025	11:10	14:10	1	2	S	0	4	2	2	0	0	9
27/01/2025	11:10	14:10	2	2	S	0	4	2	2	0	0	9



Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
27/01/2025	11:10	14:10	3	2	S	0	4	2	2	0	0	9
27/01/2025	18:30	20:30	1	2	S	0	4	2	2	0	0	8
27/01/2025	18:30	20:30	2	2	S	0	4	2	2	0	0	8
11/02/2025	13:20	17:20	1	2	W	0	8	2	2	0	0	5
11/02/2025	13:20	17:20	2	2	W	1	8	2	2	0	0	5
11/02/2025	13:20	17:20	3	2	W	0	8	2	2	0	0	5
11/02/2025	13:20	17:20	4	2	W	0	8	2	2	0	0	5
11/02/2025	18:30	20:30	1	3	SW	0	7	2	2	0	0	4
11/02/2025	18:30	20:30	2	3	SW	0	7	2	2	0	0	4
20/03/2025	05:20	06:20	1	1	SW	0	2	2	2	0	0	3

Table B-2.3: Weather data collected during nocturnal migration surveys

Date	Start of Survey (hh:mm)	End of Survey (hh:mm)	Survey Hour	Wind Speed (Beaufort)	Wind Direction	Rain	Cloud Cover (okta)	Cloud Height	Visibility	Snow	Frost	Temp. (°C)
11/11/2024	17:25	18:25	1	2	S	0	8	0	0	0	0	6
12/11/2024	06:15	07:15	1	1	S	0	7	1	1	0	1	-1
03/03/2025	18:55	19:55	1	2	SW	0	4	2	2	0	0	9
20/03/2025	05:20	06:20	1	1	SW	0	2	2	2	0	0	3





Appendix C Bird species names

Baseline Ornithology Report – Non Breeding Bird Surveys 2024/25

Cush Wind Farm Phase 2

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

13 August 2025

Table D-1: Names of bird species discussed in the report

BTO Code	Common Name	Latin Name
BH	Black-headed gull	<i>Chroicocephalus ridibundus</i>
BO	Barn owl	<i>Tyto alba</i>
BW	Black-tailed godwit	<i>Limosa limosa</i>
BZ	Common buzzard	<i>Buteo buteo</i>
CE	Corncrake	<i>Crex crex</i>
CA	Great cormorant	<i>Phalacrocorax carbo</i>
CO	Eurasian coot	<i>Fulica atra</i>
CU	Eurasian curlew	<i>Numenius arquata</i>
GG	Great crested grebe	<i>Podiceps cristatus</i>
HW	Great white egret	<i>Ardea alba</i>
GN	Common goldeneye	<i>Bucephala clangula</i>
GP	European golden plover	<i>Pluvialis apricaria</i>
H.	Grey heron	<i>Ardea cinerea</i>
HH	Hen harrier	<i>Circus cyaneus</i>
K.	Common kestrel	<i>Falco tinnunculus</i>
L.	Northern lapwing	<i>Vanellus vanellus</i>
LB	Lesser black-backed gull	<i>Larus fuscus</i>
LG	Little grebe	<i>Tachybaptus ruficollis</i>
MA	Mallard	<i>Anas platyrhynchos</i>
ML	Merlin	<i>Falco columbarius</i>
MP	Meadow pipit	<i>Anthus pratensis</i>
MR	Western marsh harrier	<i>Circus aeruginosus</i>
MS	Mute swan	<i>Cygnus olor</i>
NW	Greenland white-fronted goose	<i>Anser albifrons flavirostris</i>
PE	Peregrine Falcon	<i>Falco peregrinus</i>
PT	Northern pintail	<i>Anas acuta</i>
RB	Reed Bunting	<i>Emberiza schoeniclus</i>
RG	Red grouse	<i>Lagopus lagopus scoticus</i>
RK	Redshank	<i>Tringa totanus</i>
RP	Common ringed plover	<i>Charadrius hiaticula</i>
S.	Skylark	<i>Alauda arvensis</i>
SB	Snow bunting	<i>Plectrophenax nivalis</i>
SH	Eurasian sparrowhawk	<i>Accipiter nisus</i>
SN	Common snipe	<i>Gallinago gallinago</i>
SV	Northern shoveler	<i>Anas clypeata</i>



BTO Code	Common Name	Latin Name
T.	Eurasian teal	<i>Anas crecca</i>
TU	Tufted duck	<i>Aythya fuligula</i>
WN	Eurasian wigeon	<i>Mareca penelope</i>
WS	Whooper swan	<i>Cygnus cygnus</i>





Making Sustainability Happen



Bird Migration Survey Report

Cush Wind Farm

Cush Wind Farm Ltd

Clondargan, Stradone, Co. Cavan

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14
N2Y7

SLR Project No.: 501.065415.00001

Client Reference No: N/A

29 May 2024

Revision: 1

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	28 May 2024	Alice Magee	Dr Jonathon Dunn	Dr Jonathon Dunn
1	29 May 2024	Dr Jonathon Dunn	Sinéad Clifford	Dr Jonathon Dunn

Basis of Report

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1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd (SLR) was commissioned by Cush Wind Farm Ltd to carry out bird migration watch surveys for the proposed eight turbine wind farm at Cush, Co. Offaly (hereafter 'the Project') during April 2024. The purpose of this report is to describe these surveys and the resulting ornithological baseline.

1.1 Background

No previous planning permission has been sought on the application site for the development of wind farms by Cush Wind Farm Ltd or any other party.

Bird surveys have been previously undertaken at the proposed Project site at Cush, Co. Offaly (hereafter 'the Project Site') by SLR for the breeding 2020, non-breeding 2020/21, breeding 2021, non-breeding 2021/22, breeding 2022 seasons, non-breeding 2022/23, breeding 2023, and non-breeding 2023/24 seasons.

The Project Site also includes a linear area that was previously surveyed for a proposed overhead line¹. Flight activity surveys were carried out at two vantage point locations along the proposed overhead line route corridor during the breeding season in 2018.

These surveys were used to inform a planning application (including an Environmental Impact Assessment Report or 'EIAR' and Natura Impact Statement or 'NIS'), which was submitted to ABP in January 2024 (planning reference number ABP-313778-22).

Following the planning application, ABP received an ornithology-related submission from the Development Applications Unit (DAU) in March 2024, which related to migratory birds. The DAU response suggested that the risk to birds on migration of being involved in collisions with the proposed wind farm in its operational phase has not been satisfactorily evaluated.

1.2 Site Description

The Project Site is in the townland of Cush approximately 4 km north of Birr, Co. Offaly at approximate ITM coordinates 608237, 709946. The habitats within the Project Site are dominated by conifer plantations of varying age classes (c.327 ha), cutaway bog (c.102 ha) and agricultural grasslands (ca. 327 ha). The Project Site is not designated for nature conservation.

1.3 Scope of Work

The scope of survey work was based on existing knowledge of the area and took into account current NatureScot (NS; formerly Scottish Natural Heritage, SNH) Guidance². The survey methods guidance is recognised as standard best practice guidance throughout the UK and Ireland for surveying birds to inform impact assessment for onshore wind farms.

With specific reference to the subject of this report, NS guidance statements that "*where a high level of migration movements are considered likely, or are known, to occur, sampling within this period should be stratified to ensure adequate data collection across the spring and autumn periods. Additional survey is not always necessary but may be required to cover this adequately in large areas or areas of high activity*".

¹ SLR (2018) *Cloghan Wind Farm and Long Oak Wind Farm Breeding Bird Survey Report 2018*. Prepared for Galetch Energy Services Ltd

² Scottish Natural Heritage (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms V2*. Scottish Natural Heritage, Inverness.



It also says that “for species which are active at dawn and dusk or at night, other methods of recording or assessing activity need to be employed. Night vision/infra-red equipment and survey on moonlit nights can establish presence of nocturnal species or presence and direction of feeding/migration movements both by calls and by sight (although we accept following birds beyond short distances is almost impossible, and that for most species nocturnal activity is likely to be underestimated in any attempted survey)”.

As the extensive suite of diurnal flight activity surveys carried out to date ought to have detected any diurnal migration, a focus was given to searching for evidence of crepuscular and nocturnal migration during the current surveys.

1.4 Target Species

All bird species observed were recorded, with a focus given to species that are Special Conservation Interests (SCIs) or Qualifying Interest (QIs) for any designated nature conservation site (primary target species). All other species were classified as secondary targets.

1.5 Terminology

For this report, “flight line” refers to the line drawn to record avian movement during a vantage point (VP) survey. A single flight line may be used to indicate the collective movement of a flock of birds. Each individual bird moving within the same flight line is referred to as “a flight”. Note that the “cumulative number of flights” reflects the occupancy of the study area by a particular species. It is not equivalent to the total number of unique individuals and should not be used to infer abundance.

1.6 Purpose of this Report

This report outlines the surveys undertaken and methods used. It then summarises the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The assessment of impacts resulting from the Project and the development of mitigation measures, if required, are beyond the scope of this report. However, this report will be used to inform responses to submissions received from the DAU pertaining to migratory birds and associated impact assessment.



2.0 Methodology

2.1 Field Surveys

2.1.1 Field Survey Team: Evidence of Technical Competence and Experience

2.1.1.1 Jonathon Dunn (JD) – Project Manager and Lead Ornithologist

Jonathon is an Associate Ornithologist with SLR and holds a BA (Hons) in Natural Sciences from the University of Cambridge, an MSc in Ecology Evolution and Conservation from Imperial College London and a PhD in Avian Ecology from Newcastle University. He is a Full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). Jonathon is a highly skilled and experienced bird surveyor with eight years' post graduate experience as a professional consultant ecologist. Jonathon managed this project through liaison with the client, coordination of the survey team, supervision of the health and safety of the team, collating, quality controlling and assessing the survey data.

2.1.1.2 Darragh Nagle (DN) – Project Ecologist

Darragh is a Project Ecologist and graduated from University College Cork in 2020 with a BSc degree (Hons) in Ecology and Environmental Ecology. He is a qualifying member with CIEEM. Since joining SLR Darragh's field experience includes multiple diverse bird surveys on windfarm sites across Ireland with experience in vantage point, breeding wader, breeding raptor, feeding distribution, hen harrier roost *Circus cyaneus* and intertidal bird surveys. Darragh carried out migration watch VP surveys at the Project Site in April 2024.

2.1.2 Migration Watch Vantage Point (VP) Surveys

The three VP locations, 2 km viewing arcs and viewsheds were the same as used for previous flight activity surveys.

Note that the viewshed from VP3 mostly covers an area that is not under consideration for the current planning application and is outside the Project Site. Results from surveys carried out at this VP have been included to provide additional information on migration movements in the wider area.

The purpose of these surveys was to identify any evidence of migration, especially by qualifying interest (QI) species between the Project Site and any nearby Special Protection Areas (SPAs) around dawn or dusk.

A total of 18 hours of migration watch VP surveys were conducted from all VP locations combined during April 2024, as summarised in **Table 2-1**.

One dusk survey and one dawn survey were conducted from each VP. Dusk surveys commenced two hours before dusk and finished one hour after dusk, whereas dawn surveys commenced one hour before dawn and finished two hours after dawn.

A Helion 2 XP50 Pro Thermal Monocular was used during periods of darkness. This enables birds to be readily detected by their body heat at up to c. 350 m range. Where birds were detected, images were recorded as videos.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying bout;
- Species, age and sex (where determinable);



- Number of flights observed;
- Time spent within each height band; and
- Notes on observation.

Local circumstances may indicate that survey information should also be acquired on other species, especially those of regional conservation concern. Such species are termed secondary species. Recording of secondary species is subsidiary to recording of primary target species. A summary of observations of secondary target species was recorded at the end of each five-minute period during each VP watch to provide an index of flight activity for secondary target species within and around the Project Site, in accordance with current NS guidance.

Secondary target species included any other species not designated as primary targets.

For April 2024, height bands were determined allowing for the maximum rotor tip height of 200 m and a lowest rotor swept height of 28 m. The relation of the height bands to the latest turbine specification is shown below.

Flight heights were attributed to four distinct height bands for the non-breeding season as follows:

- 1 = <25 m (below the likely rotor swept area);
- 2 = 25 m to 160 m (potentially within the likely rotor swept area, at least in part);
- 3 = 160 m to 200 m (within the likely rotor swept area); and
- 4 = >200 m (above the likely rotor swept area).

Details of survey dates, times and observers are provided in **Appendix A** and details of weather conditions in **Appendix B**.

Table 2-1: Summary of Migration Surveys Undertaken During April 2024

Time Period	VP1 (hours)	VP2 (hours)	VP3 (hours)
Dusk	03:00	03:00	03:00
Dawn	03:00	03:00	03:00
Total hrs	6:00	6:00	6:00
VP locations ITM	608735 E 710130 N	605883 N 709097 N	607798 E 711305 N

2.2 Survey Limitations

There were no periods of poor visibility due to weather conditions during any of surveys i.e. less than 1 km. Therefore, weather conditions are not considered to be significant limitations to the survey data obtained. Details regarding weather conditions during surveys are provided in **Appendix B**.

The range of the thermal imaging camera is greater than that tip height of the proposed turbines and so any evidence of nocturnal migration ought to have been detected, if present.

3.0 Results

3.1 Migration Watch VP Surveys

A summary of the survey findings is provided in sections 3.1.1 and 3.1.2 for primary and secondary target species, respectively. Flight data for both primary and secondary target species are provided in **Appendix C**.



3.1.1 Primary Target Species

A total of four flight lines by three primary target species were recorded during the surveys.

Northern lapwing is the only species recorded during surveys that is a QI for any SPAs with 20 km of the Project Site. Flight activity is summarised in **Table 3-1**.

Table 3-1: Number of Primary Target Species Flights

Species	Number of flight lines by VP			Total number of flight lines	Time at risk height* (s)	Cumulative number of flights
	VP1	VP2	VP3 (area outside current planning application)			
Common snipe <i>Gallinago gallinago</i>	0	0	1	1	0	5
Mallard <i>Anas platyrhynchos</i>	2	0	0	2	0	4
Northern lapwing <i>Vanellus vanellus</i>	0	0	1	1	65	1
* precautionary risk height assumed to be between 20 – 200 m						

A summary of flight activity by species is presented below.

3.1.1.1 Common snipe

One flight line consisting of five flights was recorded during the dawn survey from VP3, at the edge of the 500 m survey buffer for the Project Site. The flights were recorded of snipe foraging by the water in a bog pool, drumming and flying at an average height of 5 m, which is below potential collision heights.

3.1.1.2 Mallard

Two flight lines were recorded within the Project Site from VP1, with each flight line consisting of two flights. One flight line was recorded during the dusk survey and one flight line was recorded during the dawn survey. Both flight lines were below potential collision heights and were short, comprising of birds moving over the centre of the Project Site.

3.1.1.3 Northern lapwing

One flight line consisting of one flight was recorded during the dawn survey from VP3. The flight was within the Project Site at an average height of 20 m. Due to the low height of the flightline, it is not considered that this flight was migrating between the Project Site and any nearby SPAs.

3.1.2 Secondary target species

Secondary species activity at the Project Site is summarised in **Table 3-2**.



Table 3-2: Secondary Species Activity Summary

Species	Number of 5 min periods recorded	Peak count of birds recorded in any 5 min period	Comments
Common buzzard <i>Buteo buteo</i>	6	2	Activity within the Project Site only.
Grey heron <i>Ardea cinerea</i>	3	3	Activity within the Project Site, buffer & beyond.
Northern raven <i>Corvus corax</i>	3	1	Activity within the Project Site, buffer & beyond.

4.0 Summary and Conclusions

Migration watch VP surveys were carried out at Project Site during April 2024, which comprised one dusk survey and one dawn survey conducted at each of the three VP locations.

The following primary target species were recorded during flight activity surveys:

- Common snipe;
- Mallard; and
- Northern lapwing.

A total of four flight lines were recorded during surveys, which comprised two mallard flight lines, one common snipe flight line and one northern lapwing flight line. Northern lapwing is a QI for three SPAs within 20 km.

However, none of the recorded flight lines were considered to be of migrating birds, due to the low numbers of individuals recorded, short flight durations and very low flight heights.

Overall, no evidence of SCI or QI species migrating between the Project Site and any nearby SPAs was recorded during the migration watch VP surveys in April 2024.

The results of this survey agree with the results of previously conducted bird surveys and the baseline conditions reported in the 2024 EIAR and NIS.

5.0 Legal and Conservation Status of Target Species Recorded

Table 5-1 summarises the legal and conservation status of the target species recorded during the range of ornithology surveys mentioned above. All birds are protected by the Wildlife Acts 1976 (as amended) in Ireland.

Table 5-1: Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO Code)	Legal & Conservation Status in Ireland
Primary	Common snipe (SN)	BoCCI4 Red
	Mallard (MA)	BoCCI4 Amber
	Northern lapwing (L.)	BoCCI4 Red
Secondary	Common buzzard (BZ)	BoCCI4 Green



Primary or Secondary Target	Species (BTO Code)	Legal & Conservation Status in Ireland
	Grey heron (H.)	BoCCI4 Green
	Northern raven (RN)	BoCCI4 Green





Appendix A Survey Dates, Times and Surveyors³

Bird Migration Survey Report

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

29 May 2024

³ Surveyor initials can be found in Section 2.1.1

Table A-1: Details of migration watch VP surveys

Date	Surveyor	VP	Start (hh:mm)	End (hh:mm)	Survey Duration (hh:mm)
02/04/2024	DN	1	18:44	21:44	03:00
03/04/2024	DN	3	05:23	08:23	03:00
03/04/2024	DN	2	18:46	21:46	03:00
04/04/2024	DN	1	05:21	08:21	03:00
04/04/2024	DN	3	18:48	21:48	03:00
05/04/2024	DN	2	05:19	08:19	03:00
Total Hours					18:00





Appendix B Weather data

Bird Migration Survey Report

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

29 May 2024

Table B-1: Weather data collected during migration watch VP surveys undertaken at VP1

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°C)
02/04/2024	DN	18:44	21:44	1	2	E	1	6	2	2	0	0	9
02/04/2024	DN	18:44	21:44	2	2	E	0	6	2	1	0	0	8
02/04/2024	DN	18:44	21:44	3	2	E	0	6	2	0	0	0	7
04/04/2024	DN	05:21	08:21	1	1	E	0	8	2	0	0	0	6
04/04/2024	DN	05:21	08:21	2	1	E	0	8	2	2	0	0	6
04/04/2024	DN	05:21	08:21	3	1	E	0	8	2	2	0	0	6
Rain/ Precipitation None 0 Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4			Cloud Cover Expressed in oktas (n/8) Cloud Height Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2			Visibility Poor (<1km) 0 Moderate (1-3km) 1 Good (>3km) 2 Thermal camera used during periods of poor visibility due to darkness.			Lying Snow None 0 On site 1 On higher ground 2			Frost None 0 Ground 1 All day 2	



Table B-2: Weather data collected during migration watch VP surveys undertaken at VP2

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
03/04/2024	DN	18:46	21:46	1	2	S	0	7	2	2	0	0	6
03/04/2024	DN	18:46	21:46	2	3	S	3	8	2	2	0	0	6
03/04/2024	DN	18:46	21:46	3	4	S	1	8	2	0	0	0	6
05/04/2024	DN	05:19	08:19	1	3	SE	2	7	2	0	0	0	6
05/04/2024	DN	05:19	08:19	2	3	SE	0	6	2	2	0	0	6
05/04/2024	DN	05:19	08:19	3	3	SE	0	5	2	2	0	0	6
Rain/ Precipitation None 0 Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4			Cloud Cover Expressed in oktas (n/8) Cloud Height Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2			Visibility Poor (<1km) 0 Moderate (1-3km) 1 Good (>3km) 2 Thermal camera used during periods of poor visibility due to darkness.			Lying Snow None 0 On site 1 On higher ground 2			Frost None 0 Ground 1 All day 2	



Table B-3: Weather data collected during migration watch VP surveys undertaken at VP3

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
03/04/2024	DN	05:23	08:23	1	3	NW	0	8	2	0	0	0	6
03/04/2024	DN	05:23	08:23	2	3	NW	0	5	2	2	0	0	8
03/04/2024	DN	05:23	08:23	3	3	NW	0	4	2	2	0	0	8
04/04/2024	DN	18:48	21:48	1	3	E	2	8	2	2	0	0	11
04/04/2024	DN	18:48	21:48	2	3	SE	3	8	2	2	0	0	10
04/04/2024	DN	18:48	21:48	3	3	SE	2	8	2	2	0	0	10
Rain/ Precipitation None 0 Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4			Cloud Cover Expressed in oktas (n/8) Cloud Height Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2			Visibility Poor (<1km) 0 Moderate (1-3km) 1 Good (>3km) 2 Thermal camera used during periods of poor visibility due to darkness.			Lying Snow None 0 On site 1 On higher ground 2			Frost None 0 Ground 1 All day 2	





Appendix C Flight Activity Survey Data⁴

Bird Migration Survey Report

Cush Wind Farm

Cush Wind Farm Ltd

SLR Project No.: 501.065415.00001

29 May 2024

⁴ The key to BTO Codes can be found in Section 5.0.

Table C-1: Primary target species recorded during migration watch VP surveys at all VPs combined

Date	Surveyor	VP	Flight ID	BTO Code	Num. Birds	Age ⁵	Sex ⁶	Obs. Time	Avg. flight height (m)	Flight time (s)
02/04/2024	DN	1	1	MA	2	AD	M	19:27	15	60
03/04/2024	DN	3	1	SN	5	AD	U	06:02	5	180
03/04/2024	DN	3	2	L.	2	AD	U	08:03	20	140
04/04/2024	DN	1	1	MA	2	AD	M	07:34	5	50

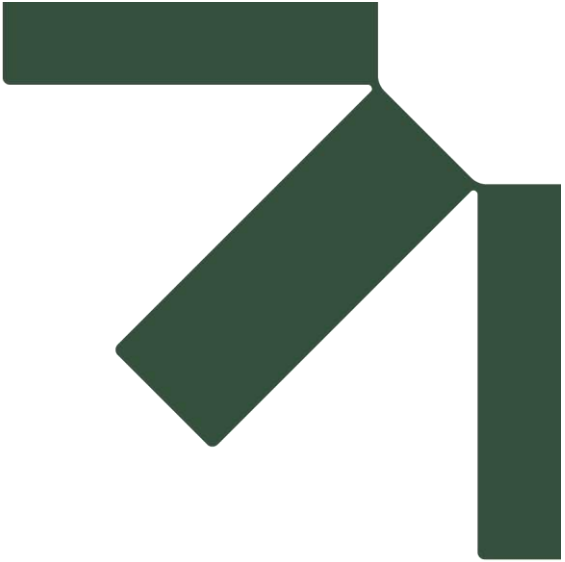
Table C-2: Secondary target species recorded during migration watch VP surveys at all VPs combined

Date	VP	Survey Start	Survey End	5 min period	BTO Code	Count
02/04/2024	1	05:19	08:19	19:00	RN	1
02/04/2024	1	05:19	08:19	19:20	H.	3
02/04/2024	1	05:19	08:19	19:20	BZ	1
02/04/2024	1	05:19	08:19	21:00	BZ	1
02/04/2024	1	05:19	08:19	21:10	RN	1
03/04/2024	3	05:23	08:23	07:00	H.	1
03/04/2024	2	18:46	21:46	19:20	BZ	2
03/04/2024	2	18:46	21:46	20:00	BZ	1
04/04/2024	1	05:21	08:21	07:00	RN	1
04/04/2024	1	05:21	08:21	07:20	BZ	1
04/04/2024	1	05:21	08:21	08:00	H.	1
05/04/2024	2	05:19	08:19	07:45	BZ	1

⁵ Age letters refer to; AD =Adult, U=Unrecorded

⁶ Sex letters refer to; M=Male, F=Female, U=Unrecorded





Appendix F Collision Risk Model Report

Appropriate Assessment Screening Report and Natura Impact Statement

Cush Wind Farm Phase II

Cush Wind Limited

SLR Project No.: 501.065723.00001

23 October 2026





Avian Collision Risk Report

Cush Wind Farm Phase II

Cush Wind Limited

Prepared by:

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SLR Project No.: 501.065723.00001

Client Reference No: IR.005810

23 October 2026

Revision: 1

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	20 August 2026	Jonathon Dunn	Michael Austin	Michael Austin
1	28 September 2026	Jonathon Dunn	Michael Austin	Michael Austin
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

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Executive Summary

The aim of this report is to describe the collision risk modelling process undertaken for the Cush Wind Farm Phase II project in Co. Offaly, and to provide outputs such that any potentially significant collision-related effects on birds can be identified in the accompanying Environmental Impact Assessment (EIA) and Natura Impact Statement (NIS) reports. Modelling was undertaken using ornithological data collected by SLR between May 2022 and March 2024 for 14 bird species. The final turbine model has not yet been selected and will be chosen from within the turbine dimension range assessed for the Project. For the purposes of the CRM, two representative turbine permutations within that range were modelled: a minimum rotor diameter / maximum ground-clearance permutation, represented by the 'GE158' turbine, and a maximum rotor diameter / minimum ground-clearance permutation, represented by the 'E175' turbine.

These permutations were selected to represent the outer limits of rotor diameter and rotor ground clearance within the turbine dimension range and thereby assess the effect of differing rotor-swept areas and potential collision heights on predicted avian collision rates.

The collision risk model chosen was a random (i.e. non-directional) model and was implemented following NatureScot (2024) best-practice guidance. At the primary avoidance rates adopted, predicted collision rates were highest for European golden plover, followed by common kestrel, with all other species predicted to incur fewer than 0.21 or fewer collisions per year under either turbine permutation. Predicted collision rates were negligible for hen harrier and whooper swan. While the model outputs provide a theoretical estimate of collision risk, they do not directly reflect whether collision is likely to have significant effects on avian populations, which is addressed within the accompanying EIA and NIS reports. Furthermore, the modelling is subject to various limitations and qualifications, which are discussed in the report.



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Appendices

**Appendix A NatureScot Spreadsheets – 158m RD Representative Permutation
(GE158)**

**Appendix B NatureScot Spreadsheets – 175 m RD Representative Permutation
(E175)**



Acronyms and Abbreviations

CIEEM	Chartered Institute of Ecology and Environmental Management
CRM	Collision Risk Model
EIA	Environmental Impact Assessment
GIS	Geographical Information Systems
HB	Height Band
MW	Megawatt
NIS	Natura Impact Statement
NS	NatureScot
PCH	Potential Collision Height
SCI	Special Conservation Interest
SPA	Special Protection Area
The Project	Cush Wind Farm Phase II
VP	Vantage Point
WP	Wind Farm Polygon



1.0 Introduction

This report presents the results of Collision Risk Modelling (CRM) undertaken for 14 bird species to inform the assessment of potential ornithological effects associated with the proposed Cush Wind Farm Phase II (hereafter ‘the Project’), which comprises a 3 no. wind turbine extension to the permitted Cush Wind Farm Phase I.

The final turbine model has not yet been selected and will be chosen from within the turbine dimension range assessed for the Project. For the purposes of the CRM, two representative turbine permutations within that range have been modelled:

- **Minimum rotor diameter / maximum ground-clearance permutation** – represented by the GE158 turbine, comprising a rotor diameter of 158 m, an overall tip height of 199.9 m and a hub height of 120.9 m; and
- **Maximum rotor diameter / minimum ground-clearance permutation** – represented by the E175 turbine, comprising a rotor diameter of 175 m, an overall tip height of 199.1 m and a hub height of 111.6 m.

These permutations were selected to represent the outer limits of rotor diameter and rotor ground clearance within the turbine dimension range. The 158 m rotor diameter permutation provides the smallest rotor-swept area and greatest ground clearance, while the 175 m rotor diameter permutation provides the largest rotor-swept area and lowest ground clearance. These parameters influence the degree of overlap between the rotor-swept height range and the flight heights recorded for target bird species and, consequently, the level of exposure incorporated within the CRM.

Other turbine-specific parameters, including blade chord width and rotational speed, can also influence the calculated collision probability. These parameters have therefore been incorporated into the modelling using the specifications of the representative turbines assessed. The suitability of the selected permutations to represent the range of potential collision-risk outcomes is considered further within the methodology below.

The CRM was undertaken in accordance with current NatureScot (NS) guidance¹, which is recognised as established best-practice guidance for the assessment of avian collision risk associated with onshore wind energy development in Ireland and the UK. Further details of the methodology, including the assumptions and parameters applied within the modelling, are provided in Section 2.0. The modelling results are presented in Section 3.0, while copies of the modelling calculations for each species and representative turbine permutation are provided in Appendix A and Appendix B.



2.0 Methods

2.1 Statement of Authority

The modelling and report writing were conducted by Dr Jonathon Dunn MCIEEM. Jonathon is a Principal Ornithologist with SLR and has over 10 years' experience in the environmental sector and has completed CRM training delivered by the Chartered Institute of Ecology and Environmental Management (CIEEM). He has conducted CRMs for multiple onshore wind farms in Ireland.

Quality assurance and technical review were provided by Michael Austin MCIEEM. Michael is an Associate Ornithologist with SLR and has over 10 years' experience undertaking CRM. He was trained in CRM at RPS and has taken a lead role in CRM at SLR having conducted many CRMs for onshore wind farms in the UK and Ireland.

2.2 Primary Target Species

Target species for the surveys were defined by legal and/ or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS (2025) guidance². Bird species of high conservation importance are those which are Annex I species and other species of high conservation importance which are potentially vulnerable to impacts from wind farm developments. The following species were therefore considered relevant as primary target species:

- Annex I raptor species;
- All red-listed non-passerine species; and
- Special Conservation Interests (SCIs) of Special Protection Areas (SPAs) within 20 km of the Project.

2.3 Overview of CRM Process

As per current NS guidance, the updated Band CRM (Band 2024³) was used to estimate collision risk based on recorded primary target species activity levels and flight behaviour, proposed turbine numbers and specifications, and the relevant species biometrics and flight characteristics. Modelling collision risk under the Band CRM³ is summarised below:

- Stage A uses bird survey data to establish the density of flying birds in the vicinity of the turbines, and the proportion flying at a risk height, between the lowest and highest points of the rotors;
- Stage B provides an estimate, based on the bird density and proportion at risk height, of the potential number of bird passages through rotors in the period in question;
- Stage C calculates the probability of collision during a single bird rotor transit;
- Stage D estimates the potential collision rate for a bird species, assuming current levels of bird use of the site, allowing for the proportion of time that turbines are not operational; and

² NatureScot (2025). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. Version 2. Note the 2017 version of this guidance was used for surveys at the time but the text on the definition of target species as mentioned here remains the same in the 2025 update.

³ Band, W. 2024. Using a collision risk model to assess bird collision risks for onshore wind farms. NatureScot Research Report 909.



- Stage E takes account of the proportion of birds likely to avoid the wind farm or its turbines, either because they have been displaced from the site or because they take evasive action or are attracted to the wind farm, e.g. in response to changing habitats.

A full description of the different stages of the CRM is given in NS (2024) guidance.

We have employed a non-directional (i.e. randomly distributed flights) CRM. The alternative modelling approach would be a directional (i.e. non-randomly distribute flights) CRM. The difference between the two modelling approaches depends on flight distributions and bird behaviours. Thus, if birds are regularly making flights along a defined axis between e.g. nesting and foraging grounds, or as part of migration, then a directional CRM is appropriate. As we have no evidence of this for the Project, a non-directional CRM is the correct choice of model.

The modelling was carried out using the spreadsheet supplied with the NS (2024) guidance. The data used for the different stages of CRM are outlined below.

2.4 Stage A

2.4.1 Viewshed Data

One vantage point (VP), VP3, was used for flight activity surveys. VP3 is the identifier used in the original survey records, the baseline survey reports and the associated mapping, and has been retained here for consistency with those documents.

Viewshed data, i.e., the area visible from the VP within the wind farm polygon (WP)⁴, are summarised in Table 2-1. The VP location and viewshed data are shown within the accompanying EIA report.

Viewshed calculations were undertaken separately for each of the two representative turbine permutations because the differing rotor ground-clearance heights result in different areas of visibility from the VP.

For the minimum rotor diameter / maximum ground-clearance permutation (GE158), based on a lower rotor height of 41.9m, the visible area from VP3 is 2,045,553 m², representing 98.82% of the relevant wind farm polygon (2,070,079 m²).

For the maximum rotor diameter / minimum ground-clearance permutation (E175), based on a lower rotor height of 24.1 m, the visible area from VP3 is 2,087,642 m², representing 98.67% of the relevant wind farm polygon (2,115,782 m²).

Table 2-1: VP Viewshed Data

VP / Viewshed Number	ITM Coordinates (x,y)	Area of visibility ⁵ (m ²)	
		158 m RD permutation	175 m RD permutation
VP3	607798, 711305	2,045,553	2,087,642

⁴ The wind farm polygon (WP) includes the area within 500 m plus rotor blade length, extending from within the centre of each turbine tower, also known as 'the turbine envelope'. Thus, the size of the WP considers both rotor blade length and potential spatial errors in flight recording accuracy.

⁵ Areas calculated in GIS using offset of 41.9 m and 24.1 m above ground level for the GE158 and E175 candidate turbines, respectively



2.4.2 Seasonal Definitions

The periods used in the flight activity survey design broadly equate to the breeding and non-breeding season periods for most bird species, defined as April – August (breeding season) and October – March (non-breeding season).

2.4.3 Year 1 and Year 2 Flight Activity Survey Data

Flight activity data from the one VP described in Section 2.4.1 were collected during baseline surveys carried out by SLR during May 2022 to March 2024 over a period of two years, comprising two complete breeding and non-breeding periods, respectively.

The total number of hours of survey at each VP are as shown in Table 2-2, which meet the minimum of 144 hours per VP over a two-year period required by NS guidance².

Table 2-2: VP Surveys undertaken at the Project, May 2022 to March 2024

VP Number	Hours of Survey Completed per Survey Period				
	May – Aug 22	Oct 22 – Mar 23	Apr – Aug 23	Oct 23 – Mar 24	Total
3	36	36	36	36	144

The raw number of flight lines (i.e. including those inside and outside the WP, and those within, below and above CRH), cumulative number of birds and flying time in each height category (also known as ‘height band’ or HB, see Section 2.4.6) per VP for each survey period is shown in Table 2-3. Note that only data for survey periods and VPs where flight activity was recorded for the relevant species are shown for brevity. Survey periods have been abbreviated, such that ‘B’ = breeding season and ‘NB’ = non-breeding season, with survey year given by the suffix.

Table 2-3: Details of Raw Flight Lines Recorded, both Inside and Outside the WP

Species	Survey Period	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)			
					HB1	HB2	HB3	HB4
Black-headed gull	Breeding 2022	68	230	3825	2985	840	0	0
	Breeding 2023	8	23	525	75	450	0	0
Common kestrel	Breeding 2022	31	31	4245	750	3495	0	0
	Non-breeding 2022/23	12	12	1365	330	1035	0	0
	Breeding 2023	9	9	1380	120	1260	0	0
	Non-breeding 2023/24	8	9	510	270	240	0	0
Common snipe	Breeding 2022	27	29	2820	1710	1110	0	0



Species	Survey Period	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)			
					HB1	HB2	HB3	HB4
	Non-breeding 2022/23	7	8	315	90	225	0	0
	Breeding 2023	13	17	1080	105	975	0	0
Eurasian teal	Breeding 2023	4	8	210	75	135	0	0
European golden plover	Non-breeding 2022/23	9	178	1560	270	1290	0	0
Great cormorant	Non-breeding 2022/23	2	2	120	90	30	0	0
Great white egret	Non-breeding 2022/23	1	1	15	15	0	0	0
Hen harrier	Non-breeding 2022/23	5	5	765	585	180	0	0
	Non-breeding 2023/24	2	2	225	225	0	0	0
Little egret	Breeding 2023	2	2	120	0	120	0	0
Mallard	Non-breeding 2022/23	1	5	135	30	105	0	0
	Breeding 2023	3	6	150	45	105	0	0
Merlin	Non-breeding 2022/23	4	4	150	105	45	0	0
Northern lapwing	Breeding 2022	95	154	3630	2880	750	0	0
	Non-breeding 2022/23	11	48	585	450	135	0	0
	Breeding 2023	17	25	870	495	375	0	0
	Non-breeding 2023/24	6	28	330	210	120	0	0



Species	Survey Period	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)			
					HB1	HB2	HB3	HB4
Peregrine falcon	Breeding 2022	4	4	285	45	240	0	0
	Non-breeding 2022/23	1	1	75	75	0	0	0
	Non-breeding 2023/24	1	1	60	60	0	0	0
Whooper swan	Non-breeding 2022/23	1	2	30	30	0	0	0

2.4.4 Flight Selection for CRM

To select flights liable to incur a potential risk of collision, i.e., within the areas occupied by proposed turbines, the CRM used only observations collected within the WP⁴. It is known that bird detection rates vary between species. To ensure the CRM used robust measures of flight activity, a 2 km distance truncation was used in the viewshed from each VP, i.e., only flights within 2 km of each VP were included (as per NS 2025 guidance²).

Analysis in Excel and GIS identified those flights described in Table 2-3 that were within the WP.

The proportion of each flight line inside vs. outside the WP was also calculated using GIS.

This was undertaken for all primary target species regardless of the number of flight lines or cumulative numbers of birds.

2.4.5 Bird Density

Flying time estimated to occur within each of the survey recording height bands was used to determine the period that target species were at risk of collision with the rotors.

This was undertaken as follows. First, the time spent flying was estimated from interval data for flight lines that entered the WP. Second, these flight times were then multiplied by the proportion of each flight line length within the WP. Third, these flight times were then multiplied by the total number of individuals recorded per flight line to identify the total flying time in bird-seconds.

The total flying time (aggregated across all survey height bands) of species taken forward to CRM is given in Table 2-4, split by survey period and VP number. As this step only involves flights within the WP, there may be some differences in Table 2-4 vs. Table 2-3, which displays all flights, regardless of whether they were within the WP or not.



2.4.5.1 Total Flying Time

Table 2-4: Total Flying Time within the WP

Species	Survey Period	Total Flying Time within the WP (bird-secs)	
		158 m RD permutation	175 m RD permutation
Black-headed gull	Breeding 2022	14273.43	14916.68
	Breeding 2023	3761.67	3761.67
Common kestrel	Breeding 2022	2190.00	2715.00
	Non-breeding 2022/23	797.50	797.50
	Breeding 2023	690.71	725.00
	Non-breeding 2023/24	24.00	24.00
Common snipe	Breeding 2022	2588.57	3150.00
	Non-breeding 2022/23	330.00	330.00
	Breeding 2023	1134.38	1134.38
Eurasian teal	Breeding 2023	435.00	435.00
European golden plover	Non-breeding 2022/23	54300.00	52260.00
Great cormorant	Non-breeding 2022/23	107.14	113.57
Great white egret	Non-breeding 2022/23	10.00	10.00
Hen harrier	Non-breeding 2022/23	765.00	765.00
	Non-breeding 2023/24	157.50	225.00
Little egret	Breeding 2023	120.00	120.00
Mallard	Non-breeding 2022/23	675.00	675.00
	Breeding 2023	450.00	450.00
Merlin	Non-breeding 2022/23	150.00	150.00
Northern lapwing	Breeding 2022	12248.38	12572.38
	Non-breeding 2022/23	2400.00	2400.00
	Breeding 2023	1225.00	1225.00



Species	Survey Period	Total Flying Time within the WP (bird-secs)	
		158 m RD permutation	175 m RD permutation
	Non-breeding 2023/24	1027.50	1155.00
Peregrine falcon	Breeding 2022	245.00	245.00
	Non-breeding 2022/23	58.33	58.33
	Non-breeding 2023/24	60.00	60.00
Whooper swan	Non-breeding 2022/23	60.00	60.00

2.4.5.2 Bird Density Results

Next, bird density was calculated by dividing flying time by the period of the watch in seconds multiplied by the area of the WP visible within each viewshed. This was undertaken using the flight time data in Table 2-4, the total survey effort given in Section 2.4.3 and viewshed data given in Section 2.4.1.

These data were calculated for each month, VP number and survey period per species.

The results of this process are given in Table 2-5. Note only months with a density of >0 birds/km² are shown for brevity.

Note that as only one VP was used bird density could not be averaged across VPs as is typical for larger projects.

Table 2-5: Bird Density Results

Species	Survey Period	Month	Bird Density (birds / km ²)	
			158 m RD permutation	175 m RD permutation
Black-headed gull	Breeding 2022	May	1.53E-01	1.53E-01
		Jun	8.25E-03	1.24E-02
	Breeding 2023	Apr	5.53E-02	5.42E-02
		Jun	2.98E-02	2.92E-02
Common kestrel	Breeding 2022	May	5.77E-03	6.15E-03
		Jun	1.78E-02	2.28E-02
		Jul	2.38E-03	2.33E-03
	Non-breeding 2022/23	Jan	9.05E-04	8.87E-04
		Oct	1.03E-02	1.01E-.02
		Nov	5.69E-03	5.57E-03
		Dec	6.79E-04	6.65E-04
		Apr	4.19E-03	4.10E-03



Species	Survey Period	Month	Bird Density (birds / km ²)	
			158 m RD permutation	175 m RD permutation
	Breeding 2023	May	1.14E-02	1.20E-02
	Non-breeding 2023/24	Dec	5.43E-04	5.32E-04
Common snipe	Breeding 2022	May	1.70E-04	1.66E-04
		Jun	1.80E-02	1.76E-02
		Jul	2.23E-02	3.43E-02
	Non-breeding 2022/23	Jan	2.49E-03	2.44E-03
		Oct	3.06E-03	2.99E-03
		Dec	6.79E-04	6.65E-04
	Breeding 2023	May	1.24E-02	1.22E-02
		Jun	1.05E-02	1.03E-02
		Jul	1.36E-03	1.33E-03
Eurasian teal	Breeding 2023	Apr	9.85E-03	9.65E-03
European golden plover	Non-breeding 2022/23	Oct	1.23E+00	1.16E+00
Great cormorant	Non-breeding 2022/23	Dec	2.42E-03	2.52E-03
Great white egret	Non-breeding 2022/23	Oct	2.26E-04	2.22E-04
Hen harrier	Non-breeding 2022/23	Jan	1.15E-02	1.13E-02
	Non-breeding 2023/24	Feb	1.53E-03	2.99E-03
		Dec	2.04E-03	2.00E-03
Little egret	Breeding 2023	Jun	2.17E-02	2.13E-02
Mallard	Non-breeding 2022/23	Nov	2.29E-02	2.25E-02
	Breeding 2023	Apr	4.07E-03	3.99E-03
		May	4.07E-03	3.99E-03



Species	Survey Period	Month	Bird Density (birds / km ²)	
			158 m RD permutation	175 m RD permutation
		Jun	2.04E-03	2.00E-03
Merlin	Non-breeding 2022/23	Oct	3.39E-04	3.33E-04
		Nov	7.64E-04	7.48E-04
		Dec	1.39E-02	1.53E-02
Northern lapwing	Breeding 2022	May	2.93E-02	3.13E-02
		Jun	2.32E-02	2.28E-02
		Jul	1.72E-01	1.70E-01
	Non-breeding 2022/23	Nov	2.85E-02	2.79E-02
		Dec	2.58E-02	2.53E-02
	Breeding 2023	Apr	1.70E-03	1.66E-03
		May	5.43E-03	5.32E-03
		Jun	9.17E-03	8.98E-03
		Jul	2.55E-03	2.49E-03
		Aug	6.34E-03	6.21E-03
	Non-breeding 2023/24	Feb	1.48E-02	1.73E-02
		Mar	8.49E-03	8.32E-03
Peregrine falcon	Breeding 2022	Jun	1.24E-03	1.22E-03
		Jul	3.06E-03	2.99E-03
	Non-breeding 2022/23	Nov	1.32E-03	1.29E-03
	Non-breeding 2023/24	Feb	4.07E-03	1.33E-03
Whooper swan	Non-breeding 2022/23	Jan	9.05E-04	8.87E-04

2.4.6 Proportion of Birds Flying at Risk Height

The baseline surveys in year 1 utilised the following four height bands:

1. 0-20 m;
2. 20 – 160 m;
3. 160 – 200 m; and
4. >200 m.

All subsequent surveys in year 2 used the following height bands:



1. 0-20 m;
2. 20 – 150 m;
3. 150 – 200 m; and
4. >200 m.

Flight heights were recorded at 15-second intervals and allocated to 15 m height classes, which were then aggregated to the survey height bands above.

The potential collision height (PCH) varies across the turbine dimension range as a consequence of the differing rotor diameters and hub heights.

For the minimum rotor diameter / maximum ground-clearance permutation (GE158), the PCH extends from 41.9 m to 199.9 m above ground level, based on a rotor diameter of 158 m and hub height of 120.9 m.

For the maximum rotor diameter / minimum ground-clearance permutation (E175), the PCH extends from 24.1 m to 199.1 m above ground level, based on a rotor diameter of 175 m and hub height of 111.6 m.

The proportion of observed flight activity occurring within PCH was therefore calculated separately for each representative turbine permutation. This allows the CRM to account for the differing degree of overlap between the rotor-swept height range and the flight-height bands recorded during the baseline surveys.

To account for this, the model adjusted the occupancy by rotor diameter as a proportion of survey risk height as described in NS (2024) guidance for both sets of candidate turbines. This assumes that in each of the height ranges within which flight height was classified, flight heights were distributed uniformly.

Thus, the proportion of flights within each of the relevant height bands within the WP that are considered to have occurred at PCH has been calculated, as shown in Table 2-6 and Table 2-7.

Table 2-6: PCH overlap by survey height band

Survey year	Height band	Height band range (m)	Height band width (m)	158 m RD permutation		175 m RD permutation	
				Overlap (m)	Overlap (%)	Overlap (m)	Overlap (%)
Year 1	1	0–20	20	0	0.00%	0	0.00%
	2	20–160	140	118.1	84.36%	135.9	97.07%
	3	160–200	40	39.9	99.75%	39.1	97.75%
	4	>200	N/A ⁶	0	0.00%	0	0.00%
Year 2	1	0–20	20	0	0.00%	0	0.00%
	2	20–150	130	108.1	83.15%	125.9	96.85%
	3	150–200	50	49.9	99.80%	49.1	98.20%
	4	>200	N/A ⁶	0	0.00%	0	0.00%

⁶ Band 4 (>200 m) is open-ended and has no finite width against which to calculate an overlap percentage. As both CRH ranges top out below 200 m, overlap with Band 4 is nil in both scenarios.



Note that data have been aggregated by year and season as has been done in NS (2024) guidance. Only seasons where flight time is >0 have been included in Table 2-7 for brevity.



Table 2-7: Proportion of Flights at PCH

Species	Season	158 m RD permutation						175 m RD permutation					
		No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (41.9 – 199.9 m) within WP	No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (24.1 – 199.1 m) within WP
			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)	
Black-headed gull	Breeding 2022	1140.86	32.57	62.29	2.34	2.80	54.88	1213.54	32.68	62.48	2.20	2.64	62.80
	Breeding 2023	438.56	33.48	66.52	0.00	0.00	55.32	438.56	33.48	66.52	0.00	0.00	64.43
Common kestrel	Breeding 2022	253.00	15.90	62.58	9.05	12.47	61.82	322.50	14.95	61.71	9.84	13.51	69.51
	Non-breeding 2022/23	89.92	18.47	71.15	2.97	7.41	62.98	89.92	18.47	71.15	2.97	7.41	71.96
	Breeding 2023	91.76	10.12	63.41	17.85	8.61	70.55	96.33	10.03	62.98	17.99	9.00	78.66
	Non-breeding 2023/24	2.80	16.67	83.33	0.00	0.00	69.29	2.80	16.67	83.33	0.00	0.00	80.71



Species	Season	158 m RD permutation						175 m RD permutation					
		No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (41.9 – 199.9 m) within WP	No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (24.1 – 199.1 m) within WP
			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)	
Common snipe	Breeding 2022	270.57	18.90	59.66	8.87	12.57	59.18	308.00	17.53	58.55	9.52	14.39	66.14
	Non-breeding 2022/23	40.33	38.57	61.43	0.00	0.00	51.82	40.33	38.57	61.43	0.00	0.00	59.63
	Breeding 2023	141.25	21.47	47.55	4.13	26.84	43.66	115.00	26.38	58.41	5.07	10.14	61.54
Eurasian teal	Breeding 2023	49.00	38.10	61.90	0.00	0.00	51.48	49.00	38.10	61.90	0.00	0.00	59.95
European golden plover	Non-breeding 2022/23	6140.00	13.27	67.34	7.71	11.68	64.50	6220.00	12.75	68.10	7.61	11.53	73.55
Great cormorant	Non-breeding 2022/23	9.14	25.00	75.00	0.00	0.00	63.27	9.57	25.87	74.13	0.00	0.00	71.96



Species	Season	158 m RD permutation						175 m RD permutation					
		No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (41.9 – 199.9 m) within WP	No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (24.1 – 199.1 m) within WP
			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)	
Great white egret	Non-breeding 2022/23	0.67	100.00	0.00	0.00	0.00	0.00	0.67	100.00	0.00	0.00	0.00	0.00
Hen harrier	Non-breeding 2022/23	63.00	10.58	82.01	7.41	0.00	76.57	63.00	10.58	82.01	7.41	0.00	86.85
	Non-breeding 2023/24	10.50	19.05	80.95	0.00	0.00	67.32	15.00	17.78	82.22	0.00	0.00	79.63
Little egret	Breeding 2023	128.00	33.33	66.67	0.00	0.00	55.44	128.00	33.33	66.67	0.00	0.00	64.56
Mallard	Non-breeding 2022/23	120.00	16.67	83.33	0.00	0.00	70.30	120.00	16.67	83.33	0.00	0.00	80.89
	Breeding 2023	54.00	39.51	60.49	0.00	0.00	50.30	54.00	39.51	60.49	0.00	0.00	58.59



Species	Season	158 m RD permutation						175 m RD permutation					
		No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (41.9 – 199.9 m) within WP	No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (24.1 – 199.1 m) within WP
			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)	
Merlin	Non-breeding 2022/23	46.50	31.54	68.46	0.00	0.00	57.75	51.50	31.07	68.93	0.00	0.00	66.91
Northern lapwing	Breeding 2022	1153.93	24.03	74.67	0.72	0.58	63.71	1175.53	24.15	74.12	0.94	0.79	72.87
	Non-breeding 2022/23	176.00	32.58	67.42	0.00	0.00	56.88	176.00	32.58	67.42	0.00	0.00	65.45
	Breeding 2023	121.00	40.04	59.96	0.00	0.00	49.86	121.00	40.04	59.96	0.00	0.00	58.07
	Non-breeding 2023/24	90.50	37.94	62.06	0.00	0.00	51.61	99.00	40.40	59.60	0.00	0.00	57.72
Peregrine falcon	Breeding 2022	30.00	21.48	78.52	0.00	0.00	66.24	30.00	21.48	78.52	0.00	0.00	76.22



Species	Season	158 m RD permutation						175 m RD permutation					
		No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (41.9 – 199.9 m) within WP	No. of flock-weighted height records within WP across all viewsheds (records)	% of flight durations observed within WP				% of flight durations at PCH (24.1 – 199.1 m) within WP
			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)			Height band 1 (0 – 20 m)	Height band 2 (20 – 160 m year 1, 20 – 150 m year 2)	Height band 3 (160 – 200 m year 1, 150 – 200 m year 2)	Height band 4 (>200 m)	
	Non-breeding 2022/23	3.89	26.67	73.33	0.00	0.00	61.86	3.89	26.67	73.33	0.00	0.00	71.19
	Non-breeding 2023/24	12.00	33.33	66.67	0.00	0.00	55.44	4.00	33.33	66.67	0.00	0.00	64.56
Whooper swan	Non-breeding 2022/23	4.00	66.67	33.33	0.00	0.00	28.12	4.00	66.67	33.33	0.00	0.00	32.36

Flight height was recorded at the start of each flight and at 15-second intervals thereafter. The proportions in each height band were calculated from the number of height records within the WP, weighted by flock size and by the proportion of each flight line within the WP. These values are therefore not directly comparable with the flying times in Table 2-4, which are expressed in bird-seconds and were used to derive bird density. Only the proportions at PCH were carried forward to the CRM. Because the two approaches allocate flight height differently, the height-band breakdown of short flights can differ between Table 2-3 and Table 2-7. For example, the single whooper swan flight (two birds, 30 seconds, non-breeding 2022/23) is allocated wholly to HB1 by flying time in Table 2-3, but one of the three height records for that flight was in HB2. This record accounts for the non-zero proportions at PCH shown for whooper swan in Table 2-7 (28.12% and 32.36% for the 158 m and



175 m RD permutations, respectively), which were the values used in the CRM. The resulting collision prediction for whooper swan is therefore very small but not zero (see Section 3.0).





farms in England¹⁴, (Blood Hill, Goole Fields I and Goole Fields II) and found empirical evidence supporting avoidance rates substantially higher than 98%, in the region of 99.5–99.8%, for wintering golden plover. This evidence was subsequently considered in the Environmental Impact Assessment for the permitted Brittas Wind Farm, Co. Tipperary (ABP-321454-24), which retained 98% as a reference/default scenario but modelled European golden plover using higher avoidance rates of 99.5% (precautionary higher-avoidance scenario) and 99.8% (higher/anticipated scenario). The Inspectorate of An Coimisiún Pleanála reviewed this approach and concluded, based on the scientific rationale and available post-construction evidence, that an avoidance rate of 99.5% was acceptable for collision risk modelling of European golden plover¹⁵. The Brittas application was subsequently granted permission by An Coimisiún Pleanála in April 2026.

On this basis, it is considered appropriate to depart from the generic 98% default for European golden plover in the present assessment. An avoidance rate of 99.5% is considered an evidence-supported and precautionary species-specific assumption, and has been adopted as the primary rate applied for this assessment, while retaining 98% as a sensitivity/reference scenario. A 99.8% scenario is additionally presented to illustrate the sensitivity of predicted collision mortality to the higher avoidance rates indicated at the upper end of the post-construction evidence reviewed by Gittings (2022). This approach aligns with NS guidance¹³, which states that text should "*point to any evidence from existing post-construction monitoring on the respective or similar bird species which might indicate what levels of avoidance are best supported by evidence*".

While the empirical evidence is based on a study of three wind farms in a different habitat type, it should be noted that the avoidance rates presented in the NS guidance are not dependant on habitat type and are consistently used for all wind farms throughout Ireland and the UK, regardless of habitat type. NatureScot accepts that species-specific avoidance rates can be based on data from any country in which the species occurs. For example, the species-specific avoidance rate for kestrel is derived from raptor data from a wind farm in Spain, the white-tailed eagle avoidance rate is based on "*sufficient evidence from flight behaviour and collision monitoring studies in Norway for vulnerability to collisions*", and the avoidance rate for swans is derived from a study conducted in the Netherlands.

A comparable evidence-based departure from the 98% default has also been applied for northern lapwing. Two of the three wind farms reviewed by Gittings (2022), Blood Hill and one of the Goole Fields sites, also supported northern lapwing, and post-construction monitoring at these sites demonstrated very high turbine avoidance by this species, consistent with the golden plover evidence discussed above. This evidence was also considered in the Brittas Wind Farm assessment (ABP-321454-24), where northern lapwing was similarly modelled using avoidance rates of 99.5% and 99.8%, and the Inspectorate concluded that 99.5% was acceptable for collision risk modelling of northern lapwing on the same basis. On this basis, an avoidance rate of 99.5% has been adopted as the primary rate for northern lapwing for this assessment, with 98% retained as a reference/sensitivity scenario and 99.8% presented to illustrate sensitivity to the upper end of the evidence range identified by Gittings (2022). The use of 99.5% should not be interpreted as implying that this rate has been directly estimated for northern lapwing from a dedicated species-specific collision study; rather, it represents an evidence-informed, species-specific assumption supported by post-construction monitoring of wind farms supporting both species, the Gittings (2022) review, and its explicit acceptance by the Inspectorate of An Coimisiún Pleanála in the Brittas Wind Farm assessment.

¹⁴ https://www.ballivorwindfarmplanning.ie/wp-content/uploads/sites/38/2023/04/Appendix_7-6_Collision_Risk_Assessment.pdf [Accessed in July 2026]

¹⁵ <https://www.pleanala.ie/anbordpleanala/media/abp/cases/reports/321/r321454.pdf?r=057637> [Accessed in September 2026]



Details of these species-specific parameters are given in Table 2-8.

Table 2-8: Bird Biometrics, Flight Type, Nocturnal Activity and Avoidance Rates used in CRM

Common Name	Bird Length (m)	Wingspan (m)	Flight Speed (m/s)	Flight Type (0 or 1) ¹⁶	Nocturnal Activity Factor (1-5) ¹⁷	Avoidance Rate (%)
Black-headed gull	0.355	1.05	11.9	0	1	99.2
Common kestrel	0.34	0.755	12.7	0	1	95.0
Common snipe	0.26	0.455	16.0	0	3	98.0
Eurasian teal	0.39	0.55	19.7	0	2	98.0
European golden plover	0.275	0.715	13.7	0	3	98.0, 99.5 and 99.8
Great cormorant	0.9	1.45	14.5	0	1	98.0
Great white egret	0.935	1.55	9.2	0	1	98.0
Little egret	0.60	0.915	10.4	0	1	98.0
Hen harrier	0.48	1.1	8	0	1	99.0
Mallard	0.58	0.9	22.0	0	2	98.0
Merlin	0.275	0.56	13.47	0	1	98.0
Northern lapwing	0.30	0.84	12.3	0	2	98.0, 99.5 and 99.8
Peregrine falcon	0.45	1.1	14.0	0	1	98.0
Whooper swan	1.52	2.3	17.3	0	2	99.5

2.5.2 Wind Farm Parameters

The turbine-specific parameters used in the CRM for the two representative turbine permutations are presented in Table 2-9. These parameters include rotor dimensions, hub height, blade chord, blade pitch and rotational speed, all of which can influence the calculated collision probability.

The two permutations represent the outer limits of rotor diameter and ground clearance within the turbine dimension range assessed for the Project. The 158 m rotor diameter

¹⁶ Key: 0=flapping and 1=gliding

¹⁷ Key: 1=0%, 2=25%, 3=50%, 4=75% and 5=100% of daytime activity



permutation is represented by the GE158 turbine, and the 175 m rotor diameter permutation is represented by the E175 turbine.

The final turbine model has not yet been selected. The use of these representative permutations is intended to test the effect of the principal dimensional differences across the turbine dimension range on the CRM outputs.

The proportion of time turbines are predicted to be operational per month were calculated based on the proportion of time available multiplied by the proportion of time the turbines were expected to be above cut-in and below cut-out speeds, using values supplied by the Client.

The Project was not considered to be a large array and so no 'large array correction' was applied.

Table 2-9: Wind Farm and Turbine Parameters

Parameter	Value	
	158 m RD permutation	175 m RD permutation
Wind farm width (km)	0.7	
Number of turbines	3	
Rotor radius / diameter (m)	79/158	87.5/175
Hub height (m)	120.9	111.6
Maximum blade chord width (m)	4.00	4.01
Blade pitch (°)	15	15
Rotation speed (r.p.m)	8.4	6.7
Turbine operation time (%) (calculated per month but mean value over whole year given here)	86.3	



3.0 Results

Table 3-1 summarises the predicted collision estimates for the 14 species assessed under the two representative turbine permutations, using the avoidance rates presented in Table 2-8. Results are presented separately for the 158 m rotor diameter permutation and the 175 m rotor diameter permutation to demonstrate the influence of the differing turbine dimensions and associated parameters on predicted collision rates. Copies of the NatureScot model calculations for each species and turbine permutation are included at Appendix A and Appendix B.

In addition to predicted collision estimates for each period of analysis, mean annual collision estimates have also been presented. For resident species, mean annual estimates are based on all breeding and non-breeding season data, and for non-resident species, mean annual estimates are based on all instances of the relevant season. For example, for whooper swan, which is a winter visitor, only the non-breeding seasons have been considered.

To calculate mean annual collision estimates for resident species, the modelled predictions for each season were summed for each year, which were then averaged across years.

Collision estimates are presented rounded to two decimal places. Period estimates were derived by summing the monthly estimates, each rounded to two decimal places, and minor differences from the unrounded totals may therefore arise. Values presented as 0.00 may represent negligible, non-zero predicted collision rates. Mean years per collision were calculated from the unrounded mean annual collision estimates and may therefore differ slightly from the reciprocal of the rounded values presented. Mean annual collision estimates were calculated from the period totals and are presented rounded half up to two decimal places. For example, the mean annual estimate for northern lapwing at 99.5% avoidance under the 175 m RD permutation is $(0.31 + 0.04) / 2 = 0.175$ collisions per year, which is presented as 0.18. The rounded values in Table 3-1 are those carried forward to the EIAR and NIS. For whooper swan, the predicted collision rate for non-breeding 2022/23 is greater than zero but falls below the two-decimal-place resolution of the NS spreadsheet output. It is therefore presented as <0.01 rather than 0.00, and should be interpreted as a negligible, non-zero collision risk (fewer than one collision in more than 100 years) rather than as an absolute zero..



Table 3-1: Summary of CRM Outputs

Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Black-headed gull	Breeding 2022	0.22	4.55	0.17 (0.08)	6.06 (3.21)	0.25	4.00	0.19 (0.09)	5.41 (3.06)
	Non-breeding 2022/23	0.00	N/A			0.00	N/A		
	Breeding 2023	0.11	9.09			0.12	8.33		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Common kestrel	Breeding 2022	0.25	4.00	0.26 (0.13)	3.85 (2.14)	0.32	3.13	0.31 (0.18)	3.23 (2.32)
	Non-breeding 2022/23	0.10	10.00			0.12	8.33		
	Breeding 2023	0.17	5.88			0.18	5.56		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Common snipe	Breeding 2022	0.20	5.00	0.16 (0.09)	6.45 (4.64)	0.27	3.70	0.21 (0.12)	4.88 (3.45)
	Non-breeding 2022/23	0.02	50.00			0.02	50.00		
	Breeding 2023	0.09	11.11			0.12	8.33		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Eurasian teal	Breeding 2022	0.00	N/A	0.02 (0.03)	50.00 (N/A)	0.00	N/A	0.03 (0.04)	40.00 (N/A)
	Non-breeding 2022/23	0.00	N/A			0.00	N/A		
	Breeding 2023	0.04	25.00			0.05	20.00		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
European golden plover (98% avoidance)	Breeding 2022	0.00	N/A	2.89 (4.08)	0.35 (N/A)	0.00	N/A	3.03 (4.28)	0.33 (N/A)
	Non-breeding 2022/23	5.77	0.17			6.05	0.17		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
European golden plover (99.5% avoidance)	Breeding 2022	0.00	N/A	0.72 (1.02)	1.39 (N/A)	0.00	N/A	0.76 (1.07)	1.32 (N/A)
	Non-breeding 2022/23	1.44	0.69			1.51	0.66		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
European golden plover (99.8% avoidance)	Breeding 2022	0.00	N/A	0.29 (0.41)	3.45 (N/A)	0.00	N/A	0.31 (0.43)	3.28 (N/A)
	Non-breeding 2022/23	0.58	1.72			0.61	1.64		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Great cormorant	Breeding 2022	0.00	N/A	<0.01 (0.01)	200.00 (N/A)	0.00	N/A	<0.01 (0.01)	200.00 (N/A)
	Non-breeding 2022/23	0.01	100.00			0.01	100.00		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Great white egret	Breeding 2022	0.00	N/A	0.00 (N/A)	N/A	0.00	N/A	0.00 (N/A)	N/A
	Non-breeding 2022/23	0.00	N/A			0.00	N/A		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Little egret	Breeding 2022	0.00	N/A	0.04 (0.06)	25.00 (N/A)	0.00	N/A	0.05 (0.06)	22.22 (N/A)
	Non-breeding 2022/23	0.00	N/A			0.00	N/A		
	Breeding 2023	0.08	12.50			0.09	11.11		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Hen harrier	Breeding 2022	0.00	N/A	<0.01 (0.01)	200.00 (N/A)	0.00	N/A	<0.01 (0.01)	200.00 (N/A)
	Non-breeding 2022/23	0.01	100.00			0.01	100.00		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Mallard	Breeding 2022	0.00	N/A	0.10 (0.06)	10.53 (9.09)	0.00	N/A	0.11 (0.06)	9.52 (7.07)
	Non-breeding 2022/23	0.14	7.14			0.15	6.67		
	Breeding 2023	0.05	20.00			0.06	16.67		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Merlin	Breeding 2022	0.00	N/A	0.01 (0.01)	100.00 (N/A)	0.00	N/A	0.02 (0.02)	66.67 (N/A)
	Non-breeding 2022/23	0.02	50.00			0.03	33.33		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		
Northern lapwing (98% avoidance)	Breeding 2022	0.96	1.04	0.64 (0.67)	1.57 (3.78)	1.05	0.95	0.69 (0.73)	1.46 (3.57)
	Non-breeding 2022/23	0.15	6.67			0.15	6.67		
	Breeding 2023	0.09	11.11			0.09	11.11		
	Non-breeding 2023/24	0.07	14.29			0.08	12.50		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Northern lapwing (99.5% avoidance)	Breeding 2022	0.23	4.35	0.15 (0.17)	6.67 (20.95)	0.27	3.70	0.18 (0.19)	5.71 (15.40)
	Non-breeding 2022/23	0.04	25.00			0.04	25.00		
	Breeding 2023	0.01	100.00			0.02	50.00		
	Non-breeding 2023/24	0.02	50.00			0.02	50.00		
Northern lapwing (99.8% avoidance)	Breeding 2022	0.08	12.50	0.05 (0.07)	20.00 (N/A)	0.11	9.09	0.07 (0.09)	15.38 (N/A)
	Non-breeding 2022/23	0.02	50.00			0.02	50.00		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



Common Name	Period	158 m RD permutation				175 m RD permutation			
		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year		Collision Estimates Per Period		Mean (Standard Deviation) Collision Estimates Per Year	
		Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision	Collisions Per Period	No. Years Per Collision (Period)	Collisions Per Year	No. Years Per Collision
Peregrine	Breeding 2022	0.02	50.00	0.02 (0.01)	66.67 (35.36)	0.03	33.33	0.02 (0.02)	66.67 (N/A)
	Non-breeding 2022/23	0.00	N/A			0.00	N/A		
	Breeding 2023	0.00	N/A			0.00	N/A		
	Non-breeding 2023/24	0.01	100.00			0.00	N/A		
Whooper swan	Non-breeding 2022/23	<0.01	>100	<0.01 (<0.01)	>100	<0.01	>100	<0.01 (<0.01)	>100
	Non-breeding 2023/24	0.00	N/A			0.00	N/A		



3.1 Limitations and Uncertainty in Outputs

It should be acknowledged that there are several limitations and uncertainties in the collision risk outputs. While the results presented here are 'best estimates', there is natural variability in the data, with predicted collision estimates differing per period of analysis for many species. To this end we have presented measures of variability (standard deviation) for our collision risk estimates for each species.

Some likely sources of variability or uncertainty in the data are as follows:

- Uncertainty in flight activity data including imprecision on flight height estimates and lack of detailed knowledge regarding night-time behaviour for some species; and
- Inherent limitations within the collision-risk model itself including the variability of bird dimensions and flight speed, and the simplification in shape of a bird and turbine blades.

For two species in particular, this variability warrants further explanation to aid interpretation of the results, as set out below.

For European golden plover, the collision risk estimate is derived entirely from flight activity recorded during a single survey period (non-breeding 2022/23), during which 178 birds were recorded across nine flight lines, an average of approximately 20 birds per flight line consistent with flock-scale movements. No golden plover flight activity was recorded within the site during the other three survey periods, despite equal survey effort (36 hours) across all four periods. The mean annual collision estimate for this species should therefore be interpreted as reflecting the occurrence of a small number of large flock movements during one non-breeding season, rather than a sustained pattern of site usage across the survey programme.

Northern lapwing showed elevated flight activity during the breeding 2022 survey period relative to subsequent periods, which is reflected in the collision estimate for that period. Flight activity was recorded across all four survey periods, indicating consistent, if variable, use of the site by this species across the survey programme.

A further source of uncertainty arises from turbine-specific parameters within the turbine dimension range. The two representative permutations capture the outer limits of rotor diameter and ground clearance, and predicted mean annual collision rates under the maximum rotor diameter permutation (E175) were up to 30% higher than under the minimum rotor diameter permutation (GE158), depending on species (approximately 50% higher for merlin, for which absolute values are very small at 0.01-0.02 collisions per year). Other parameters, particularly rotational speed and blade chord, also influence collision probability, and a final turbine model with a higher rotational speed or wider blade chord than those modelled could produce marginally higher estimates. Given the small absolute values involved, this is not expected to alter the conclusions of the EIAR or NIS.

Finally, it should be acknowledged that the collision risk outputs presented here do not directly identify whether collision is likely to have significant effects on avian populations. Further assessment to contextualise the outputs presented here is provided in the EIAR and NIS.



Appendix A NatureScot Spreadsheets – 158m RD Representative Permutation (GE158)

Avian Collision Risk Report

Cush Wind Farm Phase II

Cush Wind Limited

SLR Project No.: 501.065723.00001

23 October 2026



COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data				Turbine data									
	Species name	Black-headed gull			Site name	Cush WF			Model	GE158								
	Bird length	L	0.355	m	Latitude	53.15028			degrees	Hub height	120.9			m				
	Wingspan	W	1.05	m	No of turbines	T	3			Rotor radius	R	79			m			
	Bird flight speed	v	11.9	m s-1	Width of windfarm	w	0.7			km	No of blades	b	3					
	Flight type, flapping or gliding	flapping								Rotation speed	Ω	8.4			rpm			
	% of flights upwind/downwind	50%								Max blade width	C	4			m			
	Nocturnal activity ranking 1-5	1								Blade pitch	λ	15			degrees			
	Nocturnal activity factor	fnight	0%								Risk height range	42-200			m			
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
	Daytime bird density	DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
	Proportion at rotor risk height	Q2R	54.88%		0.153												0.00825	0.0134
	At latitude 53.2	Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	79 m															
		Total rotor frontal area m2			58820													
	Nocturnal activity factor	fnight	0%															
	Bird flight speed	v	11.9 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits			0.0	0.0	0.0	0.0	656.6	36.5	0.0	0.0	0.0	0.0	0.0	0.0	693	
Stage C																		
	No of blades	b	3		Bird length	l	0.355 m											
	Rotation speed	Ω	8.4 rpm		Wingspan	w	1.05 m											
	Rotor radius	R	79 m		Bird flight speed	v	11.9 m s-1											
	Max blade width	C	4 m		Flight type	flapping												
	Pitch	λ	15 degrees		% of flights upwind/downwind	50%		50%										
	Blade profile	see Blade profile sheet																
		Single transit risk			upwind	6.52%												
					downwind	2.87%												
					weighted mean	4.69%												
Stage D																		
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge				
	Proportion of time operational	Qop	88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
		Collision rates before avoidance												year total				
		0.00	0.00	0.00	0.00	26.41	1.42	0.00	0.00	0.00	0.00	0.00	0.00	28				
Stage E																		
	Allow for large array correction?	No																
	Width of windfarm	w	0.7 km		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
		large array correction																
	Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	26.41	1.42	0.00	0.00	0.00	0.00	0.00	0.00	27.8	
				100.00%	0.00	0.00	0.00	0.00	26.41	1.42	0.00	0.00	0.00	0.00	0.00	0.00	27.8	
				100.00%	0.00	0.00	0.00	0.00	26.41	1.42	0.00	0.00	0.00	0.00	0.00	0.00	27.8	
		99.20%		100.00%	0.00	0.00	0.00	0.00	0.21	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.2	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value					Units		Value					Units						
Bird data		Windfarm data			Turbine data													
Species name	Black-headed gull			Site name	Cush WF		Model	GE158										
Bird length	L	0.355	m	Latitude	53.15028		degrees	Hub height	120.9		m							
Wingspan	W	1.05	m	No of turbines	T	3		Rotor radius	R	79	m							
Bird flight speed	v	11.9	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3								
Flight type, flapping or gliding	flapping								Rotation speed	Ω	8.4	rpm						
% of flights upwind/downwind	50%								Max blade width	C	4	m						
Nocturnal activity ranking 1-5	1								Blade pitch	λ	15	degrees						
Nocturnal activity factor	fnight	0%								Risk height range	42-200 m							
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height	Q2R	55.32%			0.0553										0.0298		0.0071	
At latitude 53.2	Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
	Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines	T	3																
Rotor radius	R	79 m																
	Total rotor frontal area m2			58820														
Nocturnal activity factor	fnight	0%																
Bird flight speed	v	11.9 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
	Projected number of rotor transits			0.0	0.0	0.0	204.0	0.0	133.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	337	
Stage C																		
No of blades	b	3			Bird length	l	0.355 m											
Rotation speed	Ω	8.4 rpm			Wingspan	w	1.05 m											
Rotor radius	R	79 m			Bird flight speed	v	11.9 m s-1											
Max blade width	C	4 m			Flight type	flapping												
Pitch	λ	15 degrees			% of flights upwind/downwind	50%		50%										
Blade profile	see Blade profile sheet																	
	Single transit risk			upwind	6.52%													
				downwind	2.87%													
				weighted mean	4.69%													
Stage D																		
Proportion of time operational	Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%		
				Collision rates before avoidance										year total				
				0.00	0.00	0.00	8.20	0.00	5.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13	
Stage E																		
Allow for large array correction?		No																
Width of windfarm	w	0.7 km																
	large array correction																	
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
Avoidance rates modelled				Collision rates allowing for avoidance														
				0.00	0.00	0.00	8.20	0.00	5.19	0.00	0.00	0.00	0.00	0.00	0.00	13.4		
				0.00	0.00	0.00	8.20	0.00	5.19	0.00	0.00	0.00	0.00	0.00	0.00	13.4		
				0.00	0.00	0.00	8.20	0.00	5.19	0.00	0.00	0.00	0.00	0.00	0.00	13.4		
	99.20%			0.00	0.00	0.00	0.07	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.1		

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

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COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

			Value	Units				Value	Units				Value	Units				
Bird data					Windfarm data							Turbine data						
	Species name		Little egret			Site name		Cush WF			Model		GE158					
	Bird length	L	0.6	m		Latitude		53.15028	degrees		Hub height		120.9	m				
	Wingspan	W	0.915	m		No of turbines	T	3			Rotor radius	R	79	m				
	Bird flight speed	v	10.4	m s-1		Width of windfarm	w	0.7	km		No of blades	b	3					
	Flight type, flapping or gliding		flapping								Rotation speed	Ω	8.4	rpm				
	% of flights upwind/downwind		50%	50%							Max blade width	C	4	m				
	Nocturnal activity ranking 1-5		1								Blade pitch	λ	15	degrees				
	Nocturnal activity factor	fnight	0%								Risk height range		42-200	m				
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																		
	Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
	Proportion at rotor risk height	Q2R	55.44%			0.0217												0.0018
	At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
			Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	79 m															
			Total rotor frontal area m2			58820												
	Nocturnal activity factor	fnight	0%															
	Bird flight speed	v	10.4 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
			Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	84.8	0.0	0.0	0.0	0.0	0.0	0.0	85
Stage C																		
	No of blades	b	3			Bird length	l	0.6 m										
	Rotation speed	Ω	8.4 rpm			Wingspan	w	0.915 m										
	Rotor radius	R	79 m			Bird flight speed	v	10.4 m s-1										
	Max blade width	C	4 m			Flight type		flapping										
	Pitch	λ	15 degrees			% of flights upwind/downwind		50%		50%								
	Blade profile		see Blade profile sheet															
			Single transit risk			upwind	7.78%											
						downwind	3.82%											
						weighted mean	5.80%											
Stage D																		
	Proportion of time operational	Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
						88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
						Collision rates before avoidance										year total		
						0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	4
Stage E																		
	Allow for large array correction?		No															
	Width of windfarm	w	0.7 km															
			large array correction			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
						Collision rates allowing for avoidance												
Avoidance rates modelled						0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	4.1
						0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	4.1
						0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	4.1
			98.00%			0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.1

Required input data is in
Calculated output is in

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COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

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boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units						
Bird data					Windfarm data							Turbine data								
Species name		Hen harrier			Site name		Cush WF		Model		GE158									
Bird length		L	0.48	m	Latitude		53.15028		degrees		Hub height		120.9	m						
Wingspan		W	1.1	m	No of turbines		T	3			Rotor radius		R	79	m					
Bird flight speed		v	8	m s-1	Width of windfarm		w	0.7	km		No of blades		b	3						
Flight type, flapping or gliding		flapping									Rotation speed		Ω	8.4	rpm					
% of flights upwind/downwind		50%									Max blade width		C	4	m					
Nocturnal activity ranking 1-5		1									Blade pitch		λ	15	degrees					
Nocturnal activity factor		fnight	0%									Risk height range		42-200		m				
normal approach		Set to 'normal approach' to use survey data on bird density																		
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																		
Stage A																				
Daytime bird density		DA	birds/km2		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
Proportion at rotor risk height		Q2R	76.57%		0.0115														0.0010	
At latitude 53.2		Daylight hours per month		252.7		274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3		397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																				
No of turbines		T	3																	
Rotor radius		R	79		m															
		Total rotor frontal area m2		58820																
Nocturnal activity factor		fnight	0%																	
Bird flight speed		v	8		m s-1		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		23.9		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
Stage C																				
No of blades		b	3		Bird length		l	0.48		m										
Rotation speed		Ω	8.4		Wingspan		w	1.1		m										
Rotor radius		R	79		Bird flight speed		v	8		m s-1										
Max blade width		C	4		Flight type		flapping													
Pitch		λ	15		degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																		
		Single transit risk		upwind		8.60%														
				downwind		4.11%														
				weighted mean		6.36%														
Stage D																				
Proportion of time operational		Qop	Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge				
		88.8%		90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%					
		Collision rates before avoidance														year total				
		1.35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1				
Stage E																				
Allow for large array correction?		No																		
Width of windfarm		w	0.7		km															
				large array correction		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
				Collision rates allowing for avoidance																
Avoidance rates modelled				100.00%		1.35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.3	
				100.00%		1.35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.3	
				100.00%		1.35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.3	
		99.00%		100.00%		0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value					Units		Value					Units		Value					Units	
Bird data					Windfarm data					Turbine data										
Species name		Hen harrier			Site name		Cush WF			Model		GE158								
Bird length		L	0.48	m	Latitude		53.15028			degrees		Hub height		120.9			m			
Wingspan		W	1.1	m	No of turbines		T	3					Rotor radius		R	79	m			
Bird flight speed		v	8	m s-1	Width of windfarm		w	0.7			km		No of blades		b	3				
Flight type, flapping or gliding			flapping									Rotation speed		Ω	8.4			rpm		
% of flights upwind/downwind			50%									Max blade width		C	4			m		
Nocturnal activity ranking 1-5			1									Blade pitch		λ	15			degrees		
Nocturnal activity factor			fnight	0%									Risk height range		42-200			m		
normal approach					Set to 'normal approach' to use survey data on bird density															
					Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																				
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge			
Proportion at rotor risk height		Q2R	67.32%		0.00153												0.00204		0.0003	
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																				
No of turbines		T	3																	
Rotor radius		R	79 m																	
		Total rotor frontal area m2		58820																
Nocturnal activity factor		fnight	0%																	
Bird flight speed		v	8 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total			
		Projected number of rotor transits			0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	7			
Stage C																				
No of blades		b	3		Bird length		l	0.48 m												
Rotation speed		Ω	8.4 rpm		Wingspan		w	1.1 m												
Rotor radius		R	79 m		Bird flight speed		v	8 m s-1												
Max blade width		C	4 m		Flight type		flapping													
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%											
Blade profile		see Blade profile sheet																		
		Single transit risk		upwind	8.60%															
				downwind	4.11%															
				weighted mean	6.36%															
Stage D																				
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge			
				88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%												86.3%				
				Collision rates before avoidance												year total				
				0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0			
Stage E																				
Allow for large array correction?		No																		
Width of windfarm		w	0.7 km																	
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year				
				Collision rates allowing for avoidance																
Avoidance rates modelled				100.00%	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.4			
				100.00%	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.4			
				100.00%	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.4			
		99.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0			

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data							Turbine data						
	Species name	Great white egret				Site name	Cush WF			Model	GE158							
	Bird length	L	0.935	m		Latitude	53.15028		degrees		Hub height	120.9		m				
	Wingspan	W	1.55	m		No of turbines	T	3			Rotor radius	R	79	m				
	Bird flight speed	v	9.2	m s-1		Width of windfarm	w	0.7	km		No of blades	b	3					
	Flight type, flapping or gliding	flapping									Rotation speed	Ω	8.4	rpm				
	% of flights upwind/downwind	50%			50%						Max blade width	C	4	m				
	Nocturnal activity ranking 1-5	1									Blade pitch	λ	15	degrees				
	Nocturnal activity factor	fnight	0%								Risk height range	42-200			m			
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
	Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
	Proportion at rotor risk height	Q2R	0.00%			0.000226												0.0000
	At latitude 53.2	Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	79 m															
		Total rotor frontal area m2			58820													
	Nocturnal activity factor	fnight	0%															
	Bird flight speed	v	9.2 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Stage C																		
	No of blades	b	3				Bird length	l	0.935 m									
	Rotation speed	Ω	8.4 rpm				Wingspan	w	1.55 m									
	Rotor radius	R	79 m				Bird flight speed	v	9.2 m s-1									
	Max blade width	C	4 m				Flight type	flapping										
	Pitch	λ	15 degrees				% of flights upwind/downwind	50%		50%								
	Blade profile	see Blade profile sheet																
		Single transit risk				upwind	9.98%											
						downwind	5.76%											
						weighted mean	7.87%											
Stage D																		
	Proportion of time operational	Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
					Collision rates before avoidance										year total			
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	
Stage E																		
	Allow for large array correction?	No																
	Width of windfarm	w	0.7 km															
		large array correction				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
					Collision rates allowing for avoidance													
	Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
					100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
					100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units					
Bird data		Windfarm data				Turbine data										
Species name		Kestrel		Site name		Cush WF		Model		GE158						
Bird length	L	0.34	m	Latitude		53.15028	degrees	Hub height		120.9	m					
Wingspan	W	0.755	m	No of turbines	T	3		Rotor radius	R	79	m					
Bird flight speed	v	12.7	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3						
Flight type, flapping or gliding		flapping						Rotation speed	Ω	8.4	rpm					
% of flights upwind/downwind		50%	50%					Max blade width	C	4	m					
Nocturnal activity ranking 1-5		1						Blade pitch	λ	15	degrees					
Nocturnal activity factor	fnight	0%						Risk height range		42-200	m					
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																
Daytime bird density	DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Proportion at rotor risk height	Q2R	61.82%		0.00577 0.0178 0.00238												0.0022
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																
No of turbines	T	3														
Rotor radius	R	79	m													
		Total rotor frontal area m2	58820													
Nocturnal activity factor	fnight	0%														
Bird flight speed	v	12.7	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	29.8	94.7	12.7	0.0	0.0	0.0	0.0	0.0	137
Stage C																
No of blades	b	3		Bird length	l	0.34	m									
Rotation speed	Ω	8.4	rpm	Wingspan	w	0.755	m									
Rotor radius	R	79	m	Bird flight speed	v	12.7	m s-1									
Max blade width	C	4	m	Flight type		flapping										
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%									
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	6.14%											
				downwind	2.65%											
				weighted mean	4.39%											
Stage D																
Proportion of time operational	Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
				Collision rates before avoidance												
				0.00	0.00	0.00	0.00	1.12	3.46	0.45	0.00	0.00	0.00	0.00	0.00	year total
																5
Stage E																
Allow for large array correction?		No														
Width of windfarm	w	0.7	km													
			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	1.12	3.46	0.45	0.00	0.00	0.00	0.00	0.00	5.0
			100.00%	0.00	0.00	0.00	0.00	1.12	3.46	0.45	0.00	0.00	0.00	0.00	0.00	5.0
			100.00%	0.00	0.00	0.00	0.00	1.12	3.46	0.45	0.00	0.00	0.00	0.00	0.00	5.0
		95.00%	100.00%	0.00	0.00	0.00	0.00	0.06	0.17	0.02	0.00	0.00	0.00	0.00	0.00	0.3

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units	
Bird data				Windfarm data				Turbine data									
Species name		Kestrel		Site name		Cush WF		Model		GE158							
Bird length		L	0.34	m		Latitude		53.15028	degrees		Hub height		120.9	m			
Wingspan		W	0.755	m		No of turbines		T	3	Rotor radius		R	79	m			
Bird flight speed		v	12.7	m s-1		Width of windfarm		w	0.7	km		No of blades		b	3		
Flight type, flapping or gliding		flapping								Rotation speed		Ω	8.4	rpm			
% of flights upwind/downwind		50%		50%						Max blade width		C	4	m			
Nocturnal activity ranking 1-5		1								Blade pitch		λ	15	degrees			
Nocturnal activity factor		fnight	0%							Risk height range		42-200		m			
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A													
Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Daytime bird density		DA	birds/km2	0.00419 0.0114												0.0013	
Proportion at rotor risk height		Q2R	70.55%														
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of turbines		T	3														
Rotor radius		R	79 m														
		Total rotor frontal area m2		58820													
Nocturnal activity factor		fnight	0%														
Bird flight speed		v	12.7 m s-1														
		Projected number of rotor transits		0.0	0.0	0.0	21.0	67.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88	
Stage C																	
No of blades		b	3	Bird length		l	0.34 m										
Rotation speed		Ω	8.4 rpm	Wingspan		w	0.755 m										
Rotor radius		R	79 m	Bird flight speed		v	12.7 m s-1										
Max blade width		C	4 m	Flight type		flapping											
Pitch		λ	15 degrees	% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet															
		Single transit risk		upwind	6.14%												
				downwind	2.65%												
				weighted mean	4.39%												
Stage D				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion of time operational		Qop		88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
		Collision rates before avoidance														year total	
				0.00	0.00	0.00	0.79	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3	
Stage E																	
Allow for large array correction?		No															
Width of windfarm		w	0.7 km														
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
				Collision rates allowing for avoidance													
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.79	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.3	
		100.00%		0.00	0.00	0.00	0.79	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.3	
		100.00%		0.00	0.00	0.00	0.79	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.3	
		95.00%		0.00	0.00	0.00	0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units				Value		Units				Value		Units																	
Bird data						Windfarm data						Turbine data																					
Species name		Kestrel				Site name		Cush WF		degrees		Model		GE158																			
Bird length		L	0.34	m		Latitude		53.15028				Hub height		120.9		m																	
Wingspan		W	0.755	m		No of turbines		T	3				Rotor radius		R	79	m																
Bird flight speed		v	12.7	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3																	
Flight type, flapping or gliding		flapping										Rotation speed		Ω	8.4	rpm																	
% of flights upwind/downwind		50%		50%								Max blade width		C	4	m																	
Nocturnal activity ranking 1-5		1										Blade pitch		λ	15	degrees																	
Nocturnal activity factor		fnight	0%									Risk height range		42-200		m																	
normal approach		Set to 'normal approach' to use survey data on bird density																															
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																															
Stage A						Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge			
Daytime bird density		DA	birds/km2		0.000905																		0.0103		0.00569		0.000679		0.0015				
Proportion at rotor risk height		Q2R	62.98%																														
At latitude 53.2		Daylight hours per month				252.7		274.3		366.4		418.1		490.3		505.8		508.9		458.2		382.4		330.1		262.0		237.0		4486.2			
		Nighttime hours per month				491.3		397.7		377.6		301.9		253.7		214.2		235.1		285.8		337.6		413.9		458.0		507.0		4273.8			
Stage B																																	
No of turbines		T	3																														
Rotor radius		R	79		m																												
		Total rotor frontal area m2		58820																													
Nocturnal activity factor		fnight	0%																														
Bird flight speed		v	12.7		m s-1																												
		Projected number of rotor transits				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year total			
						2.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		36.4		16.0		1.7		57			
Stage C																																	
No of blades		b	3				Bird length		l	0.34		m																					
Rotation speed		Ω	8.4		rpm		Wingspan		w	0.755		m																					
Rotor radius		R	79		m		Bird flight speed		v	12.7		m s-1																					
Max blade width		C	4		m		Flight type		flapping																								
Pitch		λ	15		degrees		% of flights upwind/downwind		50%		50%																						
Blade profile		see Blade profile sheet																															
		Single transit risk				upwind		6.14%																									
						downwind		2.65%																									
						weighted mean		4.39%																									
Stage D								Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge	
Proportion of time operational		Qop	88.8%		90.5%		86.9%		85.6%		85.7%		83.1%		80.8%		82.4%		85.1%		89.8%		88.0%		88.9%				86.3%				
								Collision rates before avoidance																						year total			
								0.10		0.00		0.00		0.00		0.00		0.00		0.00		0.00		1.44		0.62		0.07		2			
Stage E																																	
Allow for large array correction?		No																															
Width of windfarm		w	0.7		km																												
				large array correction				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		per year	
								Collision rates allowing for avoidance																									
Avoidance rates modelled				100.00%				0.10		0.00		0.00		0.00		0.00		0.00		0.00		0.00		1.44		0.62		0.07		2.2			
				100.00%				0.10		0.00		0.00		0.00		0.00		0.00		0.00		0.00		1.44		0.62		0.07		2.2			
				100.00%				0.10		0.00		0.00		0.00		0.00		0.00		0.00		0.00		1.44		0.62		0.07		2.2			
		95.00%		100.00%				0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.07		0.03		0.00		0.1			

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units		
Bird data				Windfarm data				Turbine data										
Species name		Kestrel		Site name		Cush WF		Model		GE158								
Bird length		L	0.34	m		Latitude		53.15028		degrees		Hub height		120.9		m		
Wingspan		W	0.755	m		No of turbines		T	3				Rotor radius		R	79	m	
Bird flight speed		v	12.7	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3		
Flight type, flapping or gliding		flapping										Rotation speed		Ω	8.4		rpm	
% of flights upwind/downwind		50%		50%								Max blade width		C	4		m	
Nocturnal activity ranking 1-5		1										Blade pitch		λ	15		degrees	
Nocturnal activity factor		fnight	0%										Risk height range		42-200		m	
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height		Q2R	69.29%		0.000543												0.0000	
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines		T	3															
Rotor radius		R	79	m														
		Total rotor frontal area m2		58820														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	12.7	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2	
Stage C																		
No of blades		b	3	Bird length		l	0.34	m										
Rotation speed		Ω	8.4	rpm	Wingspan		w	0.755	m									
Rotor radius		R	79	m	Bird flight speed		v	12.7	m s-1									
Max blade width		C	4	m	Flight type		flapping											
Pitch		λ	15	degrees	% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	6.14%													
				downwind	2.65%													
				weighted mean	4.39%													
Stage D																		
Proportion of time operational		Qop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge			
		88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%												86.3%				
		Collision rates before avoidance												year total				
		0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.06												0				
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7	km	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
		large array correction																
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.1	
		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.1	
		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.1	
		95.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units			Value	Units			
Bird data					Windfarm data						Turbine data							
	Species name	Lapwing				Site name		Cush WF		Model		GE158						
	Bird length	L	0.3	m		Latitude		53.15028	degrees	Hub height		120.9	m					
	Wingspan	W	0.84	m		No of turbines	T	3		Rotor radius	R	79	m					
	Bird flight speed	v	12.3	m s-1		Width of windfarm	w	0.7	km	No of blades	b	3						
	Flight type, flapping or gliding		flapping							Rotation speed	Ω	8.4	rpm					
	% of flights upwind/downwind		50%	50%						Max blade width	C	4	m					
	Nocturnal activity ranking 1-5		2							Blade pitch	λ	15	degrees					
	Nocturnal activity factor	fnight	25%							Risk height range		42-200	m					
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
	Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
	Proportion at rotor risk height	Q2R	63.71%							0.0293	0.0232	0.172						0.0187
	At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
			Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	79	m														
			Total rotor frontal area m2		58820													
	Nocturnal activity factor	fnight	25%															
	Bird flight speed	v	12.3	m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
			Projected number of rotor transits			0.0	0.0	0.0	0.0	170.4	136.3	1025.4	0.0	0.0	0.0	0.0	0.0	1332
Stage C																		
	No of blades	b	3			Bird length	l	0.3	m									
	Rotation speed	Ω	8.4	rpm		Wingspan	w	0.84	m									
	Rotor radius	R	79	m		Bird flight speed	v	12.3	m s-1									
	Max blade width	C	4	m		Flight type		flapping										
	Pitch	λ	15	degrees		% of flights upwind/downwind		50%	50%									
	Blade profile		see Blade profile sheet															
			Single transit risk			upwind	6.16%											
						downwind	2.59%											
						weighted mean	4.38%											
Stage D																		
	Proportion of time operational	Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
						88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
			Collision rates before avoidance															year total
						0.00	0.00	0.00	0.00	6.39	4.96	36.27	0.00	0.00	0.00	0.00	0.00	48
Stage E																		
	Allow for large array correction?		No															
	Width of windfarm	w	0.7	km														
				large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
						Collision rates allowing for avoidance												
	Avoidance rates modelled					0.00	0.00	0.00	0.00	6.39	4.96	36.27	0.00	0.00	0.00	0.00	0.00	47.6
						99.80%	100.00%	100.00%	100.00%	0.01	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.1
						99.50%	100.00%	100.00%	100.00%	0.03	0.02	0.18	0.00	0.00	0.00	0.00	0.00	0.2
						98.00%	100.00%	100.00%	100.00%	0.13	0.10	0.73	0.00	0.00	0.00	0.00	0.00	1.0

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units					
Bird data		Windfarm data			Turbine data											
Species name		Lapwing		Site name		Cush WF		Model		GE158						
Bird length	L	0.3	m	Latitude		53.15028	degrees	Hub height		120.9	m					
Wingspan	W	0.84	m	No of turbines	T	3		Rotor radius	R	79	m					
Bird flight speed	v	12.3	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3						
Flight type, flapping or gliding		flapping						Rotation speed	Ω	8.4	rpm					
% of flights upwind/downwind		50%	50%					Max blade width	C	4	m					
Nocturnal activity ranking 1-5		2						Blade pitch	λ	15	degrees					
Nocturnal activity factor	fnight	25%						Risk height range		42-200	m					
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Daytime bird density	DA	birds/km2					0.0017	0.00543	0.00917	0.00255	0.00634					0.0021
Proportion at rotor risk height	Q2R	49.86%														
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																
No of turbines	T	3														
Rotor radius	R	79	m													
		Total rotor frontal area m2		58820												
Nocturnal activity factor	fnight	25%														
Bird flight speed	v	12.3	m s-1													
		Projected number of rotor transits		0.0	0.0	0.0	6.9	24.7	42.2	11.9	27.6	0.0	0.0	0.0	0.0	year total 113
Stage C																
No of blades	b	3					Bird length	l	0.3	m						
Rotation speed	Ω	8.4	rpm				Wingspan	w	0.84	m						
Rotor radius	R	79	m				Bird flight speed	v	12.3	m s-1						
Max blade width	C	4	m				Flight type		flapping							
Pitch	λ	15	degrees				% of flights upwind/downwind		50%	50%						
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	6.16%											
				downwind	2.59%											
				weighted mean	4.38%											
Stage D				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Proportion of time operational	Qop			88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
		Collision rates before avoidance														
				0.00	0.00	0.00	0.26	0.93	1.53	0.42	1.00	0.00	0.00	0.00	0.00	year total 4
Stage E																
Allow for large array correction?		No														
Width of windfarm	w	0.7	km													
		large array correction														
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance														
Avoidance rates modelled				0.00	0.00	0.00	0.26	0.93	1.53	0.42	1.00	0.00	0.00	0.00	0.00	4.1
		99.80%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.50%	100.00%	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%	100.00%	0.00	0.00	0.00	0.01	0.02	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units			
Bird data				Windfarm data				Turbine data											
Species name		Lapwing		Site name		Cush WF		Model		GE158									
Bird length		L	0.3	m		Latitude		53.15028		degrees		Hub height		120.9		m			
Wingspan		W	0.84	m		No of turbines		T	3				Rotor radius		R	79	m		
Bird flight speed		v	12.3	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3			
Flight type, flapping or gliding		flapping										Rotation speed		Ω	8.4		rpm		
% of flights upwind/downwind		50%		50%								Max blade width		C	4		m		
Nocturnal activity ranking 1-5		2										Blade pitch		λ	15		degrees		
Nocturnal activity factor		fnight	25%										Risk height range		42-200		m		
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																			
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave		
Proportion at rotor risk height		Q2R	56.88%														0.0285	0.0258	0.0045
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																			
No of turbines		T	3																
Rotor radius		R	79	m															
		Total rotor frontal area m2		58820															
Nocturnal activity factor		fnight	25%																
Bird flight speed		v	12.3	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total		
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.6	88.0	189		
Stage C																			
No of blades		b	3			Bird length		l	0.3	m									
Rotation speed		Ω	8.4	rpm			Wingspan		w	0.84	m								
Rotor radius		R	79	m			Bird flight speed		v	12.3	m s-1								
Max blade width		C	4	m			Flight type		flapping										
Pitch		λ	15	degrees			% of flights upwind/downwind		50%		50%								
Blade profile		see Blade profile sheet																	
		Single transit risk		upwind	6.16%														
				downwind	2.59%														
				weighted mean	4.38%														
Stage D																			
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave		
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
				Collision rates before avoidance												year total			
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88	3.43	7		
Stage E																			
Allow for large array correction?		No																	
Width of windfarm		w	0.7	km															
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year			
				Collision rates allowing for avoidance															
Avoidance rates modelled				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88	3.43	7.3		
		99.80%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0		
		99.50%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.0		
		98.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.1		

Required input data is in
Calculated output is in

boxes
boxes
boxes

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units			
Bird data				Windfarm data				Turbine data											
Species name		Mallard		Site name		Cush WF		Model		GE158									
Bird length		L	0.58	m		Latitude		53.15028		degrees		Hub height		120.9		m			
Wingspan		W	0.9	m		No of turbines		T	3				Rotor radius		R	79	m		
Bird flight speed		v	22	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3			
Flight type, flapping or gliding		flapping										Rotation speed		Ω	8.4		rpm		
% of flights upwind/downwind		50%		50%								Max blade width		C	4		m		
Nocturnal activity ranking 1-5		2										Blade pitch		λ	15		degrees		
Nocturnal activity factor		fnight	25%										Risk height range		42-200		m		
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																			
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave		
Proportion at rotor risk height		Q2R	50.30%		0.00407												0.00407	0.00204	0.0008
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																			
No of turbines		T	3																
Rotor radius		R	79 m																
Total rotor frontal area m2		58820																	
Nocturnal activity factor		fnight	25%																
Bird flight speed		v	22 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total		
Projected number of rotor transits				0.0	0.0	0.0	29.8	33.4	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80		
Stage C																			
No of blades		b	3		Bird length		l	0.58 m											
Rotation speed		Ω	8.4 rpm		Wingspan		w	0.9 m											
Rotor radius		R	79 m		Bird flight speed		v	22 m s-1											
Max blade width		C	4 m		Flight type		flapping												
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%										
Blade profile		see Blade profile sheet																	
Single transit risk				upwind	5.42%														
				downwind	3.29%														
weighted mean				4.36%															
Stage D																			
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave		
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
Collision rates before avoidance																	year total		
				0.00	0.00	0.00	1.11	1.25	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3		
Stage E																			
Allow for large array correction?		No																	
Width of windfarm		w	0.7 km																
large array correction				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year			
Collision rates allowing for avoidance																			
Avoidance rates modelled				100.00%	0.00	0.00	0.00	1.11	1.25	0.61	0.00	0.00	0.00	0.00	0.00	0.00	3.0		
				100.00%	0.00	0.00	0.00	1.11	1.25	0.61	0.00	0.00	0.00	0.00	0.00	0.00	3.0		
				100.00%	0.00	0.00	0.00	1.11	1.25	0.61	0.00	0.00	0.00	0.00	0.00	0.00	3.0		
		98.00%		100.00%	0.00	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.1		

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

			Value	Units				Value	Units				Value	Units				
Bird data					Windfarm data							Turbine data						
	Species name		Mallard		Site name		Cush WF		Model		GE158							
	Bird length	L	0.58	m	Latitude		53.15028	degrees	Hub height		120.9	m						
	Wingspan	W	0.9	m	No of turbines	T	3		Rotor radius	R	79	m						
	Bird flight speed	v	22	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3							
	Flight type, flapping or gliding		flapping						Rotation speed	Ω	8.4	rpm						
	% of flights upwind/downwind		50%	50%					Max blade width	C	4	m						
	Nocturnal activity ranking 1-5		2						Blade pitch	λ	15	degrees						
	Nocturnal activity factor	fnight	25%						Risk height range		42-200	m						
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																		
	Daytime bird density	DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
	Proportion at rotor risk height	Q2R	70.00%		0.0229											0.0019		
	At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
			Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	79	m														
			Total rotor frontal area m2		58820													
	Nocturnal activity factor	fnight	25%															
	Bird flight speed	v	22	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
			Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	177.9	0.0	178	
Stage C																		
	No of blades	b	3		Bird length	l	0.58	m										
	Rotation speed	Ω	8.4	rpm	Wingspan	w	0.9	m										
	Rotor radius	R	79	m	Bird flight speed	v	22	m s-1										
	Max blade width	C	4	m	Flight type		flapping											
	Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%										
	Blade profile		see Blade profile sheet															
			Single transit risk		upwind	5.42%												
					downwind	3.29%												
					weighted mean	4.36%												
Stage D																		
	Proportion of time operational	Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
					Collision rates before avoidance											year total		
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.00	7	
Stage E																		
	Allow for large array correction?		No															
	Width of windfarm	w	0.7	km														
			large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
					Collision rates allowing for avoidance													
	Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.00	6.8	
			100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.00	6.8	
			100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.00	6.8	
			98.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.1	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units						
Bird data		Windfarm data			Turbine data												
Species name		Merlin		Site name		Cush WF		Model		GE158							
Bird length	L	0.275	m	Latitude		53.15028	degrees	Hub height		120.9	m						
Wingspan	W	0.56	m	No of turbines	T	3		Rotor radius	R	79	m						
Bird flight speed	v	13.47	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3							
Flight type, flapping or gliding		flapping						Rotation speed	Ω	8.4	rpm						
% of flights upwind/downwind		50%	50%					Max blade width	C	4	m						
Nocturnal activity ranking 1-5		1						Blade pitch	λ	15	degrees						
Nocturnal activity factor	fnight	0%						Risk height range		42-200	m						
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																	
Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion at rotor risk height	Q2R	57.75%	0.000339 0.000764 0.0139														0.0013
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																	
No of turbines	T	3															
Rotor radius	R	79	m														
		Total rotor frontal area m2			58820												
Nocturnal activity factor	fnight	0%															
Bird flight speed	v	13.47	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.1	34.3	38
Stage C																	
No of blades	b	3	Bird length			l	0.275	m									
Rotation speed	Ω	8.4	rpm	Wingspan			w	0.56	m								
Rotor radius	R	79	m	Bird flight speed			v	13.47	m s-1								
Max blade width	C	4	m	Flight type				flapping									
Pitch	λ	15	degrees	% of flights upwind/downwind				50%	50%								
Blade profile		see Blade profile sheet															
		Single transit risk			upwind	5.72%											
					downwind	2.37%											
					weighted mean	4.05%											
Stage D																	
Proportion of time operational	Qop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge			
		88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
		Collision rates before avoidance												year total			
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	1.24	1			
Stage E																	
Allow for large array correction?		No															
Width of windfarm	w	0.7	km														
		large array correction			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
					Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	1.24	1.4
		100.00%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	1.24	1.4
		100.00%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	1.24	1.4
		98.00%	100.00%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.0

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units		
Bird data					Windfarm data				Turbine data									
Species name		Peregrine			Site name		Cush WF		Model		GE158							
Bird length		L	0.45	m	Latitude		53.15028		degrees		Hub height		120.9		m			
Wingspan		W	1.1	m	No of turbines		T	3			Rotor radius		R	79	m			
Bird flight speed		v	14	m s-1	Width of windfarm		w	0.7	km		No of blades		b	3				
Flight type, flapping or gliding		flapping									Rotation speed		Ω	8.4	rpm			
% of flights upwind/downwind		50%			50%						Max blade width		C	4	m			
Nocturnal activity ranking 1-5		1									Blade pitch		λ	15	degrees			
Nocturnal activity factor		fnight	0%									Risk height range		42-200 m				
normal approach				Set to 'normal approach' to use survey data on bird density														
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																		
Daytime bird density		DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion at rotor risk height		Q2R	66.24%			0.00124 0.00306												0.0004
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
No of turbines		T	3															
Rotor radius		R	79 m															
		Total rotor frontal area m2			58820													
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	14 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	7.8	19.4	0.0	0.0	0.0	0.0	0.0	27
Stage C																		
No of blades		b	3			Bird length		l	0.45 m									
Rotation speed		Ω	8.4 rpm			Wingspan		w	1.1 m									
Rotor radius		R	79 m			Bird flight speed		v	14 m s-1									
Max blade width		C	4 m			Flight type		flapping										
Pitch		λ	15 degrees			% of flights upwind/downwind		50%		50%								
Blade profile		see Blade profile sheet																
		Single transit risk			upwind	6.33%												
					downwind	3.07%												
					weighted mean	4.70%												
Stage D																		
Proportion of time operational		Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
					Collision rates before avoidance										year total			
					0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.74	0.00	0.00	0.00	0.00	0.00	1
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7 km															
		large array correction			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
Avoidance rates modelled					Collision rates allowing for avoidance													
					0.00	0.00	0.00	0.00	0.00	0.30	0.74	0.00	0.00	0.00	0.00	0.00	1.0	
					0.00	0.00	0.00	0.00	0.00	0.30	0.74	0.00	0.00	0.00	0.00	0.00	1.0	
					0.00	0.00	0.00	0.00	0.00	0.30	0.74	0.00	0.00	0.00	0.00	0.00	1.0	
		98.00%			0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.0	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data							Turbine data						
Species name		Peregrine			Site name		Cush WF			Model		GE158						
Bird length		L	0.45	m	Latitude		53.15028		degrees	Hub height		120.9		m				
Wingspan		W	1.1	m	No of turbines		T	3			Rotor radius		R	79 m				
Bird flight speed		v	14	m s-1	Width of windfarm		w	0.7		km	No of blades		b	3				
Flight type, flapping or gliding		flapping								Rotation speed		Ω	8.4	rpm				
% of flights upwind/downwind		50%		50%						Max blade width		C	4	m				
Nocturnal activity ranking 1-5		1								Blade pitch		λ	15	degrees				
Nocturnal activity factor		fnight	0%							Risk height range		42-200		m				
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Daytime bird density		DA	birds/km2														0.00132	0.0001
Proportion at rotor risk height		Q2R	61.86%															
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of turbines		T	3															
Rotor radius		R	79 m															
		Total rotor frontal area m2		58820														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	14 m s-1															
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	4	
Stage C					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of blades		b	3		Bird length		l	0.45 m										
Rotation speed		Ω	8.4 rpm		Wingspan		w	1.1 m										
Rotor radius		R	79 m		Bird flight speed		v	14 m s-1										
Max blade width		C	4 m		Flight type		flapping											
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	6.33%													
				downwind	3.07%													
				weighted mean	4.70%													
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion of time operational		Qop			88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
		Collision rates before avoidance												year total				
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0	
Stage E					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
Allow for large array correction?		No																
Width of windfarm		w	0.7 km															
		large array correction																
Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.2	
				100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.2	
				100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.2	
		98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data							Turbine data						
Species name		Peregrine			Site name		Cush WF			Model		GE158						
Bird length		L	0.45	m	Latitude		53.15028		degrees	Hub height		120.9						
Wingspan		W	1.1	m	No of turbines		T	3		Rotor radius		R	79					
Bird flight speed		v	14	m s-1	Width of windfarm		w	0.7		km	No of blades		b					
Flight type, flapping or gliding		flapping									Rotation speed		Ω					
% of flights upwind/downwind		50%		50%							Max blade width		C					
Nocturnal activity ranking 1-5		1									Blade pitch		λ					
Nocturnal activity factor		fnight	0%								Risk height range		42-200					
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height		Q2R	55.44%		0.00407												0.0003	
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
No of turbines		T	3															
Rotor radius		R	79 m															
		Total rotor frontal area m2		58820														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	14 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits			0.0	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	
Stage C																		
No of blades		b	3		Bird length		l	0.45 m										
Rotation speed		Ω	8.4 rpm		Wingspan		w	1.1 m										
Rotor radius		R	79 m		Bird flight speed		v	14 m s-1										
Max blade width		C	4 m		Flight type		flapping											
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	6.33%													
				downwind	3.07%													
				weighted mean	4.70%													
Stage D																		
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
				88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%												86.3%		
				Collision rates before avoidance												year total		
				0.00 0.49 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00												0		
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7 km															
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
Avoidance rates modelled				Collision rates allowing for avoidance														
				0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5		
				0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5		
				0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5		
		98.00%		0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0		

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units	Value				Units	Value				Units		
Bird data				Windfarm data				Turbine data								
Species name		Snipe		Site name		Cush WF		Model		GE158						
Bird length		L	0.26	Latitude		53.15028		Hub height		120.9		m				
Wingspan		W	0.455	No of turbines		T	3	Rotor radius		R	79	m				
Bird flight speed		v	16	Width of windfarm		w	0.7	No of blades		b	3					
Flight type, flapping or gliding		flapping						Rotation speed		Ω	8.4	rpm				
% of flights upwind/downwind		50%						Max blade width		C	4	m				
Nocturnal activity ranking 1-5		3						Blade pitch		λ	15	degrees				
Nocturnal activity factor		fnight	50%					Risk height range		42-200		m				
normal approach				Set to 'normal approach' to use survey data on bird density												
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A												
Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Daytime bird density		DA	birds/km2	0.00017												0.0034
Proportion at rotor risk height		Q2R	59.18%													
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines		T	3													
Rotor radius		R	79 m													
		Total rotor frontal area m2		58820												
Nocturnal activity factor		fnight	50%													
Bird flight speed		v	16 m s-1													
		Projected number of rotor transits		0.0	0.0	0.0	0.0	1.3	140.0	177.3	0.0	0.0	0.0	0.0	0.0	319
Stage C				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of blades		b	3	Bird length		l	0.26 m									
Rotation speed		Ω	8.4 rpm	Wingspan		w	0.455 m									
Rotor radius		R	79 m	Bird flight speed		v	16 m s-1									
Max blade width		C	4 m	Flight type		flapping										
Pitch		λ	15 degrees	% of flights upwind/downwind		50%		50%								
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	5.25%											
				downwind	2.35%											
		weighted mean		3.80%												
Stage D				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Proportion of time operational		Qop		88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
				Collision rates before avoidance												year total
				0.00	0.00	0.00	0.00	0.04	4.42	5.44	0.00	0.00	0.00	0.00	0.00	10
Stage E				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Allow for large array correction?		No														
Width of windfarm		w	0.7 km													
		large array correction		Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	0.04	4.42	5.44	0.00	0.00	0.00	0.00	0.00	9.9
		100.00%		0.00	0.00	0.00	0.00	0.04	4.42	5.44	0.00	0.00	0.00	0.00	0.00	9.9
		100.00%		0.00	0.00	0.00	0.00	0.04	4.42	5.44	0.00	0.00	0.00	0.00	0.00	9.9
		98.00%		0.00	0.00	0.00	0.00	0.00	0.09	0.11	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units	Value				Units	Value				Units			
Bird data				Windfarm data				Turbine data									
Species name		Snipe		Site name		Cush WF		Model		GE158							
Bird length		L	0.26	m		Latitude		53.15028	degrees		Hub height		120.9	m			
Wingspan		W	0.455	m		No of turbines		T	3	Rotor radius		R	79	m			
Bird flight speed		v	16	m s-1		Width of windfarm		w	0.7	km		No of blades		b	3		
Flight type, flapping or gliding		flapping								Rotation speed		Ω	8.4	rpm			
% of flights upwind/downwind		50%		50%						Max blade width		C	4	m			
Nocturnal activity ranking 1-5		3								Blade pitch		λ	15	degrees			
Nocturnal activity factor		fnight	50%							Risk height range		42-200		m			
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A													
Stage A																	
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Proportion at rotor risk height		Q2R	43.66%		0.0124 0.0105 0.00136												0.0020
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																	
No of turbines		T	3														
Rotor radius		R	79 m														
		Total rotor frontal area m2		58820													
Nocturnal activity factor		fnight	50%														
Bird flight speed		v	16 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	71.6	60.3	8.0	0.0	0.0	0.0	0.0	0.0	0.0	140
Stage C																	
No of blades		b	3		Bird length		l	0.26 m									
Rotation speed		Ω	8.4 rpm		Wingspan		w	0.455 m									
Rotor radius		R	79 m		Bird flight speed		v	16 m s-1									
Max blade width		C	4 m		Flight type		flapping										
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%								
Blade profile		see Blade profile sheet															
		Single transit risk		upwind	5.25%												
				downwind	2.35%												
				weighted mean	3.80%												
Stage D																	
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%		
				Collision rates before avoidance													
				0.00	0.00	0.00	0.00	2.33	1.90	0.24	0.00	0.00	0.00	0.00	0.00	0.00	year total
																4	
Stage E																	
Allow for large array correction?		No															
Width of windfarm		w	0.7 km														
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
				Collision rates allowing for avoidance													
Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.00	2.33	1.90	0.24	0.00	0.00	0.00	0.00	0.00	4.5
				100.00%	0.00	0.00	0.00	0.00	2.33	1.90	0.24	0.00	0.00	0.00	0.00	0.00	4.5
				100.00%	0.00	0.00	0.00	0.00	2.33	1.90	0.24	0.00	0.00	0.00	0.00	0.00	4.5
		98.00%		100.00%	0.00	0.00	0.00	0.00	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units																
Bird data		Windfarm data			Turbine data																											
Species name		Snipe		Site name		Cush WF		Model		GE158																						
Bird length		L	0.26	m		Latitude		53.15028		degrees		Hub height		120.9		m																
Wingspan		W	0.455	m		No of turbines		T	3				Rotor radius		R	79	m															
Bird flight speed		v	16	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3																
Flight type, flapping or gliding		flapping										Rotation speed		Ω	8.4		rpm															
% of flights upwind/downwind		50%		50%								Max blade width		C	4		m															
Nocturnal activity ranking 1-5		3										Blade pitch		λ	15		degrees															
Nocturnal activity factor		fnight	50%										Risk height range		42-200		m															
normal approach				Set to 'normal approach' to use survey data on bird density																												
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																												
Stage A				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge				
Daytime bird density		DA	birds/km2		0.00249																0.00306				0.000679		0.0005					
Proportion at rotor risk height		Q2R	51.82%																													
At latitude 53.2		Daylight hours per month		252.7		274.3		366.4		418.1		490.3		505.8		508.9		458.2		382.4		330.1		262.0		237.0		4486.2				
		Nighttime hours per month		491.3		397.7		377.6		301.9		253.7		214.2		235.1		285.8		337.6		413.9		458.0		507.0		4273.8				
Stage B																																
No of turbines		T	3																													
Rotor radius		R	79		m																											
		Total rotor frontal area m2		58820																												
Nocturnal activity factor		fnight	50%																													
Bird flight speed		v	16		m s-1		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year total	
		Projected number of rotor transits		13.8		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		18.3		0.0		3.7		36		
Stage C																																
No of blades		b	3				Bird length		l	0.26		m																				
Rotation speed		Ω	8.4		rpm		Wingspan		w	0.455		m																				
Rotor radius		R	79		m		Bird flight speed		v	16		m s-1																				
Max blade width		C	4		m		Flight type		flapping																							
Pitch		λ	15		degrees		% of flights upwind/downwind		50%		50%																					
Blade profile		see Blade profile sheet																														
		Single transit risk		upwind		5.25%																										
				downwind		2.35%																										
				weighted mean		3.80%																										
Stage D																																
Proportion of time operational		Qop	88.8%		90.5%		86.9%		85.6%		85.7%		83.1%		80.8%		82.4%		85.1%		89.8%		88.0%		88.9%		86.3%					
		</																														

Required input data is in
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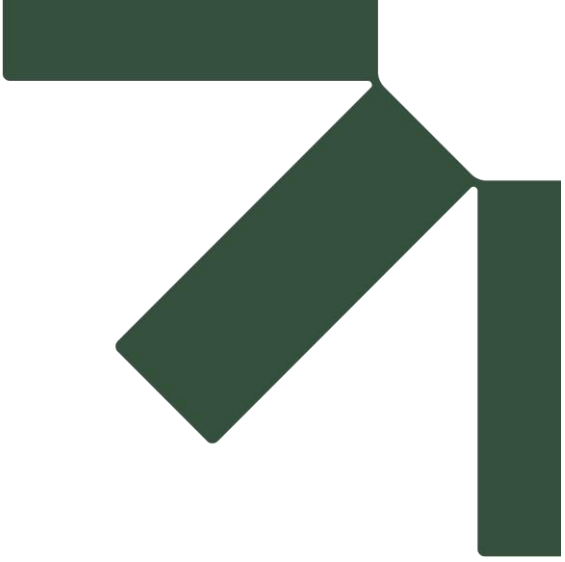
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Appendix B NatureScot Spreadsheets – 175 m RD Representative Permutation (E175)

Avian Collision Risk Report

Cush Wind Farm Phase II

Cush Wind Limited

SLR Project No.: 501.065723.00001

23 October 2026

COLLISION RISK MODEL

Required input data is in

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Calculated output is in

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boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units					
Bird data		Windfarm data			Turbine data														
	Species name	Black-headed gull				Site name	Cush WF			Model	E175								
	Bird length	L	0.355	m		Latitude	53.15028		degrees		Hub height		111.6	m					
	Wingspan	W	1.05	m		No of turbines	T	3			Rotor radius	R	87.5	m					
	Bird flight speed	v	11.9	m s-1		Width of windfarm	w	0.7	km		No of blades	b	3						
	Flight type, flapping or gliding	flapping									Rotation speed	Ω	6.7	rpm					
	% of flights upwind/downwind	50%									Max blade width	C	4.01	m					
	Nocturnal activity ranking 1-5	1									Blade pitch	λ	15	degrees					
	Nocturnal activity factor	fnight	0%								Risk height range	24-199			m				
normal approach		Set to 'normal approach' to use survey data on bird density																	
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																	
Stage A																			
	Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
	Proportion at rotor risk height	Q2R	62.80%			0.153												0.0124	0.0138
	At latitude 53.2	Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																			
	No of turbines	T	3																
	Rotor radius	R	87.5 m																
		Total rotor frontal area m2			72158														
	Nocturnal activity factor	fnight	0%																
	Bird flight speed	v	11.9 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits			0.0	0.0	0.0	0.0	832.1	69.6	0.0	0.0	0.0	0.0	0.0	0.0	902		
Stage C																			
	No of blades	b	3																
	Rotation speed	Ω	6.7 rpm																
	Rotor radius	R	87.5 m																
	Max blade width	C	4.01 m																
	Pitch	λ	15 degrees																
	Blade profile	see Blade profile sheet																	
		Single transit risk			upwind	5.60%													
					downwind	2.57%													
					weighted mean	4.08%													
Stage D																			
	Proportion of time operational	Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%		
					Collision rates before avoidance										year total				
					0.00	0.00	0.00	0.00	29.11	2.36	0.00	0.00	0.00	0.00	0.00	0.00	31		
Stage E																			
	Allow for large array correction?	No																	
	Width of windfarm	w	0.7 km																
		large array correction																	
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
	Avoidance rates modelled				Collision rates allowing for avoidance														
					0.00	0.00	0.00	0.00	29.11	2.36	0.00	0.00	0.00	0.00	0.00	0.00	31.5		
					0.00	0.00	0.00	0.00	29.11	2.36	0.00	0.00	0.00	0.00	0.00	0.00	31.5		
					0.00	0.00	0.00	0.00	29.11	2.36	0.00	0.00	0.00	0.00	0.00	0.00	31.5		
		99.20%			0.00	0.00	0.00	0.00	0.23	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.3		

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COLLISION RISK MODEL

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boxes are for information only, to show variables used at each stage

Bird data				Value		Units		Windfarm data				Value		Units		Turbine data				Value		Units									
Species name		Little egret		Site name		Cush WF		Model		E175		Hub height		111.6		m		Rotor radius		87.5		m									
Bird length		L		0.6		m		Latitude		53.15028		degrees		No of blades		b		3		rpm		Rotation speed		Ω		6.7		rpm			
Wingspan		W		0.915		m		No of turbines		T		3		Max blade width		C		4.01		m		Blade pitch		λ		15		degrees			
Bird flight speed		v		10.4		m s-1		Width of windfarm		w		0.7		km		Risk height range		24-199		m											
Flight type, flapping or gliding		flapping		50%		50%																									
% of flights upwind/downwind		50%		50%																											
Nocturnal activity ranking 1-5		1																													
Nocturnal activity factor		fnight		0%																											
normal approach				Set to 'normal approach' to use survey data on bird density																											
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																											
Stage A																															
Daytime bird density		DA		birds/km2		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge	
Proportion at rotor risk height		Q2R		64.56%												0.0213														0.0018	
At latitude 53.2				Daylight hours per month		252.7		274.3		366.4		418.1		490.3		505.8		508.9		458.2		382.4		330.1		262.0		237.0		4486.2	
				Nighttime hours per month		491.3		397.7		377.6		301.9		253.7		214.2		235.1		285.8		337.6		413.9		458.0		507.0		4273.8	
Stage B																															
No of turbines		T		3																											
Rotor radius		R		87.5		m																									
Total rotor frontal area m2				72158																											
Nocturnal activity factor		fnight		0%																											
Bird flight speed		v		10.4		m s-1																									
Projected number of rotor transits				0.0		0.0		0.0		0.0		0.0		0.0		107.4		0.0		0.0		0.0		0.0		0.0		0.0		year total	
																														107	
Stage C																															
No of blades		b		3																											
Rotation speed		Ω		6.7		rpm																									
Rotor radius		R		87.5		m																									
Max blade width		C		4.01		m																									
Pitch		λ		15		degrees																									
Blade profile				see Blade profile sheet																											
Single transit risk				upwind		6.56%																									
				downwind		3.23%																									
				weighted mean		4.90%																									
Stage D																															
Proportion of time operational		Qop				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge	
						88.8%		90.5%		86.9%		85.6%		85.7%		83.1%		80.8%		82.4%		85.1%		89.8%		88.0%		88.9%		86.3%	
Collision rates before avoidance																															
						0.00		0.00		0.00		0.00		0.00		4.37		0.00		0.00		0.00		0.00		0.00		0.00		year total	
																														4	
Stage E																															
Allow for large array correction?				No																											
Width of windfarm		w		0.7		km																									
large array correction																															
Jan																														per year	
Collision rates allowing for avoidance																															
Avoidance rates modelled						100.00%		0.00		0.00		0.00		0.00		0.00		4.37		0.00		0.00		0.00		0.00		0.00		4.4	
						100.00%		0.00		0.00		0.00		0.00		0.00		4.37		0.00		0.00		0.00		0.00		0.00		4.4	
						100.00%		0.00		0.00		0.00		0.00		0.00		4.37		0.00		0.00		0.00		0.00		0.00		4.4	
				98.00%		100.00%		0.00		0.00		0.00		0.00		0.00		0.09		0.00		0.00		0.00		0.00		0.00		0.1	

COLLISION RISK MODEL

Required input data is in

orange

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Calculated output is in

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boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units								
Bird data		Windfarm data			Turbine data														
Species name		Golden plover			Site name		Cush WF		Model		E175								
Bird length		L	0.275	m	Latitude		53.15028 degrees		Hub height		111.6 m								
Wingspan		W	0.715	m	No of turbines		T	3	Rotor radius		R	87.5 m							
Bird flight speed		v	13.7	m s-1	Width of windfarm		w	0.7 km	No of blades		b	3							
Flight type, flapping or gliding		flapping			Rotation speed		Ω	6.7 rpm	Max blade width		C	4.01 m							
% of flights upwind/downwind		50%			Blade pitch		λ	15 degrees											
Nocturnal activity ranking 1-5		3																	
Nocturnal activity factor		fnight	50%						Risk height range			24-199 m							
normal approach		Set to 'normal approach' to use survey data on bird density																	
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																	
Stage A																			
Daytime bird density		DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height		Q2R	73.55%															1.16	0.0967
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																			
No of turbines		T	3																
Rotor radius		R	87.5 m																
		Total rotor frontal area m2			72158														
Nocturnal activity factor		fnight	50%																
Bird flight speed		v	13.7 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9318.0	0.0	0.0	9318		
Stage C																			
No of blades		b	3			Bird length		l	0.275 m										
Rotation speed		Ω	6.7 rpm			Wingspan		w	0.715 m										
Rotor radius		R	87.5 m			Bird flight speed		v	13.7 m s-1										
Max blade width		C	4.01 m			Flight type		flapping											
Pitch		λ	15 degrees			% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																	
		Single transit risk			upwind	4.97%													
					downwind	2.27%													
					weighted mean	3.62%													
Stage D																			
Proportion of time operational		Qop				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%		
					Collision rates before avoidance													year total	
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	302.59	0.00	0.00	303	
Stage E																			
Allow for large array correction?		No																	
Width of windfarm		w	0.7 km																
		large array correction			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
					Collision rates allowing for avoidance														
Avoidance rates modelled					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	302.59	0.00	0.00	302.6		
		98.00%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.05	0.00	0.00	6.1		
		99.50%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51	0.00	0.00	1.5		
		99.80%			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.6		

COLLISION RISK MODEL

Required input data is in

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		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data				Turbine data									
	Species name	Hen harrier				Site name	Cush WF			Model	E175							
	Bird length	L	0.48	m		Latitude	53.15028		degrees		Hub height		111.6	m				
	Wingspan	W	1.1	m		No of turbines	T	3			Rotor radius	R	87.5	m				
	Bird flight speed	v	8	m s-1		Width of windfarm	w	0.7	km		No of blades	b	3					
	Flight type, flapping or gliding	flapping									Rotation speed	Ω	6.7	rpm				
	% of flights upwind/downwind	50%			50%						Max blade width	C	4.01	m				
	Nocturnal activity ranking 1-5	1									Blade pitch	λ	15	degrees				
	Nocturnal activity factor	fnight	0%								Risk height range	24-199			m			
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
	Daytime bird density	DA	birds/km2			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
	Proportion at rotor risk height	Q2R	86.85%			0.0113												0.0009
	At latitude 53.2	Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	87.5 m															
		Total rotor frontal area m2			72158													
	Nocturnal activity factor	fnight	0%															
	Bird flight speed	v	8 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits			29.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
Stage C																		
	No of blades	b	3				Bird length	l	0.48 m									
	Rotation speed	Ω	6.7 rpm				Wingspan	w	1.1 m									
	Rotor radius	R	87.5 m				Bird flight speed	v	8 m s-1									
	Max blade width	C	4.01 m				Flight type	flapping										
	Pitch	λ	15 degrees				% of flights upwind/downwind	50%		50%								
	Blade profile	see Blade profile sheet																
		Single transit risk				upwind	7.22%											
						downwind	3.38%											
						weighted mean	5.30%											
Stage D																		
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
	Proportion of time operational	Qop	88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%												86.3%			
		Collision rates before avoidance																
		1.39 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00												year total				
														1				
Stage E																		
	Allow for large array correction?	No																
	Width of windfarm	w	0.7 km															
		large array correction				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
					Collision rates allowing for avoidance													
	Avoidance rates modelled				100.00%	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4
					100.00%	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4
					100.00%	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4
		99.00%			100.00%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

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COLLISION RISK MODEL

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COLLISION RISK MODEL

Required input data is in

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Calculated output is in

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Value				Units	Value				Units	Value				Units				
Bird data				Windfarm data				Turbine data										
Species name		Kestrel		Site name		Cush WF		Model		E175								
Bird length		L	0.34	Latitude		53.15028		Hub height		111.6		m						
Wingspan		W	0.755	No of turbines		T	3	Rotor radius		R	87.5	m						
Bird flight speed		v	12.7	Width of windfarm		w	0.7	No of blades		b	3							
Flight type, flapping or gliding		flapping						Rotation speed		Ω	6.7	rpm						
% of flights upwind/downwind		50%						Max blade width		C	4.01	m						
Nocturnal activity ranking 1-5		1						Blade pitch		λ	15	degrees						
Nocturnal activity factor		fnight	0%					Risk height range		24-199		m						
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height		Q2R	69.51%		0.00615 0.0228 0.00233												0.0026	
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines		T	3															
Rotor radius		R	87.5 m															
		Total rotor frontal area m2		72158														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	12.7 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits		0.0	0.0	0.0	0.0	39.5	151.1	15.5	0.0	0.0	0.0	0.0	0.0	0.0	206	
Stage C																		
No of blades		b	3		Bird length		l	0.34 m										
Rotation speed		Ω	6.7 rpm		Wingspan		w	0.755 m										
Rotor radius		R	87.5 m		Bird flight speed		v	12.7 m s-1										
Max blade width		C	4.01 m		Flight type		flapping											
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	5.26%													
				downwind	2.38%													
				weighted mean	3.82%													
Stage D																		
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%			
				Collision rates before avoidance												year total		
				0.00	0.00	0.00	0.00	1.29	4.80	0.48	0.00	0.00	0.00	0.00	0.00	0.00	7	
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7 km															
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
				Collision rates allowing for avoidance														
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	1.29	4.80	0.48	0.00	0.00	0.00	0.00	0.00	6.6		
		100.00%		0.00	0.00	0.00	0.00	1.29	4.80	0.48	0.00	0.00	0.00	0.00	0.00	6.6		
		100.00%		0.00	0.00	0.00	0.00	1.29	4.80	0.48	0.00	0.00	0.00	0.00	0.00	6.6		
		95.00%		0.00	0.00	0.00	0.00	0.06	0.24	0.02	0.00	0.00	0.00	0.00	0.00	0.3		

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units		
Bird data				Windfarm data				Turbine data										
Species name		Kestrel		Site name		Cush WF		Model		E175								
Bird length		L	0.34	m		Latitude		53.15028	degrees		Hub height		111.6	m				
Wingspan		W	0.755	m		No of turbines		T	3	Rotor radius		R	87.5	m				
Bird flight speed		v	12.7	m s-1		Width of windfarm		w	0.7	km		No of blades		b	3			
Flight type, flapping or gliding		flapping								Rotation speed		Ω	6.7	rpm				
% of flights upwind/downwind		50%		50%						Max blade width		C	4.01	m				
Nocturnal activity ranking 1-5		1								Blade pitch		λ	15	degrees				
Nocturnal activity factor		fnight	0%							Risk height range		24-199		m				
normal approach				Set to 'normal approach' to use survey data on bird density														
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Proportion at rotor risk height		Q2R	78.66%		0.0041												0.012	0.0013
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines		T	3															
Rotor radius		R	87.5 m															
		Total rotor frontal area m2		72158														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	12.7 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits		0.0	0.0	0.0	25.4	87.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	113	
Stage C																		
No of blades		b	3		Bird length		l	0.34 m										
Rotation speed		Ω	6.7 rpm		Wingspan		w	0.755 m										
Rotor radius		R	87.5 m		Bird flight speed		v	12.7 m s-1										
Max blade width		C	4.01 m		Flight type		flapping											
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	5.26%													
				downwind	2.38%													
				weighted mean	3.82%													
Stage D																		
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%		
				Collision rates before avoidance												year total		
				0.00	0.00	0.00	0.83	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7 km															
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
				Collision rates allowing for avoidance														
Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.83	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7	
				100.00%	0.00	0.00	0.00	0.83	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7	
				100.00%	0.00	0.00	0.00	0.83	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7	
		95.00%		100.00%	0.00	0.00	0.00	0.04	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

			Value	Units				Value	Units				Value	Units				
Bird data					Windfarm data							Turbine data						
	Species name		Kestrel		Site name		Cush WF		Model		E175							
	Bird length	L	0.34	m	Latitude		53.15028	degrees	Hub height		111.6	m						
	Wingspan	W	0.755	m	No of turbines	T	3		Rotor radius	R	87.5	m						
	Bird flight speed	v	12.7	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3							
	Flight type, flapping or gliding		flapping						Rotation speed	Ω	6.7	rpm						
	% of flights upwind/downwind		50%	50%					Max blade width	C	4.01	m						
	Nocturnal activity ranking 1-5		1						Blade pitch	λ	15	degrees						
	Nocturnal activity factor	fnight	0%						Risk height range		24-199	m						
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																		
	Daytime bird density	DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
	Proportion at rotor risk height	Q2R	71.96%		0.000887									0.0101	0.00557	0.000665	0.0014	
	At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2	
			Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8	
Stage B																		
	No of turbines	T	3															
	Rotor radius	R	87.5	m														
			Total rotor frontal area m2		72158													
	Nocturnal activity factor	fnight	0%															
	Bird flight speed	v	12.7	m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
			Projected number of rotor transits		3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.2	19.8	2.1	70
Stage C																		
	No of blades	b	3		Bird length	l	0.34	m										
	Rotation speed	Ω	6.7	rpm	Wingspan	w	0.755	m										
	Rotor radius	R	87.5	m	Bird flight speed	v	12.7	m s-1										
	Max blade width	C	4.01	m	Flight type		flapping											
	Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%										
	Blade profile		see Blade profile sheet															
			Single transit risk		upwind	5.26%												
					downwind	2.38%												
					weighted mean	3.82%												
Stage D																		
	Proportion of time operational	Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
					88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
					Collision rates before avoidance													
					0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.67	0.07	year total	
																	2	
Stage E																		
	Allow for large array correction?		No															
	Width of windfarm	w	0.7	km														
				large array correction														
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
					Collision rates allowing for avoidance													
	Avoidance rates modelled				0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.67	0.07	2.4	
					0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.67	0.07	2.4	
					0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.67	0.07	2.4	
					0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.00	0.1	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units				Value		Units				Value		Units																
Bird data						Windfarm data								Turbine data																		
Species name		Kestrel				Site name		Cush WF				Model		E175																		
Bird length		L	0.34	m		Latitude		53.15028		degrees		Hub height		111.6		m																
Wingspan		W	0.755	m		No of turbines		T	3				Rotor radius		R	87.5	m															
Bird flight speed		v	12.7	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3																
Flight type, flapping or gliding		flapping										Rotation speed		Ω	6.7 rpm																	
% of flights upwind/downwind		50%		50%								Max blade width		C	4.01 m																	
Nocturnal activity ranking 1-5		1										Blade pitch		λ	15 degrees																	
Nocturnal activity factor		fnight	0%										Risk height range		24-199 m																	
normal approach		Set to 'normal approach' to use survey data on bird density																														
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																														
Stage A																																
Daytime bird density		DA	birds/km2		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge			
Proportion at rotor risk height		Q2R	80.71%																		0.000532		0.0000									
At latitude 53.2		Daylight hours per month		252.7		274.3		366.4		418.1		490.3		505.8		508.9		458.2		382.4		330.1		262.0		237.0		4486.2				
		Nighttime hours per month		491.3		397.7		377.6		301.9		253.7		214.2		235.1		285.8		337.6		413.9		458.0		507.0		4273.8				
Stage B																																
No of turbines		T	3																													
Rotor radius		R	87.5 m																													
		Total rotor frontal area m2		72158																												
Nocturnal activity factor		fnight	0%																													
Bird flight speed		v	12.7 m s-1				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year total	
		Projected number of rotor transits		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		1.9		2		
Stage C																																
No of blades		b	3				Bird length		l	0.34 m																						
Rotation speed		Ω	6.7 rpm				Wingspan		w	0.755 m																						
Rotor radius		R	87.5 m				Bird flight speed		v	12.7 m s-1																						
Max blade width		C	4.01 m				Flight type		flapping																							
Pitch		λ	15 degrees				% of flights upwind/downwind		50%		50%																					
Blade profile		see Blade profile sheet																														
		Single transit risk		upwind		5.26%																										
				downwind		2.38%																										
				weighted mean		3.82%																										
Stage D																																
Proportion of time operational		Qop	88.8%		90.5%		86.9%		85.6%		85.7%		83.1%		80.8%		82.4%		85.1%		89.8%		88.0%		88.9%		86.3%					
		Collision rates before avoidance		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.07		year total				
				0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0				
Stage E																																
Allow for large array correction?		No																														
Width of windfarm		w	0.7 km																													
		large array correction																														
				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		per year				
		Collision rates allowing for avoidance		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.07		0.1				
Avoidance rates modelled				100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		0.1				
				95.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		0.1				
				100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		0.1				
				100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		100.00%		0.0				

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value			Units		Value			Units		Value			Units			
Bird data			Windfarm data					Turbine data								
Species name		Lapwing	Site name		Cush WF		Model		E175							
Bird length		0.3	Latitude		53.15028		Hub height		111.6		m					
Wingspan		0.84	No of turbines		T 3		Rotor radius		R 87.5		m					
Bird flight speed		12.3	Width of windfarm		w 0.7		No of blades		b 3							
Flight type, flapping or gliding		flapping					Rotation speed		Ω 6.7		rpm					
% of flights upwind/downwind		50%	50%				Max blade width		C 4.01		m					
Nocturnal activity ranking 1-5		2					Blade pitch		λ 15		degrees					
Nocturnal activity factor		fnight 25%						Risk height range		24-199		m				
normal approach			Set to 'normal approach' to use survey data on bird density													
			Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A													
Stage A			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Daytime bird density		DA	birds/km2		0.0313		0.0228		0.17						0.0187	
Proportion at rotor risk height		Q2R	72.87%													
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of turbines		T	3													
Rotor radius		R	87.5 m													
		Total rotor frontal area m2		72158												
Nocturnal activity factor		fnight	25%													
Bird flight speed		v	12.3 m s-1													
		Projected number of rotor transits		0.0	0.0	0.0	0.0	230.6	169.7	1283.9	0.0	0.0	0.0	0.0	1684	
Stage C			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of blades		b	3		Bird length		l 0.3	m								
Rotation speed		Ω	6.7 rpm		Wingspan		w 0.84	m								
Rotor radius		R	87.5 m		Bird flight speed		v 12.3	m s-1								
Max blade width		C	4.01 m		Flight type		flapping									
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%							
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	5.30%											
				downwind	2.34%											
				weighted mean	3.82%											
Stage D			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Proportion of time operational		Qop	88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
		Collision rates before avoidance													year total	
				0.00	0.00	0.00	0.00	7.55	5.38	39.63	0.00	0.00	0.00	0.00	53	
Stage E			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
Allow for large array correction?		No														
Width of windfarm		w	0.7 km													
		large array correction														
Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.00	7.55	5.38	39.63	0.00	0.00	0.00	0.00	52.6
		99.80%		100.00%	0.00	0.00	0.00	0.00	0.02	0.01	0.08	0.00	0.00	0.00	0.00	0.1
		99.50%		100.00%	0.00	0.00	0.00	0.00	0.04	0.03	0.20	0.00	0.00	0.00	0.00	0.3
		98.00%		100.00%	0.00	0.00	0.00	0.00	0.15	0.11	0.79	0.00	0.00	0.00	0.00	1.1

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value	Units			Value	Units			Value	Units					
Bird data		Windfarm data			Turbine data											
Species name		Lapwing		Site name		Cush WF		Model		E175						
Bird length	L	0.3	m	Latitude		53.15028	degrees	Hub height		111.6	m					
Wingspan	W	0.84	m	No of turbines	T	3		Rotor radius	R	87.5	m					
Bird flight speed	v	12.3	m s-1	Width of windfarm	w	0.7	km	No of blades	b	3						
Flight type, flapping or gliding		flapping						Rotation speed	Ω	6.7	rpm					
% of flights upwind/downwind		50%	50%					Max blade width	C	4.01	m					
Nocturnal activity ranking 1-5		2						Blade pitch	λ	15	degrees					
Nocturnal activity factor	fnight	25%						Risk height range		24-199	m					
normal approach		Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Daytime bird density	DA	birds/km2					0.00166	0.00532	0.00898	0.00249	0.00621					0.0021
Proportion at rotor risk height	Q2R	58.07%														
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																
No of turbines	T	3														
Rotor radius	R	87.5	m													
		Total rotor frontal area m2		72158												
Nocturnal activity factor	fnight	25%														
Bird flight speed	v	12.3	m s-1													
		Projected number of rotor transits		0.0	0.0	0.0	8.7	31.2	53.3	15.0	34.9	0.0	0.0	0.0	0.0	year total 143
Stage C																
No of blades	b	3														
Rotation speed	Ω	6.7	rpm													
Rotor radius	R	87.5	m													
Max blade width	C	4.01	m													
Pitch	λ	15	degrees													
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	5.30%											
				downwind	2.34%											
				weighted mean	3.82%											
Stage D				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave
Proportion of time operational	Qop			88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
		Collision rates before avoidance														year total
				0.00	0.00	0.00	0.28	1.02	1.69	0.46	1.10	0.00	0.00	0.00	0.00	5
Stage E																
Allow for large array correction?		No														
Width of windfarm	w	0.7	km													
			large array correction													
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance														
Avoidance rates modelled				0.00	0.00	0.00	0.28	1.02	1.69	0.46	1.10	0.00	0.00	0.00	0.00	4.6
		99.80%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.50%		0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.0
		98.00%		0.00	0.00	0.00	0.01	0.02	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value			Units		Value			Units		Value			Units					
Bird data			Windfarm data				Turbine data											
Species name		Lapwing	Site name		Cush WF		Model		E175									
Bird length		L	0.3	m	Latitude		53.15028	degrees	Hub height		111.6	m						
Wingspan		W	0.84	m	No of turbines		T	3	Rotor radius		R	87.5	m					
Bird flight speed		v	12.3	m s-1	Width of windfarm		w	0.7	km	No of blades		b	3					
Flight type, flapping or gliding		flapping						Rotation speed		Ω	6.7	rpm						
% of flights upwind/downwind		50%		50%				Max blade width		C	4.01	m						
Nocturnal activity ranking 1-5		2						Blade pitch		λ	15	degrees						
Nocturnal activity factor		fnight	25%					Risk height range		24-199		m						
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Proportion at rotor risk height		Q2R	65.45%		0.0279												0.0253	0.0044
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines		T	3															
Rotor radius		R	87.5 m															
		Total rotor frontal area m2		72158														
Nocturnal activity factor		fnight	25%															
Bird flight speed		v	12.3 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.5	110.0	236	
Stage C																		
No of blades		b	3		Bird length		l	0.3 m										
Rotation speed		Ω	6.7 rpm		Wingspan		w	0.84 m										
Rotor radius		R	87.5 m		Bird flight speed		v	12.3 m s-1										
Max blade width		C	4.01 m		Flight type		flapping											
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	5.30%													
				downwind	2.34%													
				weighted mean	3.82%													
Stage D																		
Proportion of time operational		Qop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave			
		88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%														86.3%		
		Collision rates before avoidance														year total		
		0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 4.22 3.74														8		
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7 km		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
		large array correction		Collision rates allowing for avoidance														
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.22	3.74	8.0	
		99.80%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0	
		99.50%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.0	
		98.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.2	

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

			Value	Units				Value	Units				Value	Units			
Bird data			Windfarm data				Turbine data										
	Species name		Lapwing			Site name		Cush WF		Model		E175					
	Bird length	L	0.3	m		Latitude		53.15028	degrees		Hub height		111.6	m			
	Wingspan	W	0.84	m		No of turbines	T	3			Rotor radius	R	87.5	m			
	Bird flight speed	v	12.3	m s-1		Width of windfarm	w	0.7	km		No of blades	b	3				
	Flight type, flapping or gliding		flapping								Rotation speed	Ω	6.7	rpm			
	% of flights upwind/downwind		50%	50%							Max blade width	C	4.01	m			
	Nocturnal activity ranking 1-5		2								Blade pitch	λ	15	degrees			
	Nocturnal activity factor	fnight	25%								Risk height range		24-199	m			
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A														
Stage A																	
	Daytime bird density	DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
	Proportion at rotor risk height	Q2R	57.72%		0.0173 0.00832												0.0021
	At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
			Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B																	
	No of turbines	T	3														
	Rotor radius	R	87.5	m													
			Total rotor frontal area m2		72158												
	Nocturnal activity factor	fnight	25%														
	Bird flight speed	v	12.3	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
			Projected number of rotor transits		0.0	68.1	40.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109
Stage C																	
	No of blades	b	3				Bird length	l	0.3	m							
	Rotation speed	Ω	6.7	rpm			Wingspan	w	0.84	m							
	Rotor radius	R	87.5	m			Bird flight speed	v	12.3	m s-1							
	Max blade width	C	4.01	m			Flight type		flapping								
	Pitch	λ	15	degrees			% of flights upwind/downwind		50%	50%							
	Blade profile		see Blade profile sheet														
			Single transit risk				upwind	5.30%									
							downwind	2.34%									
							weighted mean	3.82%									
Stage D																	
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
	Proportion of time operational	Qop			88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%
					Collision rates before avoidance												
					0.00	2.36	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	year total
																	4
Stage E																	
	Allow for large array correction?		No														
	Width of windfarm	w	0.7	km													
				large array correction													
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
					Collision rates allowing for avoidance												
	Avoidance rates modelled				0.00	2.36	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7
					99.80%	100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
					99.50%	100.00%		0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0
					98.00%	100.00%		0.00	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.1

Required input data is in
Calculated output is in

boxes
boxes
boxes

Page 33 of 54

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Page 35 of 54

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units	Value				Units	Value				Units					
Bird data		Windfarm data				Turbine data													
Species name		Merlin		Site name		Cush WF		Model		E175									
Bird length		L	0.275	m		Latitude		53.15028		degrees		Hub height		111.6	m				
Wingspan		W	0.56	m		No of turbines		T	3				Rotor radius		R	87.5	m		
Bird flight speed		v	13.47	m s-1		Width of windfarm		w	0.7		km				No of blades		b	3	
Flight type, flapping or gliding		flapping												Rotation speed		Ω	6.7	rpm	
% of flights upwind/downwind		50%		50%										Max blade width		C	4.01	m	
Nocturnal activity ranking 1-5		1												Blade pitch		λ	15	degrees	
Nocturnal activity factor		fnight	0%										Risk height range		24-199		m		
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																			
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
Proportion at rotor risk height		Q2R	66.91%		0.000333												0.000748	0.0153	0.0014
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																			
No of turbines		T	3																
Rotor radius		R	87.5 m																
Total rotor frontal area m2		72158																	
Nocturnal activity factor		fnight	0%																
Bird flight speed		v	13.47 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total		
Projected number of rotor transits				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.6	48.5	53		
Stage C																			
No of blades		b	3		Bird length		l	0.275 m											
Rotation speed		Ω	6.7 rpm		Wingspan		w	0.56 m											
Rotor radius		R	87.5 m		Bird flight speed		v	13.47 m s-1											
Max blade width		C	4.01 m		Flight type		flapping												
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%										
Blade profile		see Blade profile sheet																	
Single transit risk				upwind	4.92%														
				downwind	2.17%														
weighted mean				3.55%															
Stage D																			
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
				Collision rates before avoidance												year total			
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	1.53	2		
Stage E																			
Allow for large array correction?		No																	
Width of windfarm		w	0.7 km																
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year			
Avoidance rates modelled				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	1.53	1.7			
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	1.53	1.7			
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	1.53	1.7			
		98.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.0			

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units			
Bird data		Windfarm data				Turbine data													
Species name		Peregrine		Site name		Cush WF		Model		E175									
Bird length		L	0.45	m		Latitude		53.15028	degrees		Hub height		111.6	m					
Wingspan		W	1.1	m		No of turbines		T	3	Rotor radius		R	87.5	m					
Bird flight speed		v	14	m s-1		Width of windfarm		w	0.7	km		No of blades		b	3				
Flight type, flapping or gliding		flapping								Rotation speed		Ω	6.7	rpm					
% of flights upwind/downwind		50%		50%						Max blade width		C	4.01	m					
Nocturnal activity ranking 1-5		1								Blade pitch		λ	15	degrees					
Nocturnal activity factor		fnight	0%							Risk height range		24-199		m					
normal approach				Set to 'normal approach' to use survey data on bird density															
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A															
Stage A																			
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
Proportion at rotor risk height		Q2R	76.22%		0.00122 0.00299												0.0004		
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																			
No of turbines		T	3																
Rotor radius		R	87.5 m																
		Total rotor frontal area m2		72158															
Nocturnal activity factor		fnight	0%																
Bird flight speed		v	14 m s-1		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total		
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	9.8	24.1	0.0	0.0	0.0	0.0	0.0	34		
Stage C																			
No of blades		b	3		Bird length		l	0.45 m											
Rotation speed		Ω	6.7 rpm		Wingspan		w	1.1 m											
Rotor radius		R	87.5 m		Bird flight speed		v	14 m s-1											
Max blade width		C	4.01 m		Flight type		flapping												
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%										
Blade profile		see Blade profile sheet																	
		Single transit risk		upwind	5.44%														
				downwind	2.79%														
				weighted mean	4.12%														
Stage D																			
Proportion of time operational		Qop			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
				88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%			
				Collision rates before avoidance													year total		
				0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.80	0.00	0.00	0.00	0.00	0.00	1		
Stage E																			
Allow for large array correction?		No																	
Width of windfarm		w	0.7 km																
		large array correction																	
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year			
		Collision rates allowing for avoidance																	
Avoidance rates modelled				0.00	0.00	0.00	0.00	0.00	0.33	0.80	0.00	0.00	0.00	0.00	0.00	1.1			
				0.00	0.00	0.00	0.00	0.00	0.33	0.80	0.00	0.00	0.00	0.00	0.00	1.1			
				0.00	0.00	0.00	0.00	0.00	0.33	0.80	0.00	0.00	0.00	0.00	0.00	1.1			
		98.00%		0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.0			

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

		Value		Units			Value		Units			Value		Units				
Bird data					Windfarm data				Turbine data									
Species name		Peregrine			Site name		Cush WF		Model		E175							
Bird length		L	0.45	m	Latitude		53.15028		degrees		Hub height		111.6	m				
Wingspan		W	1.1	m	No of turbines		T	3			Rotor radius		R	87.5	m			
Bird flight speed		v	14	m s-1	Width of windfarm		w	0.7	km		No of blades		b	3				
Flight type, flapping or gliding		flapping									Rotation speed		Ω	6.7	rpm			
% of flights upwind/downwind		50%									Max blade width		C	4.01	m			
Nocturnal activity ranking 1-5		1									Blade pitch		λ	15	degrees			
Nocturnal activity factor		fnight	0%									Risk height range		24-199	m			
normal approach		Set to 'normal approach' to use survey data on bird density																
		Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																		
Daytime bird density		DA	birds/km2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge	
Proportion at rotor risk height		Q2R	71.19%													0.00129		0.0001
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2		
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8		
Stage B																		
No of turbines		T	3															
Rotor radius		R	87.5	m														
		Total rotor frontal area m2		72158														
Nocturnal activity factor		fnight	0%															
Bird flight speed		v	14	m s-1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5	
Stage C																		
No of blades		b	3			Bird length		l	0.45	m								
Rotation speed		Ω	6.7	rpm			Wingspan		w	1.1	m							
Rotor radius		R	87.5	m			Bird flight speed		v	14	m s-1							
Max blade width		C	4.01	m			Flight type		flapping									
Pitch		λ	15	degrees	% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																
		Single transit risk		upwind	5.44%													
				downwind	2.79%													
				weighted mean	4.12%													
Stage D																		
Proportion of time operational		Qop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge			
		88.8% 90.5% 86.9% 85.6% 85.7% 83.1% 80.8% 82.4% 85.1% 89.8% 88.0% 88.9%												86.3%				
		Collision rates before avoidance												year total				
		0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.18 0.00												0				
Stage E																		
Allow for large array correction?		No																
Width of windfarm		w	0.7	km														
		large array correction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year		
		Collision rates allowing for avoidance																
Avoidance rates modelled		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.2		
		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.2		
		100.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.2		
		98.00%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0		

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units															
Bird data		Windfarm data			Turbine data																										
Species name		Peregrine		Site name		Cush WF		Model		E175																					
Bird length		L	0.45	m		Latitude		53.15028		degrees		Hub height		111.6 m																	
Wingspan		W	1.1	m		No of turbines		T	3				Rotor radius		R	87.5 m															
Bird flight speed		v	14	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3															
Flight type, flapping or gliding		flapping										Rotation speed		Ω	6.7	rpm															
% of flights upwind/downwind		50%		50%								Max blade width		C	4.01	m															
Nocturnal activity ranking 1-5		1										Blade pitch		λ	15	degrees															
Nocturnal activity factor		fnight	0%										Risk height range		24-199 m																
normal approach			Set to 'normal approach' to use survey data on bird density																												
			Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																												
Stage A																															
Daytime bird density		DA	birds/km2		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		year avge		
Proportion at rotor risk height		Q2R	64.56%		0.00133														0.0001												
At latitude 53.2		Daylight hours per month		252.7		274.3		366.4		418.1		490.3		505.8		508.9		458.2		382.4		330.1		262.0		237.0		4486.2			
		Nighttime hours per month		491.3		397.7		377.6		301.9		253.7		214.2		235.1		285.8		337.6		413.9		458.0		507.0		4273.8			
Stage B																															
No of turbines		T	3																												
Rotor radius		R	87.5		m																										
		Total rotor frontal area m2		72158																											
Nocturnal activity factor		fnight	0%																												
Bird flight speed		v	14		m s-1																										
		Projected number of rotor transits		0.0		4.9		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		year total			
																												5			
Stage C																															
No of blades		b	3																												
Rotation speed		Ω	6.7		rpm																										
Rotor radius		R	87.5		m																										
Max blade width		C	4.01		m																										
Pitch		λ	15		degrees																										
Blade profile		see Blade profile sheet																													
		Single transit risk				upwind		5.44%																							
						downwind		2.79%																							
						weighted mean		4.12%																							
Stage D																															
Proportion of time operational		Qop	88.8%		90.5%		86.9%		85.6%		85.7%		83.1%		80.8%		82.4%		85.1%		89.8%		88.0%		88.9%		year avge				
		Collision rates before avoidance		0.00		0.18		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		year total			
																												0			
Stage E																															
Allow for large array correction?			No																												
Width of windfarm		w	0.7		km																										
		large array correction																													
						Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		per year	
		Collision rates allowing for avoidance				0.00		0.18		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.2			
Avoidance rates modelled				100.00%		0.00		0.18		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.2			
				100.00%		0.00		0.18		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.2			
				100.00%		0.00		0.18		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.2			
		98.00%		100.00%		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.0			

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value			Units	Value			Units	Value			Units					
Bird data				Windfarm data				Turbine data								
Species name		Snipe		Site name		Cush WF		Model		E175						
Bird length		L	0.26	Latitude		53.15028		Hub height		111.6						
Wingspan		W	0.455	No of turbines		T	3	Rotor radius		R	87.5					
Bird flight speed		v	16	Width of windfarm		w	0.7	No of blades		b	3					
Flight type, flapping or gliding		flapping						Rotation speed		Ω	6.7					
% of flights upwind/downwind		50%						Max blade width		C	4.01					
Nocturnal activity ranking 1-5		3						Blade pitch		λ	15					
Nocturnal activity factor		fnight	50%					Risk height range		24-199						
normal approach			Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A													
Stage A			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Daytime bird density		DA	birds/km2		0.000166										0.0043	
Proportion at rotor risk height		Q2R	66.14%													
At latitude 53.2		Daylight hours per month		252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2
		Nighttime hours per month		491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8
Stage B			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of turbines		T	3													
Rotor radius		R	87.5 m													
		Total rotor frontal area m2		72158												
Nocturnal activity factor		fnight	50%													
Bird flight speed		v	16 m s-1													
		Projected number of rotor transits		0.0	0.0	0.0	0.0	1.6	169.5	337.5	0.0	0.0	0.0	0.0	0.0	509
Stage C			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total	
No of blades		b	3		Bird length		l	0.26 m								
Rotation speed		Ω	6.7 rpm		Wingspan		w	0.455 m								
Rotor radius		R	87.5 m		Bird flight speed		v	16 m s-1								
Max blade width		C	4.01 m		Flight type		flapping									
Pitch		λ	15 degrees		% of flights upwind/downwind		50%		50%							
Blade profile		see Blade profile sheet														
		Single transit risk		upwind	4.54%											
				downwind	2.20%											
				weighted mean	3.37%											
Stage D			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year ave	
Proportion of time operational		Qop	88.8%	90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%	
		Collision rates before avoidance												year total		
				0.00	0.00	0.00	0.00	0.05	4.74	9.19	0.00	0.00	0.00	0.00	0.00	14
Stage E			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year	
Allow for large array correction?		No														
Width of windfarm		w	0.7 km													
		large array correction														
Avoidance rates modelled				100.00%	0.00	0.00	0.00	0.00	0.05	4.74	9.19	0.00	0.00	0.00	0.00	14.0
				100.00%	0.00	0.00	0.00	0.00	0.05	4.74	9.19	0.00	0.00	0.00	0.00	14.0
				100.00%	0.00	0.00	0.00	0.00	0.05	4.74	9.19	0.00	0.00	0.00	0.00	14.0
		98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.09	0.18	0.00	0.00	0.00	0.00	0.3

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

boxes are for information only, to show variables used at each stage

Value				Units		Value				Units		Value				Units							
Bird data					Windfarm data								Turbine data										
Species name		Snipe			Site name		Cush WF		Model		E175												
Bird length		L	0.26	m	Latitude		53.15028		degrees		Hub height		111.6		m								
Wingspan		W	0.455	m	No of turbines		T	3		Rotor radius		R	87.5		m								
Bird flight speed		v	16	m s-1	Width of windfarm		w	0.7		km		No of blades		b	3								
Flight type, flapping or gliding		flapping									Rotation speed		Ω	6.7		rpm							
% of flights upwind/downwind		50%									Max blade width		C	4.01		m							
Nocturnal activity ranking 1-5		3									Blade pitch		λ	15		degrees							
Nocturnal activity factor		fnight	50%									Risk height range		24-199		m							
normal approach				Set to 'normal approach' to use survey data on bird density																			
				Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																			
Stage A					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge						
Daytime bird density		DA	birds/km2			0.0122											0.0103		0.00133		0.0020		
Proportion at rotor risk height		Q2R	61.54%																				
At latitude 53.2		Daylight hours per month			252.7	274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2						
		Nighttime hours per month			491.3	397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8						
Stage B					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total						
No of turbines		T	3																				
Rotor radius		R	87.5 m																				
		Total rotor frontal area m2			72158																		
Nocturnal activity factor		fnight	50%																				
Bird flight speed		v	16 m s-1			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total					
		Projected number of rotor transits			0.0	0.0	0.0	0.0	110.0	92.3	12.2	0.0	0.0	0.0	0.0	0.0	214						
Stage C					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total						
No of blades		b	3			Bird length		l	0.26 m														
Rotation speed		Ω	6.7 rpm			Wingspan		w	0.455 m														
Rotor radius		R	87.5 m			Bird flight speed		v	16 m s-1														
Max blade width		C	4.01 m			Flight type		flapping															
Pitch		λ	15 degrees			% of flights upwind/downwind		50%		50%													
Blade profile		see Blade profile sheet																					
		Single transit risk			upwind	4.54%																	
					downwind	2.20%																	
					weighted mean	3.37%																	
Stage D					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge						
Proportion of time operational		Qop	88.8%			90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%						
		Collision rates before avoidance														year total							
		0.00			0.00	0.00	0.00	0.00	3.18	2.58	0.33	0.00	0.00	0.00	0.00	0.00	6						
Stage E					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year						
Allow for large array correction?		No																					
Width of windfarm		w	0.7 km																				
		large array correction																					
Avoidance rates modelled		100.00%			0.00	0.00	0.00	0.00	3.18	2.58	0.33	0.00	0.00	0.00	0.00	0.00	6.1						
		100.00%			0.00	0.00	0.00	0.00	3.18	2.58	0.33	0.00	0.00	0.00	0.00	0.00	6.1						
		100.00%			0.00	0.00	0.00	0.00	3.18	2.58	0.33	0.00	0.00	0.00	0.00	0.00	6.1						
		98.00%			0.00	0.00	0.00	0.00	0.06	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.1						

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green

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Value				Units	Value				Units	Value				Units						
Bird data				Windfarm data				Turbine data												
Species name		Snipe		Site name		Cush WF		Model		E175										
Bird length		L	0.26	m		Latitude		53.15028		degrees		Hub height		111.6	m					
Wingspan		W	0.455	m		No of turbines		T	3				Rotor radius		R	87.5	m			
Bird flight speed		v	16	m s-1		Width of windfarm		w	0.7		km		No of blades		b	3				
Flight type, flapping or gliding		flapping										Rotation speed		Ω	6.7		rpm			
% of flights upwind/downwind		50%		50%								Max blade width		C	4.01		m			
Nocturnal activity ranking 1-5		3										Blade pitch		λ	15		degrees			
Nocturnal activity factor		fnight	50%										Risk height range		24-199		m			
normal approach				Set to 'normal approach' to use survey data on bird density Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A																
Stage A																				
Daytime bird density		DA	birds/km2		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge		
Proportion at rotor risk height		Q2R	59.63%		0.00244										0.00299		0.000665		0.0005	
At latitude 53.2		Daylight hours per month		252.7		274.3	366.4	418.1	490.3	505.8	508.9	458.2	382.4	330.1	262.0	237.0	4486.2			
		Nighttime hours per month		491.3		397.7	377.6	301.9	253.7	214.2	235.1	285.8	337.6	413.9	458.0	507.0	4273.8			
Stage B																				
No of turbines		T	3																	
Rotor radius		R	87.5		m															
		Total rotor frontal area m2		72158																
Nocturnal activity factor		fnight	50%																	
Bird flight speed		v	16		m s-1		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		17.2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.7	0.0	4.6	45	
Stage C																				
No of blades		b	3				Bird length		l	0.26		m								
Rotation speed		Ω	6.7		rpm		Wingspan		w	0.455		m								
Rotor radius		R	87.5		m		Bird flight speed		v	16		m s-1								
Max blade width		C	4.01		m		Flight type		flapping											
Pitch		λ	15		degrees		% of flights upwind/downwind		50%		50%									
Blade profile		see Blade profile sheet																		
		Single transit risk		upwind		4.54%														
				downwind		2.20%														
				weighted mean		3.37%														
Stage D																				
Proportion of time operational		Qop	Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge				
		88.8%		90.5%	86.9%	85.6%	85.7%	83.1%	80.8%	82.4%	85.1%	89.8%	88.0%	88.9%	86.3%					
		Collision rates before avoidance														year total				
		0.52		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.14	1				
Stage E																				
Allow for large array correction?		No																		
Width of windfarm		w	0.7		km															
		large array correction																		
		Jan		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year					
		Collision rates allowing for avoidance																		
Avoidance rates modelled		100.00%		0.52		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.14	1.3				
		100.00%		0.52		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.14	1.3				
		100.00%		0.52		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.14	1.3				
		98.00%		0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.0				

COLLISION RISK MODEL

Required input data is in

orange

boxes

Calculated output is in

blue

boxes

green boxes are for information only, to show variables used at each stage

[illegible]

COLLISION RISK MODEL

Required input data is in

orange

boxes

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blue

boxes

green

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