Response to Observations Received

Seven Hills Wind Farm (ABP-313750-22)

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1. INTRODUCTION

MKO have been instructed by the applicant, Energia Renewables ROI Ltd of Mill House, Ashtown Gate, Navan Road, Dublin 15 to prepare a response to the request issued by An Bord Pleanála (the Board) on the 25th of January 2023 in respect of the live Strategic Infrastructure Development (SID) planning application before them for consideration (ref: ABP-313750) regarding the proposed renewable energy development (the Proposed Development) in the townlands of Turrock, Cronin, Gortaphuill, Glenrevagh, Tullyneeny, Bredagh, Cuilleenirwan, Cuilleenoolagh, Curry, Milltown, Tobermacloughlin, Skeavally, Boleyduff, Clooncaltry, Feacle, Cam, Tawnagh, Cornageeha, Pollalaher, Brideswell, Knocknanool, Ballymullavill, Rooskagh, Bellanamullia, Cloonakille, Monksland and Commeen, Co. Roscommon.

The Board did not request responses to specific submissions made to the planning application; rather they invited the applicant to make a submission on the observations received to the application.

As such, this submission sets out the applicant's response to the observations received from statutory consultees followed by thematic responses to observations received from third parties.

This submission is therefore structured as follows:

- Section 1 – Introduction and background to the Proposed Development
- Section 2 – Response to Observations: Statutory Bodies and Third Parties
- Section 3 – Summary and Conclusions

1.1 Background

The applicant sought planning permission from the Board in 2021 for the following Proposed Development, set out in the public notices as follows:

The development will consist of the following:

I. *20 no. wind turbines with an overall ground to blade tip height of 180 metres, a rotor dimeter of 162m and a hub height of 99m, associated foundations, hard-standing areas*
II. *15 no. spoil storage areas at hardstands of turbines no. 1, 2, 3, 4, 5, 6 and 7 (in the townlands of Turrock, Gortaphuill, Cronin, and Tullyneeny) and turbines no. 8, 10, 11, 13, 14, 17, 19 and 20 (in the townlands of Milltown, Cuilleenoolagh, Cloonacaltry, Feacle and Tawnagh)*
III. *Provision of 1 no. permanent meteorological mast with a maximum height of 100 metres for a period of 30 years from the date of commissioning of the entire wind farm*
IV. *Provision of 1 no. 110kV onsite substation in the townland of Cam, along with associated control buildings, MV switchgear building, associated electrical plant, associated security fencing, and equipment and wastewater holding tank*
V. *All underground electrical and communication cabling connecting the proposed wind turbines to the proposed onsite substation and associated control buildings and plant*
VI. *All works associated with the connection of the proposed wind farm to the national electricity grid via underground 110kV cabling from the site to the existing Athlone 110kV substation located in the townland of Monksland. Cabling will be placed within the public road corridor of the R362, R363 and L2047, or on private land*
VII. *Upgrade works to the existing 110kV Athlone substation consisting of the construction of an additional dedicated bay to facilitate connection of the cable*
VIII. *Provision of 2 no. new site accesses north and south from the R363 and upgrade of 1 no. junction south of the R363*
IX. *Provision of new access tracks/roads and upgrade of existing access tracks/roads*
X. *7 no. overburden storage areas*
XI. *2 no. temporary construction compounds*

XII. *Site drainage works*
XIII. *Operational stage site signage*
XIV. *All associated site development works, apparatus and signage*

The application is seeking a ten-year planning permission and 30-year turbine operational period from the date of commissioning of the entire wind farm.

An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) have been prepared in respect of the proposed development and accompanies this planning application.

The planning application was lodged with the Board on the 7th of June 2022 (ref: ABP-313750-22). Initial copies of observations to the planning application were issued to the applicant on the 10th of August 2022, with one additional observation issued on the 25th of January 2023.

The Board requested a submission to observations be made by the 14th of February 2023, however this was extended in agreement with the Board to the 31st of March 2023.

It is the case that the matters raised in observations have been carefully considered by the project team and applicant. The documentation submitted to date demonstrates that the Proposed Development is appropriately located and designed. This submission updated associated drawings and information provided in the accompanying appendices necessary to satisfactorily address the maters raised in the observations received, build on the information lodged to date and should be read in conjunction with the information previously lodged.

The applicant considers the additional information on the effect of the Proposed Development on the environment contained in this submission to be significant and, as such, requests that the Board hold a further period of consultation in respect of same in accordance with section 37F(2) of the Planning and Development Act 2000 (as amended). This information is necessary in order to address the observations made in respect of the planning application.

In this context, the Development Applications Unit (DAU) in its observation of 2nd of August 2022, refers to additional data being available in relation to the Greenland white-fronted goose, Whooper Swan and Black-headed gull “which may assist the Board with its assessment”. No further details are provided in the DAU response regarding the additional data. The applicant contacted the DAU by email on 8th of February 2023 requesting this additional data. The DAU responded on 10th of February 2023 stating that in the case of a live or post-decision development application, it can, in accordance with the statutory provisions, correspond only with the relevant planning authority (the Board in this case), unless the planning authority has specifically instructed the applicant to liaise with the DAU. On that basis, the DAU refused the applicant’s request for the additional data.

In the absence of the additional data referred to in the DAU observation, it has not been possible to respond to the DAU’s submission in full at this time. The applicant wishes to obtain this information referred to by the DAU and have the opportunity once this information has been obtained to respond to same if deemed required, in the interests of fairness and justice. The applicant requests that the Board specifically instruct the applicant to liaise with the DAU to obtain the additional data so that the applicant can determine its nature, extent and utility. It may be the case that the information is already known to the applicant and its ornithological experts due to the comprehensive monitoring campaign undertaken in respect of this project. However, the applicant is keen to be in possession of best scientific evidence and so this needs to be determined.

Once the Board has considered the applicant’s responses to observations, additional data has been provided by the DAU to the applicant and the applicant has responded to this (if such a response is required), the applicant requests that the Board requires it to submit further information in order to address the DAU observation in full. The applicant anticipates that its response to such a further information request will contain significant additional information on the effect of the Proposed Development on the environment to that already submitted such that a further period of public

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consultation will be required in respect of same. It is respectfully submitted that a single further information request and one round of public consultation in respect of all further information would be most efficient and effective for all, in this regard.

2. RESPONSE TO ITEMS RAISED

The planning application lodged included a robust Environmental Impact Assessment Report (EIAR), Natura Impact Statement (NIS) and suite of technical drawings in support of the Proposed Development. Where necessary, additional clarification has been provided here in response to observations made to the planning application.

This section comments firstly on observations from statutory bodies, and then common themes prevailing in observations received from third parties.

2.1 Statutory Bodies

2.1.1 Roscommon County Council

2.1.1.1 Chief Executive's Report to An Bord Pleanála

It is of note that the Chief Executive's report issued in respect of the Proposed Development recommended to Elected Members that the principle of the Proposed Development be endorsed, and no objection was made to a grant of planning permission being issued (subject to conditions). The report concludes:

> "*Having regard to all of the foregoing considerations, it is considered that the proposed wind farm development and associated grid connection is acceptable in principle and accords with relevant national, regional and local planning policy. As a potential renewable energy project of significant scale in County Roscommon, it would provide an opportunity to reduce dependency on non-renewable resources and would assist in achieving a greater degree of energy security than is presently the case. Sufficient evidence has been presented in the application documentation, including in the EIAR, to demonstrate that the development can be undertaken to avoid adverse environmental effects and in accordance with the principles of proper planning and sustainable development.*"

The applicant endorses the Chief Executive's findings in relation to Proposed Development.

2.1.1.1.1 *Planning Department*

Section 10 of the Chief Executive's report includes a planning assessment of the Proposed Development. In relation to national policy, the assessment concludes that "*the proposed wind farm is considered to be compatible with national policy as set out in Project Ireland 2040 – The National Planning Framework…*". At regional level the assessment again considers the proposed wind farm to accord with the provisions of the Regional Spatial and Economic Strategy for the North West Region particularly Regional Policy Objective RPO 4.18 in relation to security of supply, noting that the proposed wind farm is capable of an output of up to 120MW of electricity onto the national grid. Finally in relation to local policy and the Roscommon County Development Plan 2022-2028, the assessment concludes the development is acceptable in principle.

A site-specific assessment in respect of landscape impacts, visual amenity and residential amenity was also undertaken. No objections or concerns were raised in relation to these matters.

Roads and traffic were also considered in the planning assessment. It notes that the proposed grid connection route from the wind farm site to the existing 110kV Athlone substation in the townland of Monksland substation has raised concerns from the Council's Roads Department. The recommendation to An Bord Pleanála in this regard ultimately calls for the integrity of the road network to be *"a central component of this strategic infrastructure project."* The information submitted with the application in relation to the grid connection works proposed and the mitigation set out is considered robust and the applicant remains committed to ongoing engagement with the Roads Department of Roscommon County Council should planning permission be granted. Section 2.1.1.1.2 below considers comments from the Roads Department in more detail.

The applicant endorses the planning assessment set out and welcomes the fact that no objections were raised.

2.1.1.1.2 Roads Department

Appendix 4 of the Chief Executive's report contains the internal consultation on the application from the Council's Roads Department. The Roads Department are supportive in principle of the Proposed Development. They express concerns in relation to the long term effects of works on the R362 and R363 and "*to ensure roads resilience*" make a series of recommendations. Each of these are addressed in turn below: (inter alia)

1. *The applicant should note that the preferred position for the cabling shall be in the verge at least 1.2m from the road edge. This will reduce the impact on the road and the overall cost to the applicant in terms of backfill requirements and the cost of the associated road opening licence... If the application is successful, prior to commencement of the project Roscommon County Council considers it essential that the applicant engage with the council and as part of the process provide a survey of the cabling route along the public roads which will clearly show the road cross sections and the extent of the adjacent available verge.*

   Response: Within the public road corridor 33kV electrical cabling will be required to connect the two clusters of wind turbines, north and south. Engineers for the grid route design, Galetech Energy Services and AECOM, have considered the matters raised and inputted to the responses outlined. In summary, Section 3.6 of Chapter 3 of the EIAR, as lodged, sets out a review of grid connection options. This was undertaken to establish the most appropriate solution for connecting the proposed wind farm to the national electricity network. Two options were considered in detail and in each case, it was concluded that the most suitable method for connecting to the Athlone 110kV substation in Monksland was via the installation of the grid infrastructure within or along the alignment of regional and local roads. Option 1 – along the R363, R362 and L2047 – was considered the most suitable route due to avoidance of lands designated for commercial development, avoidance of a fly-over at the M6 motorway and the avoidance of areas which presented an increased geotechnical risk. From here, detailed assessments took place of the existing characteristics of those routes, and it was identified that the grass verges along the routes are not generally of a sufficient width to accommodate the entirety of the works required. As set out in the EIAR at Section 4.3.6 the cable, ducting and trenching specifications provided within the application (Section 4.8.5 of the EIAR) are in accordance with standard EirGrid/ESB specifications to which the design must adhere. Despite this, the applicant is committed to working with the Roads Department, EirGrid/ESB, and private landowners, to achieve the desired design where feasible. The Applicant can also confirm that, in liaison with the Roads Department, requested details relating to the grid connection will be provided as part of the Traffic/Transport Management Plan and as part of a road opening licence application.

   In respect of reinstatement, as detailed in the EIAR at Section 4.8.6.4, for concrete and asphalt/bitumen and road sections, surfaces will be permanently reinstated in accordance with the specification and to the approval of the Local Authority. Reinstatement will comply with the requirements of the Local Authority and the Specification for the Reinstatement of Openings in National Roads and Transport Infrastructure Irelands (TIIs) design standards for both hardstandings and verges. The applicant has demonstrated full commitment to engage with the Local Authority in respect of this matter.

The applicant has no objection to a planning condition being attached to any planning permission which may be issued requiring a survey of the cabling route along with public roads.

2. *Details of the wearing course permanent reinstatement are to be shown on a separate set of drawings with appropriate background mapping for consideration…The applicant is required to consult with Roscommon County Council Road Design Department in advance of resubmitting the revised proposals.*

Response: The applicant has no objection to a planning condition being attached to any planning permission which may be issued requiring engagement with the Roads Department of Roscommon County Council prior to details of the wearing course permanent reinstatement being lodged. Full reinstatement shall also comply with the Specification for the Reinstatement of Openings in National Roads and Transport Infrastructure Ireland's (TII) design standards. It should be noted that electrical communications, ducting and cabling will be at a minimum depth of 750mm and is not, therefore, likely to affect any carriageway re-surfacing, widening or other upgrade works. Such installations are typical in many roads and their presence does not preclude the undertaking of maintenance or upgrade works. Mitigation measures set out in the EIAR (Section 14.1.5.1 of Chapter 14) commit to the provision of turbine component and construction material delivery details prior to the commencement of development, as part of a Traffic/Transport Management Plan, and further commit to the completion of pre- and post-construction pavement and bridge condition surveys along the relevant routes. The applicant can also confirm that the requested details relating to the grid connection will be provided as part of the Traffic/Transport Management Plan and as part of a road opening licence application.

3. *In the event that in the future the proposed infrastructure is required to be relocated to accommodate future road development or improvements along the route, the full costs and responsibility of such relocation shall be borne by the statutory undertaker in charge of the cable and ancillary infrastructure.*

Response: It should be noted that the electrical grid cabling will ultimately become an EirGrid asset and as such the applicant cannot commit to the request set out.

4. *Roscommon County Council roads department are of the opinion that the proposed project will inevitably lead to ongoing carriageway maintenance & repair works long after the defects liability period has expired and require an annual maintenance contribution of €2000/km of affected roadway from the developer.*

Response: The applicant has reviewed the Development Contribution Scheme 2014 (as amended 24th February 2020) of Roscommon County Council. It appears that the request from the Council's Roads Department (noted above) is considered under Section 48(17) of the Planning and Development Act 2000 (as amended), specifically part (e) 'the refurbishment, upgrading, enlargement or replacement of roads, car parks, car parking places, surface water sewers, flood relief work and ancillary infrastructure'. From a review of the Development Contribution Scheme we can see no reference to a required contribution of €2000/km and no category for the types of works involved here (i.e. cable being laid in the public road). There is no basis for the sum set out in item 4 above and as such, without any evidence base provided, the applicant cannot commit to such a contribution. Furthermore, as the 110kV electrical cabling will ultimately become an EirGrid asset, the applicant cannot be held liable. Such costs would typically be over an agreed defects liability period only which is to be determined in discussion with the County Council prior to construction. The applicant cannot commit to an indefinite maintenance contribution.

General Items

The Roads Section have also set out in their response a range of 'General Items' which are noted. Where required, a response/comment on the items raised is set out below. Otherwise it should be interpreted that the applicant is content to accept the requests set out.

- The Board should be clear that a Construction and Environmental Management Plan (CEMP) accompanied the EIAR as lodged (refer to Appendix 4-9). Any monetary matters – such as the appointment of a liaison engineer at a cost to the developer – require full discussion with the Roads Department in the event of a grant of planning permission being issued and cannot be committed to here.
- With regards the Cable Route Conditions set out in the Roads Department's response, the applicant has no objection to the proposed conditions set out. Specifically:
    - Details of cable installation will be submitted to RCC in advance of commencement of works. Details will include works programme, construction details, cross-sections for each road showing location of trench in road and any existing services.
    - Where road closures are required, an application shall be submitted to RCC at least 8 weeks in advance.
    - Where road works speed limits are required, an application shall be submitted to RCC at least 8 weeks in advance. Signs will be erected by the developer.
    - Diversion routes will be maintained whilst any diversion is in place.
    - Traffic management plans will be submitted for each key stage of the works.
    - Pre-condition survey of cable routes will be provided, consisting of a video survey of the full route and photographs at every entrance and boundary structure to be carried out and a copy submitted to RCC. Any damage caused to the road or adjacent properties attributable to the works shall be repaired to its pre-condition survey condition, to the satisfaction of RCC and/or landowner.
    - Pre-condition structural surveys on adjacent properties shall be carried out where necessary.
    - All works shall be in accordance with the TII Specification for Road Works unless otherwise specified.
    - Reinstatement of the trench in local and regional roads shall be in accordance with the latest version of "*Guidelines for the Opening, Backfilling and Reinstatement of Trenches in Public Roads*" (The Purple Book), except where noted otherwise.
    - Reinstatement of the trench in national roads shall be in accordance with the latest version of "*Specification for the Reinstatement of Openings in National Roads*", except where noted otherwise.
    - After temporary reinstatement of the trench:
        - A full width overlay shall be provided on all Local & Regional roads.
        - Reinstatements on national roads will be agreed with TII and RCC

- With regards Equipment and Materials Delivery Route Conditions set out in the Roads Department's response, the CEMP as lodged with the EIAR contains an outline Traffic Management Plan at Section 3.6. A final Traffic Management Plan will be compiled in the event that planning permission is granted, addressing any relevant planning conditions including any additional mitigation measures which may be attached by way of planning condition.

The applicant welcomes the fact that no objection has been raised by the Roads Department in relation to the Proposed Development.

2.1.1.1.3 *Environment Department*

The memorandum provided by the Environment Department of Roscommon County Council is noted.

Water

The Roscommon County Council Chief Executive's Report submission was reviewed, and two points raised in respect of groundwater vulnerability and the Killeglan Public Water Supply (PSW) are addressed below by Hydro Environmental Services Ltd (HES). HES inputted to the project thoughout the project development phase, constraints mapping phase and original EIAR as lodged with the planning application. Wind farm environmental impact assessment in respect of geology, hydrology, hydrogeology, and karst hydrogeology is a core business area for HES presently and also over the past 17 years. Wind farm drainage design/management requires experience both as a civil/drainage engineer, a hydrologist, and as a hydrogeological specialist. HES has these combined experiences and expertise. HES has substantial experience in karst hydrogeology and also in surface water/groundwater interactions. HES has worked on over 120 wind farm projects in Ireland and Northern Ireland. In additional HES have worked on a wide variety of karst-related projects in South and Mid Galway, Roscommon, Tipperary, Laois, Kilkenny, Limerick, Clare, Cork, and Waterford.

In relation to potential impacts on groundwater vulnerability, the Planning Authority Report notes that:

> *"The location of the proposed windfarm is in general in an area of high vulnerability. In the event of poor or improper construction standards being implemented, this has the potential to pose a risk of contamination to a Regionally Important Aquifer. Notwithstanding an average soil depth of 7.4 metres for the proposed development site, where groundwater vulnerabilities range from high to extreme, it is essential that increased control measures are employed for construction and operation activities, particularly where activities relate to hydrocarbons, cleaners and degreasing".*

Response:
A full and detailed response to this item has been provided by HES. The Proposed Development site is situated within a mapped area of high groundwater vulnerability. This vulnerability mapping is completed on a regional basis based on assumptions from broad scale investigation about depth to bedrock, subsoil type, and subsoil permeability.

By contrast, as part of the Proposed Development, the following site-specific, intrusive ground investigations have been completed to inform the relevant parties (geologists, hydrogeologists, and geotechnical engineers) on the site-specific nature of the geology at the Proposed Development site, in order to provide a site-specific baseline for the assessment of potential effects from the Proposed Development within the EIAR, which includes the site-specific groundwater vulnerability.

The following is a list of the site investigations carried out:

- 3 no. geological logs were obtained from Roadstone-Cam Quarry boreholes near the Southern Cluster of the Wind Farm Site;
- 9 no. summaries of geological logs were obtained from Roadstone-Cam Quarry boreholes near the Southern Cluster of the Wind Farm Site (the original logs could not be obtained);
- 3 no. geological logs were obtained for GSI exploration boreholes near the Wind Farm Site;
- 21 no. trial pits were excavated within the Northern Cluster of the Wind Farm Site in June 2010 (with maximum depth of 2.1m);

- 7 no. trial pits were conducted within the Southern Cluster of the Wind Farm Site in April 2011 (with maximum depth of 1.06m);
- 6 no. rotary core boreholes were drilled across the Northern and Southern Clusters of the Wind Farm Site in April 2015;
- Logging of bedrock outcrops and subsoil exposures was carried out at and in the local area near the Wind Farm Site during site visits by HES between January 2020 and May 2021 and mineral subsoils were logged according to BS: 5930;
- 40 no. Geophysical 2D resistivity profiles and 40 no. Seismic refraction profiles were carried across the turbine locations at the Wind Farm Site. This geophysical survey was undertaken by Apex Geophysics between November 2020 and January 2021;
- 6 no. down the hole hammer boreholes were drilled by HES at the Northern and Southern Clusters of the Wind Farm Site in May 2020;
- 16 no. boreholes were drilled by IGSL within the Northern Cluster, on behalf of MWP (Malachy Walsh & Partners - engineering design consultants) in December 2020 – January 2021. Bedrock was encountered in 6 of these 16 no. boreholes;
- 26 no. boreholes were drilled at the Southern Cluster by IGSL in December 2020 – January 2021. Bedrock encountered in 19 of these 26 no. boreholes;
- 10 no. slit trenches were excavated along the proposed grid route by IGSL between 21st May – 02nd June 2021;
- 3 no. down hole hammer boreholes were drilled along the proposed grid route by IGSL between 4th – 6th June 2021;
- 3 no. rotary core boreholes were drilled along the proposed grid route by IGSL between 08th – 12th July 2021;
- 16 no. trial pits were excavated and logged by Malachy Walsh and Partners (MWP) within the Northern Cluster of the Wind Farm Site (including at the proposed met mast) in November 2021 (maximum depth of 3.5m);
- 27 no. trial pits were excavated and logged by MWP within the Southern Cluster of the Wind Farm Site (including at the proposed substation) in December 2021(maximum depth of 3.7m);
- 52 no. PSD analyses were completed on subsoil samples from the 2021 MWP trial pitting;
- 28 no. trial pits were excavated and logged by HES within the Southern Cluster of the Wind Farm Site in December 2021 (maximum depth 2.1m);
- 11 no. trial pits were excavated and logged by HES within the Northern Cluster of the Wind Farm Site in December 2021 (maximum depth 2.0m);
- 38 no. PSD analyses were completed on subsoil samples from the 2021 HES trial pitting; and,
- 12 no. density and permeability tests were completed on subsoil samples from the 2021 HES trial pitting.

The average subsoil depth of 7.4m, with the site data from trial pits frequently recording CLAY within the trial pit logs, places the site within an area of Moderate groundwater vulnerability as per the groundwater vulnerability matrix produced by the GSI (refer to Table 2-1). Notwithstanding this, the potential for impacts on the regionally important aquifer has been defined and assessed within both Chapter 8 and Chapter 9 of the EIAR.

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Table 2-1: Groundwater Vulnerability Matrix

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Potential Impacts relating to the use of hydrocarbons (including fuel oils, solvents and degreasers) at the Proposed Development site have been assessed within Section 8.5.2.4 of the EIAR. The potential sources, pathways and receptors have been identified and a suite of mitigation measures have been introduced, in order to prevent any potential effects, these include:

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Where possible, off-site refuelling will occur at a controlled fuelling station;
- On site re-fuelling of plant will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- On site re-fuelling will be undertaken by suitably trained personnel only under a permit to refuel system;
- Fuels stored on site will be minimised. Storage areas located at the temporary compounds where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- All waste tar material arising from the chipping and resurfacing of the public road portion of the temporary construction access road will be removed off-site and taken to licenced waste facility; and,
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (Appendix4-9 of the EIAR). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

The completed site investigations across the northern and southern clusters are comprehensive, and the entire dataset provides a detailed understanding of the site geology. The wind farm layout, including associated drainage proposals, has been designed and optimised using this geological dataset. In addition, these mitigation measures (listed above) will ensure that "*poor or improper construction standards*" will not occur and that residual effects on the groundwater quality of the underlying regionally important aquifer will not occur.

The report from the Environment Department of Roscommon County Council also comments on the Killeglan PWS stating:

> "*Acknowledgement in the EIAR of the proximity of the development site to the Zone of Contribution for Killeglan Springs public water supply. Contrary to the inference in the EIAR that the Zone of Contribution may not expand to the extent delineated by the Geological Survey of Ireland, the Environment Department suggests, based on the conduit nature of the geology in the aquifer, that the Zone of Contribution may extend beyond the mapped extent*".

Response
No section of the EIAR infers that the delineated Killeglan Spring PWS Zone of Contribution may be smaller than the area mapped by the GSI. By contrast, Section 9.3.7.7 of the EIAR states:

> *"The Killeglan PWS exists in the townland of Rockland, where several springs are mapped by the GSI and on historic 6" mapping. The Zone of Contribution (ZoC) to this spring has been mapped (Appendix 9-4), which encompasses a small area of the Proposed Development Site, near the southern edge of Cam Hill, near the proposed turbine T17. Turbine T18 is not mapped within the*

ZoC, however, the available water level data cannot discount the potential for some groundwater flow from the T18 area occurring in a southerly direction towards Feacle Turlough."

In this instance, HES has acknowledged that observed groundwater levels at Turbine T18 are higher than those within the Killeglan Spring ZOC, and so in effect include this area within the assessment of Killeglan Spring PWS. This assessment is outlined in Section 9.4.2.11 of the EIAR.

The potential impacts on Killeglan Spring have been identified within Section 9.4.2.11 of the EIAR. The impact assessment considers all site data recorded near T16-T18, particularly those data pertinent to the area of the Southern Cluster situated within the Killeglan Spring ZOC.

Section 9.4.2.11 of the EIAR states:

"Winter groundwater levels near T17 measure ~69.5 m OD, while the ground elevation measures~90 m OD. There is ~4.5 - 4.8m of overburden (COBBLES and GRAVEL) at T17 overlying Strong to very Strong fine to medium grained Limestone with no water strikes recorded during the drilling of the site investigation boreholes. This provides a good depth of subsoil protection over an unproductive aquifer zone, where maximum water levels are at least 20m below ground during Winter.

Winter groundwater levels near T18 were dipped by IGSL at ~83 m OD following the initial drilling of rotary core boreholes (this only an indicative water level as water level dipping straight after drilling can be slightly erroneous). The subsoils at T18 are logged as 4.1 - 4.5m of sandy gravelly COBBLES and sandy GRAVEL. The underlying bedrock is logged as Limestone with no fractures noted or groundwater strikes recorded."

The above paragraphs detail the subsoil and bedrock geology at these areas, outside of the Killeglan ZOC and describe an absence of karst conduits, with good Limestone, with no fractures or groundwater strikes observed.

The Killeglan Spring has been clearly identified within the impact assessment contained within Chapter 9 of the EIAR. The impact assessment within Section 9.4.2.11 of the EIAR states no significant effects on the Killeglan Spring PWS will occur and the significant database of site-specific data justifies this conclusion.

Notwithstanding our own assessment, we also point out that Mr. Jer Keohane formed the same conclusion in respect of his independent assessment (on behalf of ABP) for the previous Phase II Seven Hills Wind Farm application, which concluded in relation to the Killeglan Spring:

"With regard to the Killeglan Springs source protection area. There is only slight encroachment of the proposed development into the source protection area. This together with the proposed mitigation measures would in my opinion present no significant risk to the quality of the source."

Cut and Fill

The response from the Environment Department cautions that the exact nature and size of cut and full operations "*may require authorisation in accordance with the provisions fo the Waste Management Act 1996 as amended and associated regulations...Similarly, all excavated material associated with installation of the proposed interconnector (electric cable) will be required to be removed to facilities authorised in accordance with the Waste Management Act 1996 as amended.".*

Response: It is the case that, as set out in Chapter 8 – Land Soils and Geology of the EIAR lodged, a limited amount of spoil material will be stored around each turbine hardstand with the remainder transported directly for disposal within the proposed disposition areas as detailed in the dedicated Spoil

Management Plan included at Appendix 4-7. In some areas of the site of the Proposed Development excavated material will be placed temporarily alongside access roads or used for landscaping. Placement of spoil alongside access roads and hardstands is set out in the EIAR as lodged at Section 4.3.4.2, and a dedicated Spoil Management Plan is included at Appendix 4-7 of the EIAR. In relation to the underground grid connection cabling specifically, any spoil resulting from works within the wind turbine clusters will be utilised on site as set out above. The 110kV electrical cabling and 33kV electrical cabling located in the public road corridor is addressed in detail at Section 4.8.5 and 4.8.6 of Chapter 4- Description of the Proposed Development of the EIAR as lodged. In relation to the 110kV cable trenching, the top layer of soil or road surfacing will be removed and stockpiled separately for reuse. Waste tar material arising from the chipping and resurfacing of the public road portion of the temporary construction access road will be removed off-site and taken to a licenced waste facility. Detail regarding waste management is set out at Section 3.10 of the Construction and Environment Management Plan (CEMP) included at Appendix 4-9 of the EIAR as lodged.

Ecology and Ornithology

The Environment Department of Roscommon County Council note the following in relation to ornithological matters:

1. *"Ornithological survey appears to demonstrate low interconnectivity between turloughs in the aera – this would not have been indicative in past surveys."*
2. *"Some consideration that all turloughs and more permanent water bodies are largely one shared unit is prudent due to the high mobility of bird life especially in relation to migratory species, and wintering birds/wildfowl."*

Response: Chapter 6 of the EIAR as lodged, prepared by SLR Consulting who have also inputting to this submission, does not state that there is low connectivity between wetlands in the area. Indeed, the assessments presented are based on the precautionary assumption that all waterbirds recorded during surveys at the site are likely to represent qualifying interests for one of the surrounding designated sites. By definition, this means that waterbirds would have to regularly move between water bodies within the wider area.

As set out in the response to the DAU's comments regarding the assessment of impacts at a landscape level and ex situ impacts, Section 7.3.1.1 of the EIAR sets out the approach to identifying connectivity between the site and the designated sites in the surrounding area. The approach taken in the EIAR assumes that all relevant waterbird species recorded at or close to the proposed development site form part of nearby designated site populations (where the site lies within the core foraging range of the relevant species). The evaluation of ornithological receptors presented in Table 7-9 in the EIAR and the assessment of impacts are subsequently made on that basis. A similar approach is also adopted in the NIS. Potential impacts on bird populations using the surrounding turloughs and more permanent water bodies have therefore been fully assessed within the EIAR and NIS.

As set out above, the assessment presented in the EIAR and NIS is based on the assumption that waterbird movements between wetlands are likely to take place and therefore that the bird populations using the surrounding wetlands are interlinked. However, for these populations to be significantly affected by the Proposed Development, waterbirds would have to be subject to significant displacement, collision or barrier effects at the proposed development site. In the absence of significant displacement, collision or barrier effects there can be no significant effects on bird populations using the surrounding turloughs and more permanent water bodies.

All of these potential effects have been considered in detail, both for the project alone and in combination with other plans or projects, in the EIAR and NIS (see Sections 7.5.3 – 7.5.6 of the EIAR and Sections 6.1.5 – 6.1.9 and 8.3 of the NIS). No significant displacement or barrier effects are likely, and the only potentially significant effects identified by the EIA relate to potential collision effects on non-breeding curlew and breeding black-headed gull. However, neither of these species represent qualifying interests for nearby European sites and therefore these potential collision effects will not affect the integrity of nearby European sites. Additional survey data and assessment provided with these responses (see response to DAU comments for further detail) support the findings of the EIAR and NIS.

In addition, the matter of botanical surveys is raised in so far as "*The botanical surveys indicate the potential for the site to hold other species of value in the context of Lepidoptera species (butterflies and moth).*"

Response: As set out in Chapter 6 of the EIAR as lodged, as there is a known occurrence of the marsh fritillary butterfly in the area, this species was focused on during site visits with dedicated surveys also undertaken. In addition the Peacock butterfly, Small tortoiseshell butterfly and Speckled wood butterfly was commonly recoded within the survey area. Moths were also recorded during multidisciplinary walkover surveys.

Dust

The Environment Department call for a dust monitoring programme to "*be agreed with the local authority for all stages of the development and agreed mitigation measures should form consideration of the proposed development.*"

Response: Dust is addressed at Chapter 10 of the EIAR as lodged. Mitigation during the construction phase is set out which includes:

- In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, substation, temporary construction compounds and overburden storage areas to ensure dust does not cause a nuisance. If necessary, de-silted water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down roads and site compound to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.
- All plant and materials vehicles shall be stored in dedicated areas (on site).
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.
- Turbines and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary.
- The transport of construction materials which may have the potential to generate dust will be undertaken with tarpaulin cover or similar, where necessary.
- The transportation of dry excavated material from the site to the designated on-site overburden storage areas, which may have potential to generate dust will be minimised. If necessary, excavated material will be dampened prior to transport to the overburden storage areas.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-9). The CEMP includes dust suppression measures, such as the implementation of wheel washing, dedicated storage areas for plant and machinery and use of de-silted water from stilling ponds to dampen down roads and site compound to prevent the generation of dust where necessary.

Within the CEMP proposed dust control measures set out include:

- Any site roads with the potential to give rise to dust will be regularly watered and dampened down with water taken form onsite stilling ponds, as appropriate, during dry and/or windy conditions;

- The designated public roads outside the site and along the main transport routes to the site will be regularly inspected by the ECoW for cleanliness, and cleaned as necessary;
- Material handling systems and material storage areas will be designed and laid out to minimise exposure to wind;
- Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods;
- Water misting or bowsers will operate on-site as required to mitigate dust in dry weather conditions;
- If necessary, water will be taken from the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and the temporary site compound to prevent the generation of dust.
- Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.
- The transport of soils or other material, which has significant potential to cause dust, will be undertaken in tarpaulin-covered vehicles where necessary;
- All construction related traffic will have speed restrictions on un-surfaced roads to 20 kph;
- Daily inspection of construction sites to examine dust measures and their effectiveness.
- When necessary, sections of the haul route will be swept using a truck mounted vacuum sweeper; and,
- All vehicles leaving the construction areas of the site will pass through a wheel cleansing area prior to entering the local road network.

Should planning permission be granted, as part of the finalised CEMP a Dust Management Plan will be prepared in line with the comments from the Environment Department.

Noise and Vibration

Nosie and vibration is raised by the Environment Department of the Council with regards the construction phase and potential impact on local communities, with particular emphasis placed on potential increased traffic movements, from excavation of soil overburden and in some instance bedrock. It raises the extraction methods for bedrock excavation and rock breakers. It further states *"vibration and noise monitoring should be carried out at the nearest sensitive receptors to such activities at the construction phase. Wind farms at the operation phase should abide by current noise control measures detailed in the national guidance documents."*

Response: Noise and vibration have been carefully assessed in relation to the Proposed Development – refer to Chapter 11 of the EIAR as lodged. The assessment includes for typical construction noise levels, resulting from, for example excavator mounted rock breakers. No rock breaking works are likely to occur within 60m of the nearest noise sensitive location. During the construction phase and per Section 11.5.2.1.2 of Chapter 11 of the EIAR the following is stated: "*considering the low levels of vibration close to construction sources, the dissipation of vibration over distance, and the temporary nature of rock breaking, there will be no vibration impact on sensitive locations in the area surrounding the Proposed Development.*" The assessment concludes that there will be no significant vibration impacts associated with the construction of the Proposed Development and that no specific mitigation measures will be required. It is recommended however that vibration from construction activities will be limited to the values set out in Section 11.4.1.3 of Chapter 11.

Construction phase mitigation measures in relation to noise are set out at Section 11.5.4 of the EIAR and include:

"While it was concluded in Section 11.5.2 that there will be no significant noise impacts associated with the construction of the Proposed Development and that no specific mitigation measures were required, the following best practice mitigation measures from BS5528-1 standard will be implemented for the duration of the construction phase:

- *limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;*
- *establishing channels of communication between the contractor/developer, Local Authority and residents;*
- *appointing a site representative responsible for matters relating to noise and vibration;*
- *monitoring typical levels of noise and vibration during critical periods and at sensitive locations;*
- *keeping site access roads even to mitigate the potential for vibration from lorries.*

Furthermore, a variety of practicable noise control measures will be employed. These include:

- *selection of plant with low inherent potential for generation of noise and/ or vibration;*
- *placing of noise generating / vibratory plant as far away from sensitive properties as possible within the site constraints, and;*
- *regular maintenance and servicing of plant items.*

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. The following list of measures will be implemented on site, to ensure compliance with the relevant construction noise criteria:

- *No plant used on site will be permitted to cause an on-going public nuisance due to noise.*
- *The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.*
- *All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.*
- *Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.*
- *Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.*
- *Any plant, such as generators or pumps, which is required to operate close to NSL's outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.*
- *During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Section 11.3.2 using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.*
- *The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 07:00hrs and 19:00hrs Monday to Friday and 8:00hrs and 13:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it will be necessary on occasion to work outside of these hours.*

Should rock-breaking be employed, the following are examples of measures that will be implemented, where necessary, to mitigate noise emissions from these activities:

- *Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.*
- *Ensure all leaks in air lines are sealed.*
- *Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.*
- *Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.*
- *Air overpressure from a blast is difficult to control because of its variability, however, much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.*
- *Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 in relation to blasting operations.*

The methods used to minimise effects may consist of some or all the following:

- *Restriction of hours within which blasting can be conducted.*
- *A publicity campaign undertaken before any work and blasting starts (e.g. 48 hours written notification).*
- *The firing of blasts at similar times to reduce the 'startle' effect.*
- *On-going circulars informing people of the progress of the works.*
- *The implementation of an onsite documented complaints procedure.*
- *The use of independent monitoring by external bodies for verification of results.*
- *Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.*

An assessment of the operational phase noise levels has been undertaken in accordance with guidance as outlined in Section 11.3.2.2 of Chapter 11. The findings of the assessment confirm that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations and therefore no further specific mitigation measures are required. However, in order to ensure the long-term protection of residential amenity and the avoidance of significant noise effects, the applicant accepts the imposition of a planning condition as follows:

"The operation of the subject development, by itself or in combination with other permitted wind energy developments, shall not result in turbine noise emissions when measured externally at nearby noise-sensitive locations, which exceed:

- *40 dB LA90,10min for daytime periods (07:00hrs – 23:00hrs) at integer wind speeds with background noise levels of less than 30 dB LA90,10min;*
- *45 dB LA90,10min for daytime periods (07:00hrs – 23:00hrs) at integer wind speeds with background noise levels of greater than or equal to 30 dB LA90,10min or a maximum increase of 5 dB above background noise (whichever is higher);*
- *43 dB LA90,10min for night-time periods (23:00hrs – 07:00 hrs) or a maximum increase of 5 dB above background noise (whichever is higher).*

These turbine noise emission limits apply at any noise-sensitive location which is lawfully existing or has planning permission at the date of this permission.

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At noise-sensitive receptors where the resident is financially involved with the subject development, the maximum wind turbine noise emissions (in combination with other permitted wind energy developments) shall not result in turbine noise emissions when measured externally of 45 dB LA90,10min or a maximum increase of 5 dB above background noise (whichever is higher) for all periods.

The determination of the of turbine noise emissions shall be undertaken in accordance with an assessment protocol to be submitted to and approved in writing by the Local Planning Authority prior to the construction of the wind energy development.

The results of the initial noise compliance monitoring shall be submitted to and agreed in writing with the planning authority within 12 months of the commissioning of the wind farm."

2.1.1.2 Member Recommendations

Document 2 of the Chief Executive's report contains Members Recommendations which have been considered here as part of this response.

1. *If the project proceeds, that any household within a 3km radius of a wind turbine would receive free electricity*

Response: The electricity generated from the wind turbines, if granted, will be fed directly to the national grid via the existing 110kV Athlone substation in Monksland. Control of electricity from there to the wider public is not a matter the applicant can control. The community benefit fund as included in the *Community Consultation Report* submitted with the planning application at Appendix 2-2 of the EIAR, clearly states that the community fund will prioritise households within 1km of the wind turbines by offering electricity bill payers an annual contribution of €1,000 towards their electricity usage.

2. *In the event of a wind turbine being erected, that an independent agency will be available, when an issue arises, to immediately identify the problem and get an immediate solution.*

Response: The recommendation is not specific with regards to a particular issue, making a response difficult. As outlined below at Section 2.2.10 Community Engagement, the team and dedicated Community Liaison Officer (CLO) remain available and will continue to be so over the course of development, construction and operation of the Proposed Development (should planning permission be granted), to respond to any queries from members of the public.

3. *If the development proceeds, that the maximum height of a turbine is 120 metres and that the Community Benefit Fund be increased to €500,000 for local community projects.*

Response: The planning application lodged with the Board seeks planning permission for 20 no. wind turbines with an overall ground to blade tip height of 180 metres. The design parameters set out within the planning application are considered to best-reflect the most suitable candidate turbine on the market at the time of application, to achieve maximum output from the zoned wind energy site. To reduce the overall height (and associated parameters) of the turbine proposed would not represent best use of the designated lands in question in a time of climate crises.

The community benefit fund as included in the Community Consultation Report submitted with the planning application at Appendix 2-2, will invest in excess of €300,000 a year in local community projects. This is based on a minimum of €16,000 per turbine per annum for the lifetime of the project. The allocation of grants will commence one year after the start of commercial operation. The fund will prioritise households within 1km of the wind turbines by offering electricity bill payers an annual contribution of €1,000 towards their electricity usage.

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4. *Anyone living within a distance of 10 x height of a turbine should be entitled to seek relocation compensation equivalent to the value of their current property, should it be affected by the turbine.*

Response: The Member Recommendation is not specific with regards what affect might arise in the context of this Recommendation. There is no onus on any wind energy developer within the County to consider or offer relocation compensation to any individual. Should the Proposed Development be granted planning permission, a range of mitigation measures as set out in the EIAR as lodged will be actioned as necessary where matters which affect residential amenity might arise.

5. *The setback distance of the turbines from any residential property to be 1.5km.*

Response: The closest third-party dwelling to the Proposed Development is located approximately 724m from the nearest proposed turbine (T8), i.e. greater than the recommended setback distance (i.e. 4 times the tip height, 720m), as per the Draft Revised Wind Energy Development Guidelines (Department of Housing, Planning and Local Government, December 2019 (currently out for public consultation)). There is therefore no rationale to increase this setback distance to 1.5km. All mitigation measures as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in the EIAR as lodged will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the Proposed Development works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

2.1.2 Transport Infrastructure Ireland (TII)

Proposed Loadings

Transport Infrastructure Ireland (TII) has outlined their opinion in their observation on the application that an assessment review (by the applicant/developer) of all national road structures concerned is required to confirm that all the structures can accommodate the proposed loading associated with the delivery of turbine components where the weight of the delivery vehicle and load exceeds that permissible under the Road Traffic Regulations.

Response: In response to TII's concern regarding the importance of undertaking an assessment of the road network along the haul route, we recognise and are in agreement with TII in that it is always necessary to evaluate structures along the delivery routes for wind turbine components. The applicant commits to preparing a Transport Route Structural survey of the necessary route pending the decision of the application, which can be attached by way of a planning condition should planning permission be granted. This survey will be carried out prior to the construction stage when the final details of the delivery process are agreed with the wind turbine manufacturer.

Consultation Requested

TII requests that the applicant shall consult with any relevant Public-Private Partnership (PPP) Concession companies, Motorway Maintenance and Renewal Contracts (MMaRC) and local road authorities.

Response: The applicant can confirm that all relevant stakeholders will be consulted with prior to the delivery of turbine components.

Abnormal Weight Loads

TII questions whether 'abnormal weight loads' will feature as part of the Proposed Development and submit that all structures along the national road network to be utilised are subject to an assessment to confirm their capacity any such 'abnormal weight loads'.

Response: Firstly, it is important to note that while the delivery of 'abnormal size loads' are a common feature of wind energy developments (i.e. turbine components), 'abnormal weight loads' are relatively uncommon. Generally, and as will be the case in this instance, the appointed specialist transportation contractor will select appropriate delivery vehicles, with a sufficient number of axles, to ensure that loadings do not exceed the limit of 10-tonne per axle. This will ensure that no load will constitute an 'abnormal weight load' and will ensure that the structural integrity and surface condition of the public road network; national, regional and local; is protected. Notwithstanding this, and as set out above, all relevant stakeholders, including local authorities, will be consulted prior to the delivery of turbine components and all necessary licences and permits will be obtained.

With regards to a capacity assessment of all structures along the haul route (national road network), the Applicant reiterates that the proposed development will not involve 'abnormal weight loads' and, accordingly, submits that such an assessment would not be warranted in this instance. However, as part of committed-to consultation with all relevant stakeholders (see above), in the event that a concern is raised in relation to a particular structure, the applicant will ensure that an assessment of that structure is undertaken to confirm its capacity to accommodate vehicles associated with the construction of the proposed development.

N6 Crossing

TII requests that all relevant parties are consulted with, and the relevant consents obtained, relating to the crossing of the N6 by the proposed grid connection.

Response: The Applicant can confirm that TII, the Roscommon County Council Roads Department and the Motorway Maintenance and Renewal Contracts (MMaRC); in addition to any other relevant stakeholder; will be consulted with regarding design and construction proposals at this location.

2.1.3 Geological Survey Ireland (GSI)

As a general comment, we reiterate that all available databases on the GSIs website were used during the preparation of the EIAR for the Proposed Development. Hydro Environmental Services consultants (HES) has extensive wind farm drainage and hydrogeological experience relevant to this project. Wind farm environmental impact assessment in respect of geology, hydrology, hydrogeology, and karst hydrogeology is a core business area for HES presently and also over the past 17 years. Wind farm drainage design/management requires experience both as a civil/drainage engineer, a hydrologist, and as a hydrogeological specialist. HES has these combined experiences and expertise.

HES has substantial experience in karst hydrogeology and also in surface water/groundwater interactions. HES has worked on over 120 wind farm projects in Ireland and Northern Ireland. In additional HES have worked on a wide variety of karst-related projects in South and Mid Galway, Roscommon, Tipperary, Laois, Kilkenny, Limerick, Clare, Cork, and Waterford.

HES work at all stages of wind farm developments including feasibility stage, layout design & preliminary drainage design/planning stage, and also at construction stage.

HES's experience also covers the key area of water quality and drainage controls and mitigation during the construction phase of wind farm developments. HES works at EIAR/planning stage to assist with developing the optimal site layout which involves creating hydrological constraints maps and interaction with geotechnical and ecological specialists and with site designers. HES also provide a follow-on

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consultancy service (if planning is granted and the development proceeds to construction) of detailed drainage design and construction management for drainage during wind farm development/construction stage. This practical on-site experience is invaluable as it has led to development of improved preliminary and detailed drainage layouts and also many improvements/optimisations to standard drainage mitigation measures.

HES also specialises in wetland eco-hydrology. We also complete flood risk assessments for all types of developments across the country.

All these experiences are particularly relevant to the Proposed Development, and they have been applied through the project development phase, the constraints mapping phase, and EIAR preparation work, including the cumulative impact assessment.

Geoheritage

The GSI state the following in respect of Geoheritage in their letter (dated 25th November 2022) to An Bord Pleanála:

> *"With the current plan, there may be potential impacts on the integrity of current CGS's (County Geological Sites), envisaged by the proposed development, should these sites not be assessed as constraints. The proposed development will cause a loss of 3.9ha of the Killeglan Karst Landscape Geological Heritage Site".*
>
> *"The Killeglan Karst Landscape CGS is important because it is unique in the country as an area of lowland, boulder-strewn, limestone glacial karst. It is of national importance and is recommended for future Geological NHA. As such this site should be assessed as an environmental constraint".*
>
> *"In Section 10.6 'Geological Heritage' of the current Roscommon County Development Plan 2022-2028, it is a policy objective of Roscommon County Council to 'Preserve and protect sites of geological importance from inappropriate development where they comprise designated sites or national heritage areas".*
>
> *"Where the integrity cannot be preserved, we ask that careful consideration would be given in design to accommodating preservation of the limestone boulders and that a geological survey be conducted by an appropriately qualified person during construction to record the exposures to strengthen our knowledge and datasets. In addition, the following measures could be considered in order to mitigate against the potential impacts of the development on the CGS:*
>
> - *Turbine locations should be situated outside of the CGSs boundaries. Where this may not be feasible, the turbines should then be located as close to the perimeter of the CGS margins as possible.*
> - *We understand that under the current proposed development there will be a requirement for access and service roads to cross the CGS. These should avoid the Esker in all instances. Where roads are required to cross the site, we would request that these be smaller service roads".*

Geoheritage Response

The issue of Geoheritage, including proximity to the Killeglan Karst Landscape and Castlesampson Esker, was raised in the GSI's two previous submissions at EIA Scoping stage (dated 08th September 2020, and 04th November 2020) of the Proposed Development. Please refer to Section 8.2.3 of the EIAR and also Table 8.1 of the EIAR where those submissions are acknowledged. As such, these landscape features were considered carefully during the design process for the proposed wind farm.

Baseline descriptions of the Killeglan Karst Landscape and Castlesampson Esker are presented in Section 8.3.6.1 of the EIAR.

The Killeglan Karst Landscape (RO015) is designated as a geological heritage site. The southern cluster of wind turbines overlaps with this geological heritage site. A total of 2 no turbines located within the Killeglan Karst Landscape area (T10 and T9). A further 2 no. turbines (T12 and T16) are partially located within the KKL area. The Killeglan Karst Landscape is described within the County Geological Heritage Site Report as *"an extensive area of bouldery terrain in southern Roscommon, the area comprises a number of low, quasi-linear and hummocky ridges".*

The design iterations of the proposed wind farm layout have taken into account the sensitivity of the Killeglan Karst Landscape and engaged in mitigation by avoidance wherever possible. Careful consideration of the limestone boulders has already been incorporated into the layout design. Mitigation measures outlined in the EIAR for the protection of the Killeglan Karst Landscape include:

- Using the paths of existing cleared tracks within the landscape for site access roads and emplacing the turbines on previously cleared lands where possible;
- Locating the turbines as near to the boundary/extent of the Killeglan Karst Landscape as possible, taking into account other design constraints;
- During construction, all vehicle and construction plant operators will be advised of the location of the geological sites and instructed to avoid those areas;
- Exclusions zones will be marked out on the ground to ensure these areas are avoided; and,
- When the above mitigation was taken into account, the Proposed Development (as originally submitted) only accounted for a loss of 4.05ha of the Killeglan Karst Landscape Geological Heritage Site, with an actual area of new disturbance of 2.775ha, or 0.92% of the total area of the Killeglan Karst Landscape CGS (302.57ha total area). (Note these areas have been updated to account for the 29m diameter turbine bases).
- If turbines T9 and T10 were to be omitted, then the directly affected areas reduce to 2.13Ha, with an actual area of new disturbance of 0.853ha, or 0.28% of the total area of the Killeglan Karst Landscape.

As outlined in Section 8.5.2.6 of the EIAR as lodged, the Killeglan Karst landscape will be impacted by the Proposed Development, however, by emplacing the access roads and hardstands in areas that have previously been cleared for agricultural practices, where possible, that disruption will be minimised.

In addition to the above, and as suggested by the GSI, the following additional mitigation is proposed:

- During construction in each area of the Killeglan karst landscape, the works will be surveyed (mapped) and monitored by an appropriately qualified geologist, and that person will have the ability to direct works, and also will record the geology of the glacial environment along the full length of the works. That full geological dataset will be shared with the GSI to provide a record of and strengthen the available knowledge in respect of the Killeglan Karst Landscape; and,
- The GSI will be notified in advance of proposed works within the Killeglan Karst Landscape, and they will be provided access to the site during the construction phase to make their own records and observations of the exposed geology.

The Design Team has also considered the other two mitigation measures suggested by the GSI:

1: *"Turbine locations should be situated outside the CGSs boundaries. Where this is not feasible (all efforts of avoidance should be clearly demonstrated as having been considered), the turbines* *should then be located as close to the perimeter of the CGS margins as possible to minimise or mitigate potential impacts".*

Turbines are proposed within the CGS boundary. As outlined above, the proposed layout has already, through the iterative design process (refer to the first set of bullet points on the previous page), achieved the avoidance and minimisation of potential impact criteria recommended by the GSI.

2: *"We understand that under the current proposed development there will be a requirement for access and service roads to cross the CGS. These should avoid the Esker in all instances. We strongly recommend that haul roads to be used for the delivery of wind turbines to their final Installation locations should not cross the CGS as we understand that these will need to be up to 5m in width, and this will have a negative impact on the integrity of the CGS. Where roads are required to cross the site, we would request that these be smaller service roads where possible and should be kept to the minimum width necessary for service purposes. We note that the proposed final road width would be 5m, however we would hope that the developer would consider a smaller narrower road in areas crossing the CGS as we consider a 5m road width to be a considerable increase on the existing unpaved farm tracks that are already present and would have a negative impact on the Integrity of the CGSs."*

While we note the comments and suggestions set out in this paragraph, we respond as follows:

- A proposed access road crosses the alignment of the mapped Castlesampson esker at one location. This issue is discussed and assessed in Section 8.5.2.6 of the EIAR.

"The northern end of the Castlesampson Esker is situated ~350m south of the nearest turbine location. There is 1 no. proposed access road which bisects two areas of esker deposit, south of T17. There is already a ~6m wide farm road in place which passes between these two deposits, therefore the access road will not lead to any additional widening of the track. Some fill material and local excavations may be required during construction, but as these are being placed on an existing farm track, there will be no effect on the adjacent in-situ esker deposits. The remainder of the Castlesampson Esker deposit will be avoided, with no excavation of the glacial deposits which constitute the esker."

As outlined in the EIAR, at this location where the access track crosses the esker alignment, the esker material has previously been removed, and any proposed works in this area will not affect the integrity of the remaining esker deposits. A plan of the proposed alignment is shown in Figure A.

In respect of the GSI's submissions, we summarise as follows:

- The proximity and overlap with CGSs (Killeglan Karst landscape and Castlesampson Esker), were considered very carefully during the iterative design phase of the proposed wind farm.
- By proposing infrastructure in areas where land reclamation has already been completed, by using existing farm track alignments, and also by working as close to the CGS boundaries as possible, the proposed layout has the least potential impact on the CGSs,
- As noted above, at this stage it is not proposed to alter the layout of the proposed wind farm as a result of the presence of the Karst landscape. Notwithstanding the current climate change targets, zoning of the application site for wind energy within the recently adopted Development Plan, the size and scale of the Proposed Development and its ability to directly contribute in excess of 100 Megawatts of renewable energy to overall contributions targets, should the Board determine otherwise, the applicant is prepared to omit turbines T9 and T10 from the layout currently under consideration;
- Also, the width of the proposed access tracks are fixed by the turbine suppliers to ensure safe and efficient delivery of the turbine components, and cannot be altered;

- All mitigation in respect of the Killeglan Karst Landscape and Castlesampson Esker outlined in the EIAR will be implemented; and,
- In addition, the GSI's additional recommendations regarding geological surveys/monitoring and notification (so they can complete their own geological surveys) are included as additional mitigation/monitoring measures.

Groundwater

In their 25th November 2022 letter, the GSI commented as follows with respect to Groundwater:

> *"In the area there is a groundwater drinking water abstraction for which there is a zone of contribution/source protection area: Killeglan Public Water Supply- Tobermore Spring. Key to groundwater protection in general, and protection of specific drinking water supplies is preventing ingress of runoff to the aquifer. Design of the windfarm drainage will need to be cognizant of the Public Water scheme and the interactions between surface water and groundwater as well as run-off. Appropriate design should be undertaken by qualified and competent persons to include mitigation measures as necessary.*
>
> *Any excavation/cuttings required should ensure that groundwater flow within the zones of contribution to the groundwater abstraction points is not disrupted, resulting in diminished yields. The effect of any potential contamination / dewatering as a result of the windfarm development would need to be assessed".*
>
> *"In Chapter 9 'Water' we note "Furthermore, the mitigation measures (including drainage design measures) outlined in Sections 9.4.2.1-9.4.2.7, which will protect groundwater quality and quantity, will mean there will be no net effect on any groundwater from the T17 area and other areas identified which may flow towards Killeglan PWS."*

Response:

As outlined by the GSI, mitigation measures relating to the protection of the Killeglan Spring, domestic groundwater wells and groundwater quality and quantity generally have been proposed in detail within the EIAR, within Sections 9.4.2.1 – 9.4.2.7.

Baseline information on the Killeglan Spring PWS and on groundwater within the EIAR Study Area has been gathered from the Roscommon Groundwater Protection Scheme Report[1] and associated sub-reports, including the Killeglan Water Supply Scheme Groundwater Source Protection Zone Report[2]. While the Roscommon Groundwater Protection Scheme Report was not specifically mentioned in the EIAR (that was an omission on our part), we can confirm it was used as reference material for the baseline assessment. The Killeglan Water Supply Scheme Groundwater Source Protection Zone Report is referenced and is also included in Appendix 9-4 of the EIAR.

The drainage design (Section 9.3.14.1) has incorporated multiple lines of control to prevent any potential impacts on groundwater quality or quantity. As outlined within Section 9.3.14.1 of the EIAR:

> *"Two distinct methods will be employed to manage drainage water within the Proposed Development. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage and recharge patterns. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards settlement ponds prior to controlled diffuse release over vegetated surfaces and*

1 County Roscommon Groundwater Protection Scheme – Main Report, June 2003, Geological Survey of Ireland and Roscommon County Council.
2 Killeglan Water Supply Scheme (Tobermore Spring) - Groundwater Source Protection Zones, April 2003, Geological Survey of Ireland and Roscommon County Council.

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subsequent infiltration through the subsoil. As per the prevailing baseline conditions at the site, there will be no direct discharges to surface waters (as there are none local to the Wind Farm site). During the construction phase all drainage water from works areas (i.e., potential dirty water) will be attenuated and treated to a high quality prior to being allowed to slowly percolate to ground."

The impact assessment within Sections 9.4.2.1 – 9.4.2.7 of the EIAR, relates to the proposed earthworks at the site, the potential effect on groundwater flows/levels due to alteration of recharge, potential effects of dewatering (none proposed), the potential effects of the release of hydrocarbons and/or wastewater during construction, and potential effects from cement-based products. Standard mitigation measures, as well as site-specific mitigation measures, have been included within those sections of the EIAR and they will be implemented at the site, providing the necessary protection to the underlying groundwater aquifer.

In summary, we consider that the issues raised by the GSI in respect of "groundwater" are comprehensively addressed in the submitted EIAR.

2.1.4 Development Applications Unit (DAU)

Comments received from the DAU relate to matters of nature conservation including impact on birds, Special Conservation Interests of Special Protection Areas, bats and impacts on karst features. Each of the points raised are dealt with in turn below.

2.1.4.1 Nature Conservation

Wind Farm Impacts at Landscape Level

> *"The Department notes that the location of the proposed development is situated within a zone of influence of 18 known designated sites of conservation interest, many of which are wetlands, in South Roscommon. It is located on the only high ground in a karst landscape of wetlands. The Department has concerns that the impacts of the proposed windfarm have not been sufficiently assessed at a landscape level to ensure the absence of significant effects to the connectivity of European sites and species with other wetlands and ecological receptors, e.g. not purely focused on designated areas but takes into account connecting features, topography, habitats, ground water hydrology, and the potential impacts of bird movements between the wetlands, both designated and undesignated."*

Response:

Figure 7-1 of Chapter 7 – Ornithology of the EIAR as lodged shows the location of sites designated for their ornithological interest within 15 km of the proposed development site. Section 7.3.1.1 of the Chapter sets out the approach to identifying connectivity between the site and the designated sites in the surrounding area. The approach taken assumes that all relevant waterbird species recorded at or close to the proposed development site form part of nearby designated site populations (where the site lies within the core foraging range of the relevant species). The evaluation of ornithological receptors presented in Table 7-9 in the EIAR and the assessment of impacts are subsequently made on that basis. A similar approach is also adopted in the NIS. Impacts have therefore been assessed at a landscape level that takes into account connectivity between European sites and other wetlands.

As set out above, the assessment presented in the EIAR and NIS is based on the assumption that waterbird movements between wetlands are very likely to take place. However, for these movements to be significantly affected by the Proposed Development, waterbirds would have to be subject to significant displacement, collision or barrier effects at the wind farm proposed development site. In the absence of significant displacement, collision or barrier effects there can be no significant effects on bird species at the landscape scale.

All of these potential effects have been considered in detail, both for the project alone and in combination with other plans or projects, in the EIAR and NIS (see Sections 7.5.3 – 7.5.6 of the EIA Report and Sections 6.1.5 – 6.1.9 and 8.3 of the NIS). No significant displacement or barrier effects are likely and the only potentially significant effects identified by the EIA relate to potential collision effects on non-breeding curlew and breeding black-headed gull. Neither of these species represent qualifying interests for nearby European sites and therefore these potential collision effects will not affect the integrity of nearby European sites. In the absence of potentially significant effects on waterbird species forming part of surrounding designated site populations, it can also be concluded that no significant effects to the connectivity of European sites and other wetlands are likely.

A fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**. The results from the 2021/22 winter surveys were broadly similar to those recorded during previous winter surveys in terms of the suite of species, distribution and abundance of birds recorded.

Collision risk modelling (CRM) carried out to inform the EIA has been updated to reflect the results of the winter 2021/22 surveys (report appended here at **Appendix 1).** Although the updated CRM predicts a relatively high level of mortality for non-breeding black-headed gull (4.405 birds per year) this figure is based on a number of highly precautionary assumptions and actual mortality is likely to be much lower and is not likely to be significant. For all other species the CRM predicted similar levels of mortality to those presented in the EIAR and NIS and the conclusions made in the EIAR and NIS remain unchanged.

Additional nocturnal surveys targeting golden plover and lapwing were undertaken in winter 2022-23 (report appended here at **Appendix 3**). Further details are provided below in relation to specific comments regarding golden plover, but in summary the surveys indicated that numbers of golden plover and lapwing using the proposed development site at night are small and birds are only present occasionally. This confirms the findings reported in the EIAR and NIS.

In summary, the additional survey data and assessment provided with these responses support the findings of the EIAR and NIS. The conclusion that no significant effects to the connectivity of European sites and other wetlands are likely therefore remains unchanged.

Additional Data

> " *"The proposed turbine development is in close proximity to a number of European sites, with one of the closest sites, Lough Croan Turlough SAC and SPA, within 1km of the proposed windfarm, being an important site for Greenland White-fronted Geese. They use this site for both feeding and roosting and are known by staff of the Department to fly across the proposed wind turbine site to the River Suck Callows SPA. The site is also important for Whooper Swans and other special conservation interest (SCI) species, which are recorded in the surveys feeding and flying through the proposed windfarm site. The Department is conscious that there is additional data available that is not presented in the impact evaluation, which may assist An Bord Pleanála with their assessment. The DAU submission makes reference to additional data available in relation to Greenland white-fronted goose and whooper swan which is not presented in the assessment."*

Response:

No further details were provided in the DAU response regarding the additional data that the DAU says are available.

The DAU were contacted by email on 8th February 2023 asking whether the additional data referenced in the letter could be provided. The DAU responded on 10th February 2023 stating that in the case of a live or post-decision development application, they may, in accordance with the statutory provisions, correspond only with the relevant planning authority (An Bord Pleanála in this case). The DAU went on to note that an exception can only be made where the deciding authority has specifically instructed the applicant to liaise with the Department in advance of preparing a further information response. Without this the DAU are unable to provide the additional data referred to.

In the absence of the additional data referred to in the DAU letter it is not possible to respond to this comment at this time.

Loss of Annex I Grasslands

> *"The proposed development will result in the loss of approximately 2.7ha of Annex I habitat, calcareous grassland (6210/6210* important orchid sites), outside of European sites. The Department recommends that the rarity and importance of this species-rich calcareous grassland is recognised during the assessment of this application."*

Response:

The site of the Proposed Development is located entirely outside of the Killeglan Grasslands SAC, and the Annex 1 grassland recorded within the Site does not represent QI habitat of the SAC.There will be no loss of QI grassland associated with the SAC, and it has been assessed that the proposed loss of Annex 1 grassland within the Site would have no potential for any significant direct or indirect effects on the QI habitat of the SAC.

The total area of proposed Annex 1 grassland within the site was calculated as 144.6ha, with a 3.5ha (formerly 2.7ha) (2.4% of the total habitat) loss proposed within the site to facilitate the Proposed Development. This represents a comparatively small proportion of the on-site habitat of this nature, and robust habitat restoration measures are proposed within areas of calcareous and agriculturally improved grassland that do not currently conform to Annex 1 status to ensure that there would be a net gain and improved connectivity in this habitat in the long-term (refer to Biodiversity Management Enhancement Plan (BMEP), Appendix 4-5 of EIAR). It is judged that there can therefore be no significant indirect residual effects resulting from the proposed loss of Annex 1 grassland outside the SAC that could affect the condition or integrity of the SAC QI habitat, as is alluded to within the DAU submission.

Detailed botanical surveys of the habitat within the Site of the Proposed Development were carried out to inform the EIAR, and all species recorded were documented; green-winged Orchid (Anacamptis morio, previously Orchis morio) as specifically mentioned in one third party, were not recorded anywhere within the Site, and in addition no botanical species listed under the Flora (protection) Order (as amended 2015), listed in the EU Habitats Directive (92/43/EEC), or listed in the Irish Red Data Books were recorded on the Site. It was noted within the Biodiversity chapter that a single autumn lady's-tresses orchid (Spiranthes spiralis) was recorded at one location (grid ref: 53.433275, -8.177963) over 60 metres to the west of the Proposed Development footprint; this species is listed as "near threatened" as per the IUCN. The majority of the Annex 1 habitat within the site (97.69%) will be retained under the proposals, including the area where the Spiranthes spiralis orchid was recorded, with restoration proposed of non-Annex 1 calcareous grassland to Annex 1 status grassland as compensation to ensure a net gain in habitat within the site to ensure the long-term future of orchid and other grassland species diversity within the site.

Compensation for lost habitat would take place outside the development footprint, within retained areas of calcareous and improved grassland that would be restored to Annex 1 status grassland through appropriate management by the relevant landowners. There would therefore be no loss of areas of compensation habitat during decommissioning of the proposed development. The management of the lands within the site according to the BMEP will ensure the long-term management of these areas of grassland within the Site for biodiversity and will restrict the reclamation of calcareous grassland within the site for agriculture. The habitat compensation strategy under the BMEP has been carefully considered and proposes areas for restoration which would also contribute to increased connectivity between existing areas of species rich grassland. A total area of between approximately 9 – 12 ha (a minimum of three times of the area lost to the footprint) will be created as part of this plan, which will result in a long-term net gain in this habitat within the locality of the Proposed Development.

The restoration of the grassland area where enhancement measures are proposed has been carefully considered with local site-specific objectives and targets as regards the conservation status of species and community present within the Site. The proposed development will ensure the long-term management of retained areas of 6210 Annex 1 grassland (which represents 97.6% of the Annex 1 grassland habitat occurring within the site) and enhanced areas as part of the management proposals, which could otherwise be subject to further agricultural intensification or abandonment at any time, factors that are two of the main threats to 6210 Annex 1 grassland habitat throughout Ireland (Martin et al. 2018[3]).

Areas proposed for management have been selected due to their proximity to adjacent areas of existing, retained areas of Annex 1 calcareous grassland, and the proximity of these habitats with their existing seed bank and mycorrhizal fungal networks present in the soil, all of which will ensure that the measures prescribed within the BMEP to improve and restore the grassland species diversity within these areas will develop the characteristics of local Annex 1 priority calcareous grassland habitat communities. The management proposals within the BMEP have been proposed by the project ecologist of MKO with a full understanding of this habitat type, its regenerative capacity and the management measures required to ensure that the community that develops will conform to the desired Annex 1 6210 priority grassland habitat. A full programme of monitoring of vegetation composition and of soil nutrients/ chemistry will be carried out within lands to be managed under the BMEP, which will ensure that restoration of these areas to target habitat and condition is achieved through appropriate management, and any additional measures proposed and implemented where required. It is fully recognised in the EIAR Biodiversity Chapter and associated BMEP that there would be some temporal delay between loss of Annex 1 grassland during construction and the establishment of the desired vegetative community and stability of this community within management areas, which is estimated as being 3-5 years. Additional habitat restoration has been proposed, totalling 9-12 ha (circa three times that to be lost) of species rich semi-natural grassland, to account for this and to ensure long-term enhancement and net gain in species-rich priority grassland within the Site as a result of the Proposed Development.

Ex-situ Species

> *"The Department has concerns that there is insufficient consideration of species in ex-situ locations, i.e. species that use lands outside of designated areas. Species or habitats that are intrinsically linked to and support the qualifying interests (QIs) or special conservation interests (SCIs) of a European site (SAC/SPA) but that occur outside of that specific European site must also be assessed for potential impacts from the proposed development."*

Response*:*

Section 7.3.1.1 of the EIAR sets out the approach to identifying connectivity between the site and the designated sites in the surrounding area. The approach taken in the EIAR assumes that all relevant waterbird species recorded at or close to the proposed development site form part of nearby designated site populations (where the site lies within the core foraging range of the relevant species). The evaluation of ornithological receptors presented in Table 7-9 in the EIAR and the assessment of impacts are subsequently made on that basis. A similar approach is also adopted in the NIS.

[3] *Martin, J.R., O'Neill, F.H. & Daly, O.H. (2018) The monitoring and assessment of three EU Habitats Directive Annex I grassland habitats. Irish Wildlife Manuals, No. 102. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.*

Impacts on qualifying bird species for designated sites, whilst using areas outside of the designated sites themselves (i.e., whilst using the proposed development site and immediately surrounding land) have therefore been fully assessed within the EIAR and NIS. Potential indirect effects on wetland habitats supporting SPA qualifying species are also assessed (see Section 9.4.2.9.1 of the EIAR). No significant effects are likely for any SPA qualifying bird species and with embedded mitigation in place, no significant effects are predicted in relation to wetland habitats that may support SPA qualifying bird species.

Please also see response to comments regarding the assessment of impacts at a landscape level for further information, which is also relevant to this comment.

2.1.4.1.2 *Landscape Level Assessment*

Designated and Other Wetlands

HES have considered the comments made by the DAU in respect of Designated and Other Wetlands, specifically

> *"The constraints map partly shows the location of the proposed turbines in relation to the winter extent of most lakes and turloughs. It is not at the appropriate scale to really appreciate the location of the proposed windfarm in relation to the extent of the wetland sites, but goes some way to demonstrate the location in relation to the surrounding wetlands. A better representation of the extent of the surrounding wetlands is illustrated in Fig 8-12, but it still omits Commons and Gortaphuill (which overlap the northern turbine cluster), Cornalee and Feacle South Turloughs. (Further representation of wetlands is shown in the Water Chapter Fig 9-4, Local Hydrology Grid connections with water course crossings map)".*

This is a general statement, which raises no specific issue of concern other than the scale of submitted mapping and presentation of information in the EIAR as lodged.

HES provided a hydrological constraints map in Figure 9-13 (Mapped Turloughs near the Proposed Development). This map is at a scale of 1:65,000, required to show the turloughs and the wider development of the Northern and Southern clusters. The two clusters are spread over a large geographical area.

Outside of this mapping, the location and distance of turloughs with respect to the Proposed Development are detailed in the following water related sections within the EIAR:

- Figure 8-12 (Designated Sites Map);
- Figure 9-6 (Groundwater Flooding Map);
- Figure 9-13 (Mapped Turloughs near the Proposed Development);
- Figure 9-14 (SAR Flood Map);
- Figure 9-18 & 9-19 (Groundwater Contour Maps);
- Figure 9-21 (Designated Sites Map);
- Drainage Management Plan (App 4-8);
- Figure H of Appendix 9-1 (Flood Risk Assessment);
- Section 9.3.7.6(Turloughs) of the EIAR; and,
- Table 9-15 (Turloughs near the Proposed Development site).

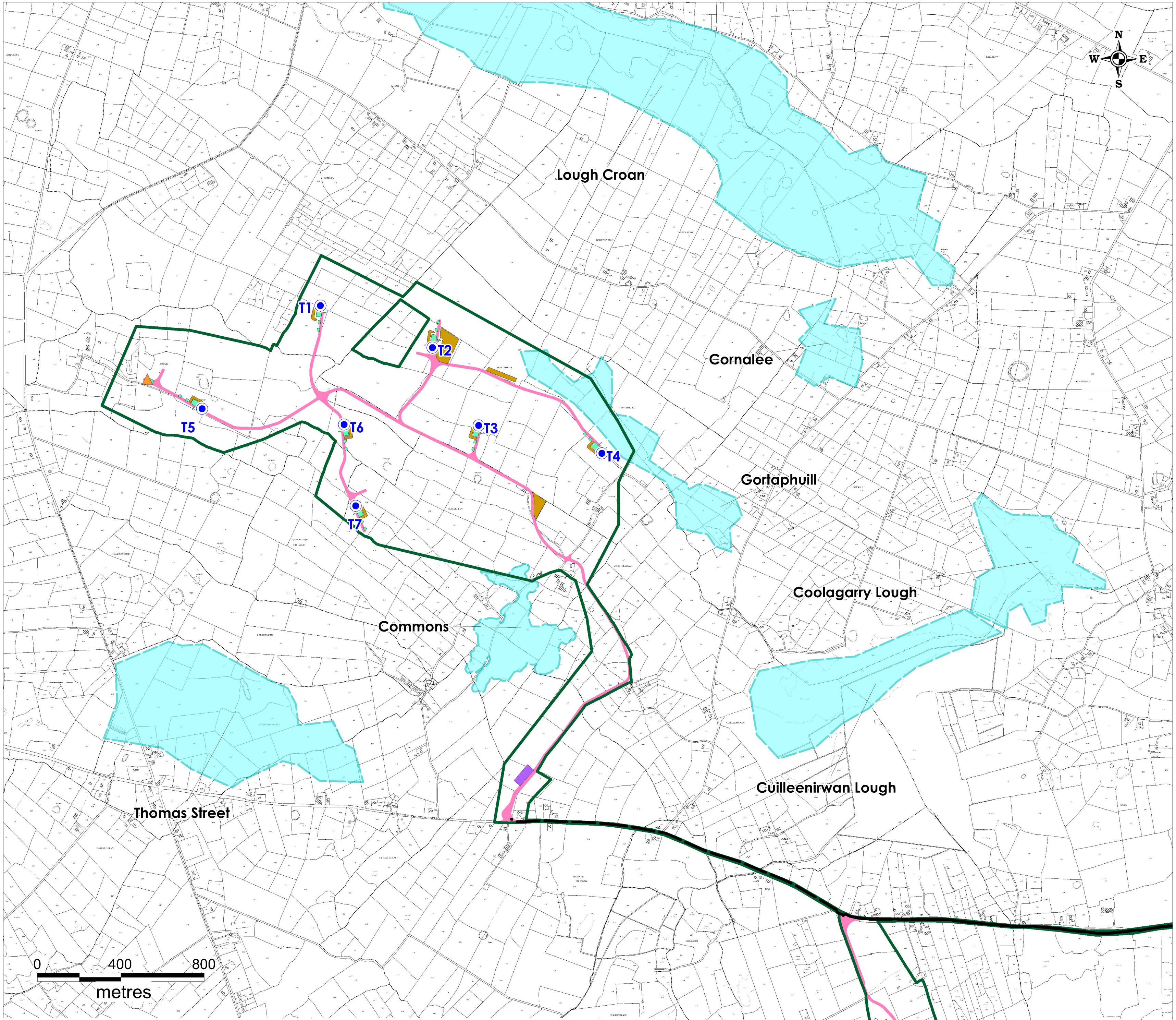
Commons and Gortaphuill turlough do not overlap with the development footprint of the Northern Cluster. There are no turbines located within any mapped turlough area.

The closest turbine to a mapped turlough is T4 which is situated ~50m upgradient of the maximum flood extent of Gortaphuill (as outlined in Section 9.3.5). A cross-section of the separation distance between Gortaphuill turlough and T4 is given in Figure H of Appendix 9-1 (Flood Risk Assessment).

Figure 8-12 (Designated Sites Map) omits Commons and Gortaphuill turlough as these are not designated sites.

In the interest of clarity, Figure 9-13 has been presented at a larger scale and divided between the Northern and Southern Clusters at a scale of 1:25,000. These maps are presented overleaf in Figure 9-13A and Figure 9-13-B.

The word turlough is mentioned 349 times in Chapter 9 of the EIAR. Clearly, turloughs and turlough wetlands have been given considerable and appropriate attention and assessment in the EIAR. Baseline information on turloughs is presented in Section 9.3.7.6, and impact assessment on turloughs is outlined in Section 9.4.2.8 of the EIAR.



Legend

- EIAR Site Boundary
- Proposed Grid Route
- Proposed Turbine Layout
- Proposed Me Mast
- Proposed Substation
- Proposed Temporary Construction Compounds
- Proposed Spoil Storage Areas
- Proposed Access Roads
- Proposed Hardstand
- Turloughs*

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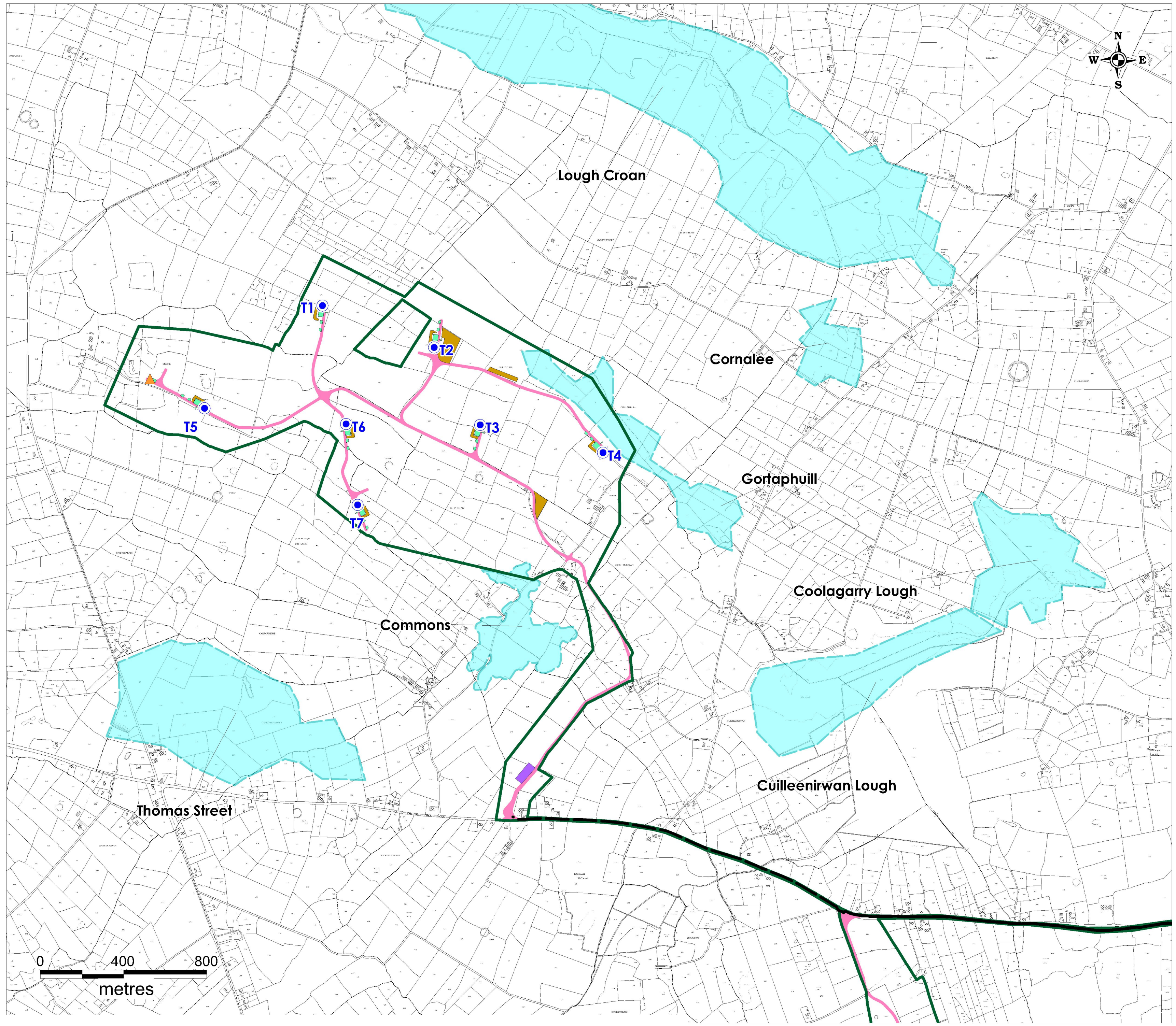
Client: Energia Renewables ROI Ltd	
Job: Seven Hills WF, Co. Roscommon	
Title: Mapped Turloughs near the Proposed Development - Northern cluster	
Figure No: 9-13A	
Drawing No: P1500-0-0323-A3-913A-0A	
Sheet Size: A3	Project No: P1500-0
Scale: 1:17,500	Drawn By: GD
Date: 28/03/2023	Checked By: MG

Figure 2-1: Mapped Turloughs near the Proposed Development (Northern Cluster) (Figure 9-13A of EIAR)



Legend

- EIAR Site Boundary
- Proposed Grid Route
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- Proposed Access Roads
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Sheet Size: A3	Project No: P1500-0
Scale: 1:17,500	Drawn By: GD
Date: 28/03/2023	Checked By: MG

Figure 2-2:: Mapped Turloughs near the Proposed Development (Southern Cluster) (Figure 9-13B of EIAR)

2.1.4.1.3 *Impacts on Birds (QI and non-QI)*

Special Conservation Interests (SCIs) of SPAs

Greenland White-Fronted Geese

> *"It is important to highlight the use of Lough Croan SPA (1.5 km north of windfarm, northern cluster) as an overnight roost for this declining species, with a peak of 267 geese in January 2021. The site forms part of the range of a small wintering flock of Greenland White-fronted Geese, a globally vulnerable scarce winter visitor.*
>
> *The EIAR Birds chapter states "Lough Croan is also a winter roost for Greenland Whitefronted Geese but is located beyond the 1 km survey buffer of the northern and southern cluster layouts. These intervening distances make it very unlikely disturbance or displacement will impact waterfowl and waders." However the known foraging range of this species is up to 8km from the roosting site.*
>
> *The bird survey data did not generate a significant collision risk modelling collision value, however, the report describes Greenland White-fronted Goose (Annex I; EU Birds Directive, SCI of several nearby SPAs) as having high sensitivity to collision. Departmental staff reported agricultural disturbance in some areas of the site, so a lack of records of Greenland White-fronted Geese could have been biased by this."*

Response:

Potential effects on Greenland White-Fronted Geese (GWFG) forming part of the Lough Croan SPA population are assessed in the EIAR and NIS (see Sections 7.5.3, 7.5.4.1.1, 7.5.4.2.3 and 7.5.4.3 of the EIAR and Section 6.1.5 of the NIS). Surveys of the roost at Lough Croan indicated that all observed flights to/from the roost site occurred to the west, north or east, away from the Proposed Development site. Feeding distribution surveys for GWFG recorded no GWFG within 1 km of the Proposed Development site and therefore disturbance to GWFG is unlikely. Collision risk for GWFG was calculated as 0.054 birds per year, which is not significant in the context of background annual mortality. Significant effects on the Lough Croan SPA GWFG population are therefore not likely.

The EIA is based on data from three years of monthly (fortnightly in 2020-21) non-breeding surveys, which is more than the two years required by NatureScot (NS) guidance. The survey data therefore provides a representative assessment of GWFG activity and should more than adequately capture variation between and within years, e.g., in response to changes in agricultural activity between years.

The above notwithstanding, a fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**. The 2021/22 winter surveys of the roost at Lough Croan again indicated that all observed flights to/from the roost site occurred to the west, north or east, away from the proposed development site. Feeding distribution surveys for GWFG again recorded no GWFG within 1 km of the proposed development site and therefore disturbance to GWFG is unlikely. No flights through the proposed development site were recorded during flight activity surveys and therefore the estimate of collision risk is unchanged. The 2021/22 survey data therefore support the previous conclusion that significant effects on the Lough Croan SPA GWFG population are not likely.

Whooper Swan

The DAU submission highlights the importance of undesignated sites (grassland feeding habitat and wetland roost sites) for whooper swans which are associated with European sites.

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"A notable outcome of the 2020 Whooper Swan census was that there was considerable variation in almost all counties when compared with the 2015 census. Less than half of the Republic's 14,467 Whooper Swans were recorded on SPAs during the census, as birds feeding on grasslands away from wetland sites will return to nearby wetlands (including SPAs) to roost at night. This illustrates the importance of undesignated sites (grassland feeding habitat and wetland roost sites), which are associated with designated European sites.

Although Whooper Swan are not special conservation interests of the SPAs of Lough Croan and Four Roads Turloughs, Departmental staff have reported movements of Whooper Swans between these turloughs and the River Suck Callows SPA, where they are a qualifying interest of the SPA. So potential ex-situ impacts to Whooper Swans must be considered in these areas as they potentially impact the SPA interest of the River Suck Callows SPA.

The Whooper Swan International Census highlights the tendency of Whooper Swan to graze in grasslands but roost in wetlands, and to regularly move between sites, both designated SPAs and other sites, due to land use changes. Notwithstanding the conclusions presented in the EIAR that there would be no significant impact to Whooper Swan (data collected and collision risk modelling carried out in accordance with best practice), this does not take into account changes to their flight lines that might occur due to future land use changes. This makes it difficult to defend very definitive conclusions about Whooper Swan usage of sites, and expected consistency of flight paths over an extended period of time."

Response:

Use of undesignated sites by whooper swans is fully considered in the EIAR and NIS (see Sections 7.5.3, 7.5.4.1.1, 7.5.4.2.2 and 7.5.4.3 of the EIAR and Sections 6.1.6 of the NIS). A precautionary approach is adopted whereby all whooper swans recorded are considered to form part of nearby SPA populations. Feeding distribution surveys for whooper swan recorded only small numbers of whooper swans within 500 m of the Proposed Development site and collision risk for whooper swan was calculated as 0.228 birds per year, which is not significant in the context of background annual mortality. Significant effects on whooper swan, including whooper swans forming part of the River Suck Callows SPA population, are therefore not likely. It is impossible to meaningfully predict how bird activity could be affected by future land use changes (currently unknown) and it is not reasonable to expect this to be included in the EIA. As noted above for GWFG, the assessment was based on three years of winter survey data, which is more than the two years required by NatureScot (NS) guidance. The survey data therefore provide a representative assessment of whooper swan activity and more than adequately capture variation between and within years.

Despite this, as noted above for GWFG, a fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**.

Feeding distribution surveys for whooper swan in winter 2021/22 recorded no whooper swans within 500 m of the proposed development site. 16 whooper swan flights were recorded during flight activity surveys, although most flights were outside the proposed development site. The updated collision risk for whooper swan (updated CRM report appended here at **Appendix 1**) is calculated as 0.1585 birds per year, which is not significant in the context of background annual mortality. The 2021/22 survey data therefore support the previous conclusion that significant effects on whooper swan, including whooper swans forming part of the River Suck Callows SPA population, are not likely.

<u>Breeding Waders/Curlew</u>

The DAU submission states that insufficient attention has been paid to potential impacts on breeding curlew. The DAU response goes on to suggest that breeding lapwing and redshank are also subject to insufficient attention in the EIA:

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"However, in the breeding season, rare breeding Curlew were noted in the EIAR as one of the target species, and small numbers of Curlew were recorded in flight over the windfarm during two breeding seasons (4 in 2019; 3 in 2021, Table 7.7). This seems to be mostly around Lough Feacle Turlough, close to the southern cluster. There have been Curlew nest sites in the area, approximately 3 km to the east during 2020 and 2021 and Lough Ree SPA is also a breeding stronghold of this severely declining species.

The reports concentrate on using the collision risk modelling data to look at the potential impacts on the wintering populations of the special conservation interests (SCI) of the SPAs and on local wintering populations of Curlew. Curlew is not an SCI of any of the five SPAs, however, given the very small numbers of breeding Curlew pairs remaining in Ireland (National Survey 2015-17: 138 pairs; 2018: 81 pairs; 2019: 69 pairs), and a collision calculation of one collision occurring every ten months, insufficient attention has been paid to the potential impact of the proposed development on this declining breeding species.

This similarly applies to the declining populations of breeding waders, Lapwing and Redshank. Departmental staff observed a Lapwing pair in 2020 at Feacle Turlough, however the breeding wader survey found none."

Response:
Potential effects on curlew are assessed in the Chapter 7 – Ornithology of the EIAR (see Sections 7.5.3 and 7.5.4.2.8). The DAU submission refers to records of breeding curlew approximately 3km to the east and within Lough Ree SPA (approximately 8km to the east). However the numbers of curlew recorded during the breeding season surveys (2019-2021) were very low, with no evidence of breeding recorded within at least 500m of turbine locations. Significant effects on curlew during the breeding season are therefore not likely.

The DAU submission suggests that impacts on non-breeding birds could affect the local breeding curlew population. The EIAR clearly states the predicted impacts on non-breeding curlew and concludes, on a very precautionary basis, that collision impacts may potentially be significant at a regional level. Section 7.7 of the EIAR proposes post-construction monitoring for collisions and the development and implementation of mitigation measures if monitoring indicates potentially significant levels of collision mortality. Linking impacts on non-breeding curlew to impacts on the Irish breeding population is difficult as different birds may be involved, for example birds breeding in Scotland and Scandinavia regularly winter in Ireland. Nevertheless, with the proposed monitoring and mitigation measures (if required) in place, significant effects on non-breeding curlew would be avoided and therefore there would be no potential for significant effects on breeding curlew populations.

With respect to lapwing and redshank, the results of the breeding wader surveys (2019-2021) are summarised in Section 7.3.1.2.3 of the EIAR as lodged. In three years of breeding wader surveys there was just one record of lapwing (not exhibiting breeding behaviour) and no records of breeding redshank. There were also no redshank records during three years of vantage point surveys. The DAU submission refers to departmental staff observing a lapwing pair at Feacle Turlough in 2020 but no evidence indicating breeding is provided and this could therefore have easily been non-breeding birds. Whilst the breeding wader surveys could have missed occasional presence by non-breeding lapwing, e.g., if present briefly between survey visits, it is very unlikely that the surveys would have missed a breeding pair.

Even if lapwing had bred at Feacle Turlough in 2020, Feacle Turlough is over 730 m from the closest proposed turbine and therefore no disturbance or displacement effects would be likely due to the intervening distance (as set out in Section 7.5.2.1 of the EIAR disturbance to breeding lapwing is unlikely beyond 300 m). In addition, any flights at potential risk of collision would have been recorded during vantage point surveys. As such, no significant effects on breeding lapwing are likely.

<u>Golden Plover</u>

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"Given the small number of birds recorded, and the difficulties undertaking this survey (Section 7.2.5), nocturnal surveys were not repeated in winter 2020-21. Because nocturnal bird surveys were abandoned, it is not known if European golden plover (or other waterbird species, e.g. Northern Lapwing), uses the site for foraging at night. "Based on the results of three years of diurnal surveys there is no reason to expect there to be significant migration routes across the site at night". This is accepted in the NatureScot guidance, although some research has shown that diurnal studies do not necessarily predict nocturnal patterns"

Response:
Details of nocturnal golden plover surveys carried out in 2020 are provided in Section 7.2.3.2.6 of the Chapter 7 – Ornithology of the EIAR lodged. These surveys would also have recorded nocturnal use of the Proposed Development site by other waterbird species, including lapwing and wildfowl species, if present.

The 2020 nocturnal golden plover surveys were limited due to health and safety concerns and other significant limitations associated with undertaking such surveys at night, notably the availability of suitable technology at that time. However, the results that were obtained did not indicate significant usage of the site by golden plover at night and the assessment was undertaken on that basis.

In response to this comment and following substantial technological advances since the time of the original surveys in 2020, further nocturnal surveys took place over five visits between December 2022 and March 2023. A report providing further details of these surveys is appended here at **Appendix 3.** A brief summary of survey findings provided below.

The surveys were undertaken using a Helion 2 XP50 Pro Thermal Monocular. This enables birds to be detected by their body heat at up to circa 350 m range. Equipment of this standard was not widely available at the time of the 2020 surveys.

Survey transects were identified within each proposed wind farm cluster (north and south) which aims to provide a representative sample of potentially suitable habitat for golden plover and lapwing (noting that access to all potentially suitable habitat was not possible due to health and safety concerns). Each transect was walked at least once per month, after dark, using the thermal monocular to detect and identify the presence of the target species.

The only record of golden plover and lapwing was a mixed flock of 13 birds recorded in a small, flooded area within the northern cluster on one date in February 2022.

The results from the 2022-23 nocturnal surveys support the findings of the initial nocturnal golden plover surveys carried out in 2020. Both surveys indicate some nocturnal usage of the site by golden plover and lapwing, but the numbers are involved are small and birds are only present occasionally. As such, the assessment of impacts on golden plover presented in the EIAR and NIS (see Sections 7.5.3 and 7.5.4 of the EIAR and Sections 6.1.5 – 6.1.9 of the NIS) which identified no likely significant effects, remain unchanged.

<u>Black-headed Gull</u>

"Black-headed Gulls are a qualifying species at one SPA within 15 km (Middle Shannon Callows) but also breed on Lough Ree SPA, also within 15 km. The EIAR Birds Chapter states "Important breeding colony at Lough Ree (100 individuals)". This population figure is incorrect, as Departmental staff have recorded much higher numbers of pairs at the breeding colonies in Lough Ree that could be described as an internationally important breeding population.

"Birds at Seven Hills are unlikely to contain a high proportion of individuals from Middle Shannon Callows SPA, given the intervening distance, as this species is common and widespread in the non-breeding season. The black-headed gull population within the study

area is therefore considered to be of no more than regional importance in the non-breeding season". However, this SPA is within 15 km and recent ringing studies have shown that some of the breeding population stays around in local counties during the winter.

During the breeding season, the maximum foraging range of the Black-headed Gull6 is 18.5 km and Departmental staff have observations of Black-headed Gulls foraging all over south Roscommon while feeding their chicks. The breeding season appears to have been inadequately considered, given the internationally important breeding population within the zone of influence of the proposed windfarm."

Response:
Potential effects on black-headed gull during the breeding season are assessed in the EIAR (see Sections 7.5.3, 7.5.4.1 and 7.5.4.2.9).
No further data were provided in the DAU submission regarding the size of the breeding colony at Lough Ree. As highlighted above in relation to GWFG and whooper swan, the DAU were contacted by email on 8th February 2023 asking whether the additional data referenced in the letter could be provided but were unable to provide any additional data in the absence of a specific instruction from ABP. In the absence of the additional data referred to in the DAU letter it is not possible to directly respond to this comment in full at this time. However, the following comments can be made.

Breeding black-headed gull is not listed as a qualifying feature for Lough Ree SPA (or any other SPA in the surrounding area) and any effects on the black-headed gull breeding population are therefore not relevant to the appropriate assessment presented in the NIS.

Habitat loss and disturbance/displacement are not likely to be significant for breeding black-headed gull given their large foraging range and the wide availability of more optimal, alternative foraging habitats located outside the proposed development site (see Sections 7.5.3 and 7.5.4.1 of the EIAR).

Collision risk for black-headed gull was assessed in Section 7.5.4.2.9 of the EIAR. This predicts a potentially significant effect on the regional black-headed gull population during the breeding season, although collision risk is likely to have been over-estimated. The predicted significant effect was based on a regional black-headed gull breeding population of 100 pairs. If, as suggested by the DAU, the regional population is much larger, the collision mortality predicted in the EIA is likely to be of lower significance, because the predicted mortality will affect a much smaller proportion of the regional population. For example, whilst the predicted collision rate of 0.697 would represent a 6.97% increase in background mortality rates for a population of 100 birds, if, hypothetically, the population was 200 birds or 500 birds the increase in background mortality would be much lower at 3.49% or 1.39% respectively.

On the basis of the above, impacts on black-headed gull during the breeding season have been adequately considered and the significance of potential impacts is actually likely to have been overestimated in the EIAR.

Non-QI Species

<u>Yellowhammer</u>

"Given that there is a small South West-North East line of low, karstified hills in the area (close to the southern cluster) and there are areas of scrub and hedgerows in the area, it is evident that there is good potential habitat for the declining (BoCCI Red listed) Yellowhammer (which is still found in limestone areas like the Burren). The reports ignore passerines, stating that they are not considered to be regular turbine collision victims and have large populations and so are not considered Valued Ornithological Receptors (VORs). However, the rare Yellowhammer, if present, could be negatively impacted by scrub of hedgerow removal during the construction phase of the windfarm. There is no sign that this species was

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considered during the impact assessment process at all. There are previous records of Yellowhammer in nearby areas, in tetrad M84W during the 1988-1991 second breeding atlas survey and in tetrad M94S during the 2007-2011 combined atlas survey."

Response:
Passerines were scoped out of the EIA in accordance with current NS guidance, which states *"It is generally considered that passerine species are not significantly impacted by wind farms."* The exclusion of yellowhammer from consideration is therefore not a significant omission.

In terms of scrub and hedgerow removal, Section 6.7.3.1 of the EIAR confirms that there would be no loss of dense scrub as part of the proposed development, although there would be a loss of 2.53 km of hedgerows and associated scrub (out of a total of 6.66 km of hedgerow and associated scrub within the proposed development site). With regard to hedgerows, Section 6.7.3.1.2 of the EIAR states that it is proposed to plant 2.82 km of new hedgerow to offset the potential loss and to provide additional habitat connectivity within the site. Overall, the proposed replanting will result in a net gain of approximately 290 m in the linear landscape features within the site, which should be beneficial to yellowhammer in the medium to longer term.

Other bird related comments

The DAU submission notes that peregrine, buzzard, kestrel and sparrowhawk were all recorded in close proximity to the turbine locations.

Response:
Potential impacts on peregrine and kestrel, including collision, were assessed in Sections 7.5.3, 7.5.4.1, 7.5.4.2.5 and 7.5.4.2.10 of the EIAR. No significant effects are predicted.

Buzzard and sparrowhawk were not subject to detailed assessment because they are common and widespread and, in the case of buzzard, have increased in numbers substantially in recent years. They are not considered important at a local or higher level (see Table 7-9 in the EIAR). This approach accords with CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland, as set out in Section 7.2.4.1 of the EIAR.

Impact on Bats

Bat Surveys

"The Department notes that the bat report concludes "There is no potential for the construction of the Proposed Development to result in significant effects on bat populations at any geographic scale. There will be no significant effect on the conservation status of any bat species." The Department has concerns that the quantity and quality of survey and analysis is insufficient to reach this conclusion."

"...Karst landscapes are often important to bats, and although no caves were found on a desk top search, the Environmental Sensitivity Mapping tool shows many dolines and other karst features in the area. Departmental staff have reported dolines and caverns in the footprint of the proposed development, and the Department recommends that investigative work is required to locate these caves. Potential bat use would be required to be surveyed at these features if present.

The Department has concerns that the level of survey carried out for this large windfarm proposal could not adequately rule out the possibility of a significant loss of bats ..."

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The DAU submission highlights the presence of a number of dolines and other karst features within the surrounding landscape, stating that departmental staff have reported such features within the footprint of the Proposed Development. As detailed in Section 3.2.4 of the detailed Bat Report (Appendix 6-1 to the EIAR), a thorough desk study was undertaken to inform the EIAR during, which included searches using the Geological Survey Ireland (GSI) online mapping and the University of Bristol Speleological Society (UBSS) Cave Database for the Republic of Ireland were consulted for any indication of natural subterranean bat sites, such as caves, within 10km of the proposed site. The archaeological database of national monuments was reviewed for any evidence of manmade underground structures, e.g. souterrains, that may be used by bats. The desk study did not indicate the possible presence of any subterranean sites or caves within the application Site. As detailed within the Bat Report, a search of the National Monuments Database did reveal the presence of three manmade subterranean sites within the EIAR Site Boundary which the Proposed Development has completely avoided.

The site was subsequently fully surveyed and appraised in terms of the suitability of habitats to support roosting, commuting and foraging bats. As part of this, the potential for subterranean features to support bats was assessed; no caves were recorded within the Site and souterrains/depressions recorded were assessed as being unsuitable for roosting bats. A single derelict building located outside the EIAR Study Area was assessed as having *Moderate to High* roosting potential as detailed in the bat report; all other habitats within the Site were assessed as offering Negligible potential for roosting, and no bat roosts were identified within the EIAR study area. Following this a thorough assessment of the impacts of the Proposed Development on bats, including assessment of potential collision risk, was carried out based on the actual recorded bat activity levels within the Site.

It is judged that the concerns of the Department in relation to the adequacy of the baseline survey effort to inform the EIAR is unwarranted. As described in the dedicated Bat Report submitted as Appendix 6-2 to the EIAR, the bat survey methodology and assessment followed the most recent recognised industry best practice i.e. Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (NatureScot 2021). This allowed for a robust approach to the surveys and assessment undertaken in the bat impact assessment. The Department recommended, as part of its scoping response, that bat surveys should comprise 30-day survey periods in each season; however there is currently no scientific basis for this recommendation for additional survey effort, which is based on an online webinar '*Patterns of Bat Activity at Upland Windfarms: Implications for Sampling and Mitigation*' (CIEEM, 2020[4]). The presenter stated during the '*Summary & Questions'* that their Scottish company undertake surveys for '*30 days*' although they '*haven't derived 30 days in any scientific way*' and concludes that they '*have not looked to see what is the optimum efficiency*'. The information presented has not been published; the speaker states that '*there have been meetings to review the guidance'* (i.e. SNH, 2019). However the recently published NatureScot 2021 guidance has not changed in this regard, and the surveys undertaken at the Site of the Proposed Development are fully in line with the industry best practice and a comprehensive assessment was achieved. Results of surveys at height, where data was obtained were provided in the Bat Report to provide supplementary information; however surveys at height are not a specific requirement under the guidance.

In relation to the hedgerow replanting proposals as mitigation for bats, the replanting has been designed to maintain/enhance habitat connectivity around the site. Appropriate removal of hedgerow for which the compensatory habitat has been proposed has been specified in order that bats would not be drawn in close to turbines. Post-construction monitoring will be carried out and the mitigation/monitoring programme will be reassessed following Year 1 of operation. If deemed to be required, the mitigation and monitoring programme will be increased and tailored to provide any additional mitigation/curtailment that is judged to be required to safeguard bats.

A robust assessment of bat use of the Site has therefore carried out in full accordance with published best practice guidance, and a full and comprehensive assessment of the potential for impact on bat

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[4] *CIEEM, 2020, Patterns of Bat Activity at Upland Windfarms: Implications for Sampling and Mitigation, Online, Available at: https://cieem.net/resource/cieem-webinar-patterns-of-bat-activity-at-upland-windfarms-implications-for-sampling-and-mitigation/, Accessed, 04.02.2021*

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populations at the Proposed Development site was made in the EIAR. A comprehensive suite of best practice measures and a robust bat mitigation and monitoring plan has been prescribed, including adaptive curtailment and operational monitoring to ensure that any changes in bat activity post-construction, monitor the implementation of the mitigation strategy and to confirm the efficacy of the curtailment during different periods of bat activity, so that if additional mitigation is judged to be required to safeguard bats this can be prescribed accordingly. This does not detract from the robust assessment of the baseline use of the Site by bats that was completed. Bat foraging and commuting habitat is present within the Site as fully detailed within the Bat Report; however following the habitat compensatory measures proposed, no net loss of habitat for bats would occur. Following consideration of the residual effects (post mitigation) it has been concluded that the Proposed Development will not result in any significant effects on bats.

2.1.4.1.4 *Impacts on Grassland Habitats*

A detailed assessment of the likelihood of the Proposed Development having either a significant effect or an adverse impact on any relevant European Sites (i.e. SACs, cSACs, SPAs or cSPAs) has been carried out in the Appropriate Assessment Screening Report and Natura Impact Statement (NIS) respectively; the NIS concluded that with the implementation of mitigation measures proposed, that the Proposed Development, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site.

Reference is made in a number of submissions to the loss of Annex 1 grassland within the SAC and that this represents a loss of Qualifying Interest (QI) habitat for the Killeglan Grasslands SAC. This is not the case. The Site of the Proposed Development is located entirely outside of the SAC, and Annex 1 grassland within the Site does not represent QI habitat of the SAC. Whether or not the SAC has changed in character over the years is immaterial; there will be no loss of QI grassland associated with the SAC.

The total area of proposed Annex 1 grassland within the Site was calculated as 144.6ha, with a 2.7ha (1% of the total habitat) loss proposed within the Site to facilitate the Proposed Development. This represents a small proportion of the on-site habitat of this nature, and long-term restoration is proposed of areas of calcareous and agriculturally improved grassland that did not conform to Annex 1 status to ensure that there would be a net gain and improved connectivity in this habitat in the long-term (refer to Biodiversity Management Enhancement Plan, Appendix 4-5 of EIAR). It is judged that there can therefore be no indirect effects resulting from the proposed loss of Annex 1 grassland outside the SAC that could affect the condition or integrity of the SAC QI habitat, as is alluded to within the DAU submission.

2.1.4.1.5 *Impacts on Karst Features*

Dolines and Turloughs

The DAU submission to the Board states the following in respect of Dolines and Turloughs:

Dolines

> *"The Land Soils Geology Chapter notes there are large numbers of karst features mapped on the lower lands near the wind farm site, the majority are Dolines. It is unclear where the information in the Karst Feature Map is from (Figure 8-13) but the department is aware of several dolines that are present in the higher ground in the vicinity of the proposed turbines that are not present in the map. The department recommends that further research is undertaken to find out where additional karst features are present on the site".*

Turloughs

> *"The location of mapped Annex I habitat (as part of the 2013 Article 17 reporting) is shown in Figure 6-7. This is not the most recent Article 17 report (2019), and this does not show the*

widespread known extent of the undesignated turloughs, although these are nonetheless Annex I priority habitats. The Department recommends that turloughs are more accurately mapped or [sic.] and presented to An Bord Pleanála".

Response
HES have considered the matters raised above and have prepared a detailed response below.

Dolines
The karst features mapped within Figure 8-13 include all karst features mapped by the GSI[5]. This database of karst features is comprehensive and compiles karst features included on geological maps produced by the GSI from ~1859-present. This dataset is described as:

> *"This karst dataset contains mapped karst landforms in Ireland including: boreholes, caves, dry valleys, enclosed depressions, estavelles, springs, superficial solution features, swallow holes and turloughs. It is displayed as point features, locating the centre (or, in the case of a cave, the entrance) of the karst landform, and records details of the landform's dimensions and functioning."*

The dolines are included within this dataset, in this case referred to as "enclosed depressions", which are present in Figure 8-13.

HES has comprehensively mapped all geological features, including dolines within the Wind Farm Site during site walkover surveys conducted between 21st – 23rd January 2020 and during follow-up visits (refer to Section 8.2.2 and Section 9.2.2 of the EIAR for dates) involving groundwater monitoring equipment downloads, water quality sampling, and trial pit and borehole drilling works.

Along with geological mapping of the Proposed Development site, we have completed comprehensive site investigations across the Northern and Southern Clusters of the Proposed Development site, including:

- 21 no. trial pits were excavated within the Northern Cluster of the Wind Farm site in June 2010 (with maximum depth of 2.1m);
- 7 no. trial pits were conducted within the Southern Cluster of the Wind Farm site in April 2011 (with maximum depth of 1.06m);
- 6 no. rotary core boreholes were drilled across the Northern and Southern Clusters of the Wind Farm site in April 2015;
- Logging of bedrock outcrops and subsoil exposures was carried out at and in the local area near the Wind Farm site during site visits by HES between January 2020 and May 2021 and mineral subsoils were logged according to BS: 5930;
- 40 no. Geophysical 2D resistivity profiles and 40 no. Seismic refraction profiles were carried across the turbine locations at the Wind Farm site. This geophysical survey was undertaken by Apex Geophysics between November 2020 and January 2021;
- 6 no. down the hole hammer boreholes were drilled by HES at the Northern and Southern Clusters of the Wind Farm site in May 2020;
- 16 no. boreholes were drilled by IGSL within the Northern Cluster, on behalf of MWP (Malachy Walsh & Partners - engineering design consultants) in December 2020 – January 2021. Bedrock was encountered in 6 of these 16 no. boreholes;
- 26 no. boreholes were drilled at the Southern Cluster by IGSL in December 2020 – January 2021. Bedrock encountered in 19 of these 26 no. boreholes;
- 10 no. slit trenches were excavated along the proposed grid route by IGSL between 21st May – 2nd June 2021;
- 3 no. down hole hammer boreholes were drilled along the proposed grid route by IGSL between 4th – 6th June 2021;

5 Groundwater Karst Data Ireland - https://dcenr.maps.arcgis.com/home/item.html?id=aaa493208ff04f059ce5107e96089a71

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- 3 no. rotary core boreholes were drilled along the proposed grid route by IGSL between 08th – 12th July 2021;
- 16 no. trial pits were excavated and logged by Malachy Walsh and Partners (MWP) within the Northern Cluster of the Wind Farm site (including at the proposed met mast) in November 2021 (maximum depth of 3.5m);
- 27 no. trial pits were excavated and logged by MWP within the Southern Cluster of the Wind Farm site (including at the proposed substation) in December 2021(maximum depth of 3.7m);
- 52 no. PSD analyses were completed on subsoil samples from the 2021 MWP trial pitting;
- 28 no. trial pits were excavated and logged by HES within the Southern Cluster of the Wind Farm site in December 2021 (maximum depth 2.1m);
- 11 no. trial pits were excavated and logged by HES within the Northern Cluster of the Wind Farm site in December 2021 (maximum depth 2.0m);
- 38 no. PSD analyses were completed on subsoil samples from the 2021 HES trial pitting; and,
- 12 no. density and permeability tests were completed on subsoil samples from the 2021 HES trial pitting.

Following these extensive investigations, no further dolines or swallow holes were observed during these works, other than what is included in Figure 8-13. Figure 8-13 contains over 200 no. mapped karst features. The location and distribution of karst features has been investigated and a considerable database of these features has been built up.

Given the nature and scale of the completed site investigations, site mapping, and walkover surveying that has been completed across the northern and southern clusters HES are satisfied that all significant karst features have been mapped and assessed in the EIAR. No further research is required.

Turloughs

Figure 6-7 shows the location of the Proposed Development site in relation to Annex I habitats. It does not contain all known turloughs as the remaining turloughs are not included in the database of Annex I habitats as described in the Article 17 report. The turloughs included in Figure 6-7, and mapped within the updated Article 17 report (2019) are the same as those mapped within the previous 2013 version.

Turloughs have been comprehensively mapped and assessed in Chapter 9 of the EIAR. As outlined above, the location and distance of turloughs with respect to the Proposed Development, are detailed in the following within the EIAR:

- Figure 8-12 (Designated Sites Map);
- Figure 9-6 (Groundwater Flooding Map);
- Figure 9-13 (Mapped Turloughs near the Proposed Development);
- Figure 9-14 (SAR Flood Map);
- Figure 9-18 & 9-19 (Groundwater Contour Maps);
- Figure 9-21 (Designated Sites Map);
- Drainage Management Plan (App 4-8);
- Figure H of Appendix 9-1 (Flood Risk Assessment);
- Section 9.3.7.6(Turloughs) of the EIAR; and,
- Table 9-15 (Turloughs near the Proposed Development site).

All potential impacts on turloughs have been assessed in detail in Sections 9.4.2.8 and 9.4.2.10.1 of the EIAR, with the conclusion that there will be no residual effects on designated and undesignated turloughs as a result of the Proposed Development.

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2.1.4.1.6 Miscellaneous comments

Marsh Fritillary Butterfly

> *"The Marsh Fritillary Butterfly is Ireland's only legally protected butterfly. Protected under the Berne Convention and Annex II of the European Habitats Directive. Significant populations of the rare butterfly are recorded from the footprint of the proposed development, in suitable species-rich grassland containing devil's bit scabious, its larval food plant.*
>
> *However, where habitat is destroyed and conditions are unfavourable, small subpopulations will go extinct. It is important to emphasise the importance of connectivity between isolated subpopulations in a mosaic of habitats. The smaller the subpopulation, the more prone it is to extinction."*

In relation to marsh fritillary, which is raised in a number of the submissions, extensive survey effort in accordance with published best practice guidance, was carried out for the species (i.e. detailed habitat assessments, walked transects (for adults on the 8th and 22nd May 2020) and larval web surveys (on the 4th & 24th September 2020 and 30th March 2021), however no evidence of this species was recorded within the Site of the Proposed Development. The species is assumed to be present within the wider area, and where potentially suitable (but already fragmented) habitat within the Site is lost this will be compensated for as part of the proposed grassland habitat restoration within the site to ensure that there is no net loss of suitable habitat for this species. All areas of more extensive, optimal habitat for the species have been avoided as part of the siting of the Proposed Development, with no proposed infrastructure located within these areas.

Hedgerow Loss

The DAU raise concerns regarding hedgerow loss vis a vis the proposed replanting set out in the Bat Report as lodged:

> *"...the replanting proposed as mitigation in the Bat Report is not fully explained. The directions of some of the new hedgerows would appear to steer bats in the direction of a turbine, such as atT1, T5, T19 and T20. The new hedgerow will not replace the lost hedgerow and its ecological function unless it is of same height and structure as the one being lost. If the proposal is to remove the existing hedgerow and plant a new one with whips or saplings it will be several years before physical connectivity across the site is restored. Hedgerow translocation may be preferred if possible."*

As noted above at Section 2.1.4.1.3, in relation to the hedgerow replanting proposals as mitigation for bats, the replanting has been designed to maintain/enhance habitat connectivity around the site. Appropriate removal of hedgerow for which the compensatory habitat has been proposed has been specified in order that bats would not be drawn in close to turbines. Post-construction monitoring will be carried out and the mitigation/monitoring programme will be reassessed following Year 1 of operation. If deemed to be required, the mitigation and monitoring programme will be increased and tailored to provide any additional mitigation/curtailment that is judged to be required to safeguard bats.

Invasive Species

While not raised as a concern per se, the DAU make reference to the grasslands being "*largely free from invasive species at present"* but add *"... even though the invasive low-growing shrub Cotoneaster integrifolius has been recorded nearby and could have a negative impact on this type of habitat. This is easily spread and should be monitored."*

As detailed at Chapter 6 of the EIAR as lodged, during the multidisciplinary surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities

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Regulations 2011 (S.I 477 of 2015) was conducted. As part of the Desk Study undertaken (Section 6.5.1 of Chapter 6 refers), the NBDC database was consulted. Table 6-12 sets out the NBDC records for invasive species in hectads M84 and M94. No invasive species were recorded within the application site, and there is therefore no potential for significant effect. Invasive species are not identified as a Key Ecological Receptor (KER). Therefore while there is no indication from the work undertaken to date that invasive species are of concern for this development, an Invasive Species Management Plan has been prepared and is included at Section 3.6 of the Construction and Environmental Management Plan (CEMP) included at Appendix 4-9 of the EIAR. The Management Plan notes:

"…should an invasive species be encountered at any stage during the construction phase of the Proposed Development, an Invasive Species Management Plan (ISMP) will be prepared for the site (to prevent the introduction or spread of any invasive species within the footprint of the works). This ISMP will set out the best practice control methods which are summarised in the following sections. The ISMP would be updated during construction."

The Management Plan sets out general best practice control methods, good practice on-site management and good site hygiene. Taken together, it is held that sufficient controls are in place should an invasive species be discovered during the course of the site development, should planning permission be granted.

Timing of Surveys

All protected surveys were carried out at appropriate times and within optimal conditions. Notably a single third-party submission questions the validity of the protected species surveys carried out, given that some were carried out during COVID restriction periods; this assertion is unfounded, especially given that the Site is comprised of private farmland where use and management of the land would have remained to all intents and purposes the same during restrictions. In conclusion then, the timing of the survey work undertaken was in no way compromised.

2.2 Third-Party Submissions

This section of the document deals specifically with matters raised in third-party submissions received in relation to the application. It does not seek to duplicate information presented earlier in the document, and where possible directs the reader to the relevant section(s) of this submission and/or information already lodged in relation to the application.

2.2.1 Landscape

2.2.1.1 Landscape and Visual Impact Assessment – Killeglan Karst Landscape

Chapter 12 of the EIAR comprises a complete and robust Landscape and Visual Impact Assessment (LVIA). The LVIA included an assessment of the likely significant direct effects on the landscape of the Proposed Development Site and also the effects on its landscape character, including the effects on the Killeglan Karst Landscape receptor. The Landscape Baseline (Section 12.4 of Chapter 12) acknowledges the GSI designation of the Killeglan Karst Landscape which forms a portion of the EIAR Site Boundary to the south-west of the southern turbine cluster. Excerpts from Section 12.4 of Chapter 12 under the heading 'Landscape Policy Pertaining to Wind Energy' are quoted below, this text address the status of the County Roscommon Wind Energy Policy and the Killeglan Karst Landscape designation at the time of submitting the EIAR in June 2022.

Excerpt from the EIAR, Chapter 12, Section 12.4.1.1, 'Landscape Policy Pertaining to Wind Energy Development - RCDP', paragraphs 5, 6 and 7:

> *"the Proposed Development is predominant sited in a landscape 'Most Favoured' for wind energy development. However, as shown in* **Error! Reference source not found.***, four of the proposed turbines (T9, T10, T12 & T16) are located in an area recently (April 2022) designated as 'Not Favoured' on account of geological sensitivities in an area to the south-west of the Proposed Development site.*
>
> *As noted previously, the initial site selection for the Proposed Development was plan lead, followed closely by a detailed and rigorous iterative design process required to effectively bring a viable, appropriate and suitable wind farm design to the planning stage over circa a two year period. Throughout this time and process it was always the intention to site all of the proposed infrastructure within lands zoned as 'Most Favourable', which had been the case up until very recently.*
>
> *The newly added 'Not Favoured' wind energy zoning within the Proposed Development site is attributed to the 'Killeglan Karst Landscape', a 'Geological Heritage Site (GHS) designated by the Geological Survey of Ireland due to karst characteristics of lands to the south-west of the Southern Cluster. It is noted that it does not appear in any of the maps seemingly utilised for the sieve mapping process in Appendix 1 of the RES but was introduced during the Material Alterations stage of the Draft Roscommon County Development Plan 2021-2027. These new wind zoning designations are relatively small areas enclosed by large areas of 'Most Favoured' zoning. In this regard, it appears these areas are newly designated as 'Not Favoured' for wind on account of potential for direct landscape effects and the designation has no real bearing on the visual impact of a wind farm in terms of the character and aesthetic of the wider landscape setting. The direct effects of the Proposed Development on the Killeglan Karst Landscape are therefore considered in this chapter. However, a comprehensive technical appraisal of the likely effects of the Proposed Development on the karst geology of the site in general and this specific area are included in Chapter 8 of this EIAR – Lands Soil and Geology."*

As reported in the excerpts above, the LVIA in Chapter 12 acknowledged designations of landscape areas around the site in the Roscommon Wind Energy Strategy, including the 'Most Favoured' areas for Wind and the 'Not Favoured' area covered by the Killeglan Karst Landscape GSI Designation. It is important to note that the proposed turbines were only temporarily, and in error, sited in a 'Not Favoured' area between April 2022 and July 2022. The designation of an area of the Killeglan Karst Landscape as 'Not Favoured' in Map 7 of the Roscommon Renewable Energy Strategy was an error, it was incorrectly included in the Roscommon Renewable Energy Strategy for period of time (April - July) in which the planning application and EIAR was submitted in June 2022. In a letter to the applicant dated the 28th July 2022, Roscommon County Council committed to inserting an updated and correct Map 7 into the Roscommon Renewable Energy Strategy. Therefore, as demonstrated by Figure 2-1 below, all of the proposed turbines are now sited in a 'Most Favoured' area for wind energy development, including the turbines located in the Killeglan Karst Landscape. Details of this correction of the local planning policy are reported previously in this submission (Section 2.2.11).

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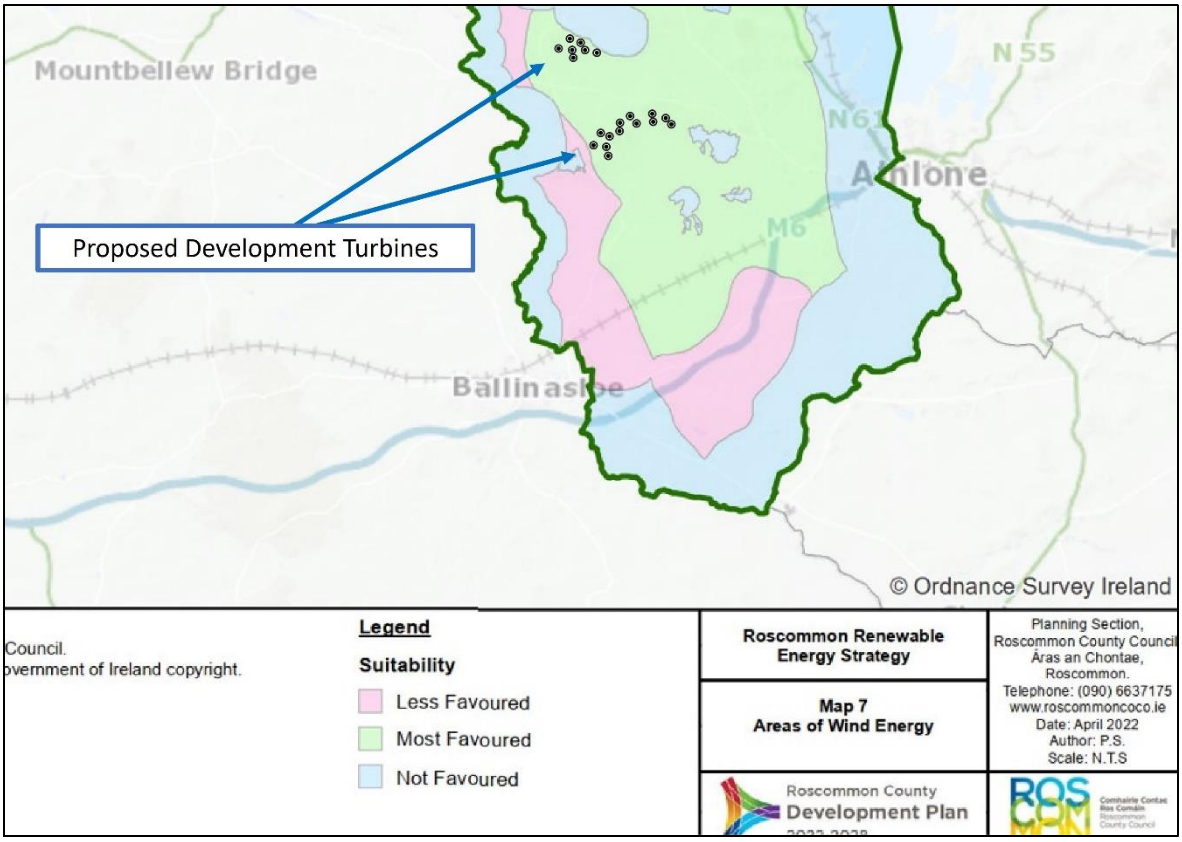

Figure 2-3 Extract from Map 7 (current) of the Roscommon Renewable Energy Strategy 2022-2028 : All turbines of the Proposed Development are located in an Area 'Most Favoured' for Wind Energy.

Notwithstanding the recent change in planning policy, the LVIA in the EIAR considered that a balance was required in relation to the assessment of the Killeglan Karst Landscape, considering both the wind energy designation at that time and the GSI landscape designation. In this regard, it was logically considered that the greatest potential landscape and visual impact on the Killeglan Karst Landscape related to direct landscape effects only, where the Proposed Development will materially alter the landscape. In terms of effects on landscape character this related to how the Proposed Development is perceived within the landscape. Considering the landscape surrounding the proposed turbines sited in the GSI designation is primarily designated as a Most Favoured Area, the EIAR determined that viewing turbines in this landscape setting is acceptable, as it is envisioned in the local planning policy. Consequently, the focus of the impact assessments in the LVIA in relation to the Killeglan Landscape considered the factor that impacts on landscape and landscape character are highly localised to this small area of the site. This approach is strongly supported by the recent correction and reclassification of this area of the Killeglan Karst Landscape as an area 'Most Favoured' for wind energy. As presented in the mapping Figure above, all of the proposed turbines are now again sited in a landscape 'Most Favoured' for wind energy development, including those within the GSI Killeglan Karst Landscape designation. Section 12.4.2 of Chapter 12 of the EIAR describes the baseline landscape character of the Proposed Development Site acknowledging features of the Killeglan Karst Landscape at the south-west of the southern turbine cluster:

Excerpt from the EIAR: Chapter 12, Section 12.4.2, Land Cover, paragraph 4:

> *"Due to the karstic geology of the site, scrub, dry grassland and limestone boulder fields are prevalent at higher elevations of the Southern Cluster. As shown in Plate 12-9 below, agricultural fields are regularly interspersed with rocky outcrops, bushes and scrub"*

Plate 12-9 View to the north-east from the west of the site at the Southern Cluster in proximity to turbine T8.

Whilst the karstic features do exist, the existing landscape of the site is heavily modified by agriculture, as evidenced by the fields of pasture, well defined field boundaries, existing access tracks and other agricultural infrastructure. As per the Guidelines for Landscape and Visual Impact Assessment 3rd Edition (IEMA& LI, 2013 - referred to as the GLVIA3), Section 12.4.2.2 of Chapter 12 summarises all factors (including the Killeglan Karst Landscape) relating to landscape value in Table 12-5, which were then balanced with factors relating to the susceptibility of the landscape to change as detailed in planning policy; finally arriving at a determination of sensitivity for the site of the Proposed Development, which was deemed to be Low.

Fundamentally, the essential valuable characteristics and sensitivities of the Killeglan Karst Landscape are its geological attributes which are described and assessed thoroughly in Chapter 8, as noted in Table 12-5.

Excerpt from the EIAR: Chapter 12, Section 12.4.2.2, Table 12-5, Row 4:

> *"A comprehensive technical appraisal of the likely effects of the Proposed Development on the karst geology of the site in general and the Killeglan Karst Landscape are included in Chapter 8 of this EIAR – Land Soil and Geology."*

It is emphasised that the Proposed Development layout was designed to avoid impacts (where possible) on karstic features, this careful micro-siting is thoroughly detailed in Chapter 8 of the EIAR (and mentioned throughout this submission), as reported in Chapter 12. Landscape Effects the Proposed Killeglan Karst Landscape are reported in Section 12.7 of Chapter 12 – *Operation Phase Effects*:

Excerpt from the EIAR: Chapter 12, Section 12.7.3.1.1, Effects on the Killeglan Karst Landscape, Paragraph 1:

> *"The boundary lines defining the Killeglan Karst Landscape Geological Heritage Site (GHS) are directly mapped around surface karst features such as limestone boulders. There will be a loss of karst surface features in a very small area of the GHS where the footprint of the Proposed Development overlaps the existing ground cover of the GHS, and this comprises a very small percentage of the overall development footprint.* ***The iterative design process***

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included extensive geological and hydrological surveys (Chapters 8 and 9) to minimise the extent of the Proposed Development footprint sited within sensitive habitats or on top of unsuitable karst geology. *Where possible, the micrositing of all infrastructure utilises agricultural land or existing agricultural tracks within the site and the GHS. Therefore, highly localised direct landscape effects will occur, but overall, loss of very small areas of land cover will be Slight in the context of the wider landscape setting and its overall character."*

As detailed in the Landscape and Visual Chapter 12, there will be **highly localised impacts** (landscape effects) on small areas of the Killeglan Karst Landscape and where possible, these have been avoided. The scale and localised nature of the impacts on this receptor do not significantly alter its key values or sensitivities – the karstic geology (as detailed in Chapter 8). Considering the overall Low sensitivity of the Proposed Development Site as a landscape already highly modified by agriculture and designations in planning policy, it is considered that the assessments and conclusions in the LVIA are appropriate and balanced, and there will not be any Significant landscape effects on the Killeglan Karst Landscape.

2.2.1.2 Assessment of Landscape Character Areas (LCAs)

A third-party submission cites the Landscape and Visual Impact Assessment which forms Chapter 12 of the EIAR under the heading *'Insufficient evidence presented upon the severity of visual impact from the assessments undertaken.'.* The submission includes reference to the assessment of landscape effects on the Killeglan Karst Landscape, a response to this is included in the section above. The submission includes an unspecific, high-level critique of the methods used to conduct the landscape and visual impact assessments in Chapter 12. The methods used to conduct the impact assessment for the LVIA are comprehensively detailed in Appendix 13-1. The methods for the 'Assessment of Landscape Effects' (Section 1.5.2 in Appendix 13-1) used for Chapter 12 align with the clearly documented methods in best practice guidance for LVIA - GLVIA3 (LI, IEMA, 2013).

The submission also suggests an insufficient assessment of the impacts on designated Landscape Character Areas (LCAs) and inaccurate assignment of the LCA in which the Proposed Development is sited as being 'Low' sensitivity. This is not accepted. The following excerpt is from Section 12.4.1 of Chapter 12 – *Landscape Designations and Policy Context;* it reports the relevant policy as detailed in The Landscape Character Assessment of County Roscommon which now forms part of the current Roscommon County Development Plan 2022-2028:

Excerpt from the EIAR: Chapter 12, Section 12.7.4.1.1, Landscape Character Assessment of County Roscommon (LCARCR), Paragraphs 2, 3 and 4:

"Each LCA is designated one of four value classifications based upon criteria such as 'Distinctiveness', 'Quality', 'Rarity' and 'Representativeness' the hierarchy of these values from most valuable to least valuable is reported below:

- *Exceptional Value*
- *Very High Value*
- *High Value*
- *Moderate Value*

The LCARC states that landscape of Exceptional value are very sensitive to change whereas "Landscapes of Moderate Value, on the other hand, tend to be less sensitive and are therefore more tolerant of change".

As shown in ***Error! Reference source not found.*** *above, the Proposed Development is located in LCA 34 – Lough Funshinagh, Stone Wall Grasslands and Esker Ridges which primarily comprises a Landscape Type of 'Dry Farmland'. This LCA has the lowest value rating – 'Moderate Value'. In this regard, the Proposed Development is appropriately sited in an LCA of the lowest value and therefore a landscape of lower sensitivity than other potential locations in County Roscommon. A comprehensive description of LCA 34 and all other LCAs screened in* *for assessment in the wider landscape surrounding the Proposed Development (to 15km) is included in Appendix 12-2."*

A preliminary LCA assessment of all 17 No. designated LCAs within 15km of the Proposed Development is reported in Section 12.4.2.1 of the LVIA. The preliminary assessment used ZTV mapping and information gathered from visibility appraisals during site visits to screen out 6 No. designated LCAs and screen in 11 No. LCAs for further assessment. Section 12.4.2.1 states:

Excerpt from the EIAR: Chapter 12, Section 12.4.4.2.1, Paragraph 4:

> *"A detailed description of the eleven LCAs screened in for assessment (Table-12 8) and the likely effects on landscape character as a result of the Proposed Development are presented in the Landscape Character Assessment Tables that form Appendix 12-2. A summary of landscape effects on these LCAs are reported in Section 12.7.3.1 of this chapter - Operational Phase Effects."*

Appendix 12-2 of the EIAR is a substantial document, providing a comprehensive and detailed assessment of each of the 11 No. individual designated Landscape Character Areas screened in for assessment, using best practice guidance (GLVIA3) for assessment of landscape effects (as detailed in the Methodology Appendix 12-1). The significance of the effect on each LCA is presented in Table 12-18 and then discussed in Section 12.7.3.1. No significant landscape effects are deemed to occur on any of the designated LCAs assessed in Chapter 12.

2.2.2 Ornithology

The submissions/observations received from third parties in relation to ornithological matters have been carefully considered by SLR Consulting, who prepared Chapter 7 – Ornithology of the EIAR as lodged. For ease, each matter arising where a response/clarification is warranted (ie where not already clearly set out in the EIAR information lodged), has been attributed a number and a dedicated response below.

1. *One submission suggests that designated sites >15km from the site should have been considered.*
   Response:
   The rationale for assessing sites designated for their ornithological interest within 15 km of the Proposed Development site is set out in Section 7.3.1.1 of the EIAR. In addition, Section 7.3.1.1 of the EIAR notes that the next closest designated site beyond 15km, Mongan Bog SPA (17 km from the Proposed Development site) is designated for Greenland White-Fronted Goose (GWFG) only. As the core foraging range for GWFG is 5-8 km, this SPA is not ecologically connected to the Proposed Development site. The next closest SPA to the site is River Little Brosna Callows, which is located circa 30 km from the Proposed Development site. This is well beyond the likely regular dispersal or foraging distance for any special conservation interest (SCI) species.

   Designated sites beyond 15km were therefore considered and the reasons for scoping them out of further assessment are clearly set out in the EIAR.

2. *One submission states that nocturnal studies for migrating birds should have been carried out.*
   Response:
   Carrying out meaningful surveys for nocturnal migrating birds is very difficult, if not impossible. The rationale for not undertaking nocturnal surveys for migrating birds is set out in Table 7-1 of the EIAR, which states:
   "Current NatureScot guidance accepts that following nocturnal movements of birds beyond very short distances is almost impossible other than by use of radar, which it recommends "is only used to assess sites where there is likely to be high nocturnal activity of important species". Many waterbird species migrate by day and by night so if the site lay on a significant migratory route used at night, significant migratory activity during daylight hours would also be expected. Based on the results of three years of diurnal surveys, during which no flights of apparently migrating

geese or swans were recorded, there is no reason to expect there to be significant migration routes across the Proposed Development site at night. Specific surveys for migrating birds at night were therefore not considered necessary and were not undertaken.

A fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**. The results from the 2021/22 winter surveys were broadly similar to those recorded during previous winter surveys in terms of the suite of species, distribution and abundance of birds recorded and there was no evidence of any significant diurnal migration routes across the proposed development site. The previous conclusion that surveys for migrating birds at night were not necessary therefore remains valid.

3. *One submission states that without nocturnal surveys for golden plover there cannot be certainty regarding the assessment of no significant effect on nearby SPA golden plover populations.*
Response:
This matter has been responded in full at Section 2.1.4.3 of this response, in relation to comments received from the DAU and further survey reporting is contained in **Appendix 3** of this submission.

4. *One submission refers to increasing numbers of raptors during the survey period and suggests that collision risk could therefore be greater than that concluded by the EIA, which could in turn represent a significant impact.*
Response*:*
The EIA is based on three years of survey data, which is more than the two years required by NatureScot (NS) guidance so more than adequately capture variation between years.
In addition, a fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**. The results from the 2021/22 winter surveys were broadly similar to those recorded during previous winter surveys in terms of the suite of species recorded. A higher number of flights for some raptor species were recorded during the winter 2021/22 surveys than in previous years. However, the updated CRM carried out to reflect the results of the winter 2021/22 surveys (report appended here at **Appendix 1**) does not predict significant levels of mortality for any raptor species, despite the apparent increase in activity. For example, the predicted number of collisions during the non-breeding season, based on 2021/22 data, are 0.03 per year for peregrine and 0.18 per year for kestrel. Taking background mortality rates into consideration (see Sections 7.5.4.2.5 and 7.5.4.2.10 of the EIAR) these levels of mortality are not likely to be significant.

Section 7.7 of the EIAR also proposes post-construction monitoring for collisions, and the development and implementation of mitigation measures if monitoring indicates potentially significant levels of collision mortality. As such, in the unlikely event that significant levels of collisions did occur, mitigation measures would be implemented accordingly.

5. *One submission highlights regular sightings of whooper swan at Milltown.*
Response*:*
Regular sightings of whooper swan at Milltown, Dysart are consistent with the findings of the surveys carried out to inform the EIA, which also recorded whooper swans in the Milltown/ Ballyglass area (see Technical Appendices 7.1, 7.3 and 7.5 to the EIAR).

Additional non-breeding bird surveys carried out during the winter of 2021/22 (report appended here at **Appendix 2**) also recorded whooper swans in this area, although there were no records of feeding birds within 500 m of the Proposed Development site.

Whooper swan has been subject to detailed assessment in Sections 7.5.3 – 7.5.5 of the EIAR and no significant effects are predicted. The reported sightings at Milltown do not affect the conclusions made within the EIAR with respect to whooper swan.

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6. *One submission refers to a sighting of a hen harrier within 2km of the wind farm in July-September 2021.*
Response:
Occasional records of Hen Harrier are to be expected across much of Ireland and a single hen harrier was recorded during surveys carried out to inform the EIA in April 2020 – see Section 7.3.1.2.4 of the EIAR. The hen harrier reported within 2 km of the Proposed Development site in 2021 is consistent with this. Given the low number of records significant effects on hen harrier are very unlikely and detailed assessment was not necessary. This approach accords with CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland, as set out in Section 7.2.4.1 of the EIAR.

7. *One submission highlights the lack of nocturnal surveys for barn owl.*
Response*:* As stated above, carrying out meaningful nocturnal flight activity surveys is very difficult, if not impossible, and nocturnal surveys for barn owl are no exception. Barn owls typically hunt at low elevations and are not generally considered to be at significant risk of collision with wind turbines or significant displacement due to wind turbines[6]. The lack of nocturnal survey for barn owl therefore doesn't affect the conclusions of the assessment.

8. *One submission states that the failure to consider white-tailed eagle is a conspicuous omission.*
Response:
White-tailed eagle was not recorded during the three years of survey reported in the EIAR, not was it recorded during the additional non-breeding bird surveys undertaken in 2021/2022 (report appended here at **Appendix 2**).

We are aware of recent records of white-tailed eagle in County Roscommon, but these are likely to represent rare occurrences and any regular flight activity by white-tailed eagle would have been picked up by the surveys. Impacts are only likely to be significant for species that were regularly recorded at the Proposed Development site and on that basis significant impacts on white-tailed eagle are unlikely, even if they did occasionally overfly the site.

9. *One submission contends that the predicted impacts on curlew due to collision, displacement and habitat loss should be considered to be of greater than regional importance. Another submission highlights a number of sightings of curlew on land at Ballyglass, Dysart.*
Response:
The rationale for considering the local curlew population to be regionally and not nationally important is set out in Table 7-9 in the EIAR. In summary, peak counts recorded during baseline surveys represent <1% of the Irish wintering population. Under the standard '1% criterion' method the presence of >1% of the international population of a species is considered internationally important; >1% of the national population is considered nationally important; etc. The level of significance of predicted effects cannot exceed the value of the local population.

Ballyglass is beyond 500 m from the closest proposed turbine and therefore lies outside the survey area for waders (the wader survey included a 500 m buffer in accordance with NS guidance). However, any curlew sightings within 500 m of the proposed turbine locations would have been recorded. Curlew has been subject to detailed assessment in Sections 7.5.3 – 7.5.5 of the EIAR and the reported sightings at Ballyglass do not affect the conclusions made within the EIAR with respect to curlew.

10. *One submission contends that the predicted impacts on black-headed gull due to collision, displacement and habitat loss should be considered to be of greater than regional importance.*
Response:

[6] *https://www.barnowltrust.org.uk/hazards-solutions/barn-owls-wind-turbines/*

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The rationale for considering the local black-headed gull population to be regionally and not nationally important is set out in Table 7-9 in the EIAR. The methodology used to determine importance is set out in Section 7.2.4.1 of the EIAR and summarised above in relation to curlew. As for curlew, the level of significance of predicted effects cannot exceed the value of the local population.

11. *One submission states that proposed timing restrictions on construction work during the breeding season would result in potential disturbance to wintering bird species.*
Response*:*
Mitigation to avoid damage to active nests, as set out in Section 7.5.2.1 of the EIAR, is required for legal compliance and represents standard good practice. Potential construction disturbance to wintering birds is considered in Section 7.5.3 of the EIAR and no significant effects are predicted, whether or not timing restrictions are implemented during the breeding season.

A fourth year of non-breeding bird survey was carried out during the winter of 2021/22. Results were not available at the time the EIAR and NIS were written but the report is appended here at **Appendix 2**. The results from the 2021/22 winter surveys were broadly similar to those recorded during previous winter surveys in terms of the suite of species, distribution and abundance of birds recorded. The conclusion made in the EIAR, that no significant disturbance effects are predicted during the non-breeding season, therefore remains valid.

2.2.3 Ecology/Biodiversity

Concerns raised by the DAU, addressed above at Section 2.1.4, overlap with some comments received from third parties with regards ecological and biodiversity issues. These are not repeated here.

Appropriate Assessment

Contrary to what is inferred in one submission, pine marten has no bearing on the Appropriate Assessment as they are not an Annex II species. This submission subsequently refers to 'Issues pertaining to failure to conduct an AA in two other Proposed Developments as assessed within the EIAR, rendering any cumulative impacts uncertain'. Stage 2 Appropriate Assessment was not required in the case of the two previous applications for temporary met masts within the Site (Pl. Ref: 21275 (ABP ref: PL20.313999) and Pl. Ref: 21274 (ABP ref: PL20.313998) given that an Appropriate Assessment Screening assessment was carried out for these applications in accordance with prepared in accordance with the European Commission's Assessment of Plans and Projects Significantly affecting Natura 2000 Sites: Methodological Guidance on the provisions of Article 6(3) and 6(4) of the Habitats Directive 92/43/EEC (EC, 2001) and Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (EC, 2018) as well as the Department of the Environment's Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities (DoEHLG, 2010). No pathway for significant effect was identified during the screening assessments for these temporary met masts, and therefore no requirement for a Natura Impact Assessment or full Appropriate Assessment was identified.

The met mast applications were assessed within the Appropriate Assessment Screening Reports in relation to development plans and other projects to identify any potential pathway for cumulative and/or in-combination impacts on European Sites. No potential pathways for effect on European Sites that could reasonably arise as a result of those plans or projects in combination with the Proposed Development were identified. At the time of the application for the temporary met mast applications, the design of the Proposed Development had not been finalised and no application was ready to be submitted. The NIS and EIAR reports submitted in support of the application for the Proposed Development fully assessed the two pending applications for the temporary met masts as part of the in-combination/cumulative assessments carried out within these documents. The Proposed Development also includes a proposed permanent met mast, which would replace the temporary masts should permission for the Proposed Development be granted; there is therefore no possibility that the two temporary met masts could result in any cumulative impacts in-combination with the Proposed Development.

An additional assertion within the submission in question that the met mast applications are functionally necessary to the Proposed Development and that this constitutes project splitting is erroneous; the meteorological masts that were the subject of previous applications are temporary in nature, and are not dependent on the approval of the associated wind farm (i.e. the temporary meteorological mast can be installed and operational whether or not a wind farm is constructed). Similarly, the Proposed Development is not dependent on the outcome of the temporary meteorological mast applications, which constitute their own, stand-alone applications. Therefore, the Proposed Development does not constitute project splitting.

Biodiversity Loss

A number of submissions cite a general concern that the Proposed Development would lead to a loss of biodiversity associated with the site of the Proposed Development and the surrounding area. In order to ensure that the Proposed Development will not negatively impact on biodiversity, a thorough assessment of the baseline biodiversity of the site was carried out to inform the biodiversity chapter of the EIAR (Chapter 6).

Ecological Receptors

The biodiversity chapter took full account of the value of ecological receptors recorded within the site, impacts on all receptors judged to be Key Ecological Receptors were fully assessed, and appropriate mitigation/compensation prescribed where required, to ensure that no significant effects on these receptors would occur as a result of the Proposed Development. The EIAR as lodged then is considered fully robust.

Biodiversity Assessment, Appropriate Assessment Screening and Natura Impact Statement

The Biodiversity assessment, AA Screening Report and NIS were prepared in full accordance with the EU Habitats Directive (92/43/EEC) together with the Birds Directive (79/409/EEC), as subsequently codified by Council Directive 2009/147/EC on the conservation of wild birds. Species and habitats provided National and International protection under legislative and policy documents have been considered in the EIAR Biodiversity Chapter.

Loss of Plants and Mosses

An ecological impact assessment has been carried out as part of the EIAR, Chapter 6 refers. The Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) lists the species, hybrids and/or subspecies of flora protected under Section 21 of the Wildlife Acts. It provides protection to a wide variety of protected plant species in Ireland including vascular plants, mosses, liverworts, lichens and stoneworts. Under Flora Protection Order it is illegal to cut, pick, collect, uproot or damage, injure or destroy species listed or their flowers, fruits, seeds or spores or wilfully damage, alter, destroy or interfere with their habitat (unless under licence). In establishing the ecological baseline, a wide-ranging desk study took place. A search of the NPWS online database for bryophytes (non-vascular land plants comprising of mosses, hornworts and liverworts) was also undertaken with no protected bryophytes recorded within or adjacent to the Proposed Development (NPWS, 2021). A full walkover of the Proposed Development Site also took place. Mosses were found to occur in scrub habitat and hedgerows. Vascular plants were considered within the EIAR also (Section 6.5.1.3 refers). The assessment concludes that the potentially significant effects on the Key Ecological Receptors identified have been avoided through infrastructure siting, project design and mitigated by the implementation of specific mitigation measures set out. It is ultimately concluded that *"Taking the above information into consideration and having regard to the precautionary principle, the Proposed Development will not result in a residual loss of any habitat of high ecological significance and will not have any significant impacts on the ecology of the wider area."*

Loss of Trees

Contrary to statements made by third parties, no tree loss is scheduled to take place as a result of the Proposed Development.

Nocturnal Wildlife

A third party submission raises concern with regards nocturnal wildlife crossing the turbine delivery route (TDR) through Monkstown from Athlone. The level of traffic increase at construction stage is minimal as demonstrated within Chapter 14 of the EIAR:

> *"...Assuming an 18-month civil works construction phase, this equates to approximately 1,157 no. loads per month or an average daily increase of 53 no. loads per day6 excluding Sundays and public holidays. On the basis of a 10-hour working day; this equates to an additional 5.3 no. vehicles utilising the public road network per hour. Given the characteristics of the existing road network, as described at Section 14.1.3 above, this increase is assessed to be negligible."*

The majority of construction traffic will be on the public road network during daylight hours. Typically, turbine component delivery to site will take place during night time hours. Whilst every operation to transport abnormal loads is different and requires careful consideration and planning, escort vehicles, traffic management plans, drive tests, road marshals and convoy escorts from the Garda Traffic Corps are all measures that are regularly employed to get unusual loads from origin to destination. As outlined in the Construction and Environmental Management Plan (CEMP) (Appendix 4-9 of the EIAR), *"The deliveries of turbine components to the site will be made in convoys of three to four vehicles at a time, and mostly at night when roads are quietest..."*

The CEMP lodged with the application (Appendix 4-9 of the EIAR) sets out at Section 3.6.1 the turbine and construction materials transport route. It notes:

> *"The delivery route for general Heavy Goods Vehicles (HGV) construction traffic will be via the R363, with traffic either coming east or west of the site. It is assumed that deliveries of smaller component parts for the wind turbines will follow the same route towards the Proposed Development. In practice the delivery route for these component parts could change, but as the associated traffic volumes are low, as established in Section 14.1.4 of the EIAR, the impacts will be minimal regardless of the route selected. A detailed traffic and transport management plan for turbine delivery will be prepared by the haulage company, when appointed and will be submitted to Roscommon County Council for approval..."*
>
> *"Prior to the Traffic Management Plan for turbine delivery being finalised, a full dry run of the transport operation along the route will be completed using vehicles with attachments to simulate the dimensions of the wind turbine transportation vehicles. This dry run will inform the final traffic management plan.*
>
> *All turbine deliveries will be provided for in a transport management plan which will have to be prepared in advance of the turbine delivery stage, when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. Such a transport management plan is typically submitted to the Planning Authority for agreement in advance of any abnormal loads using the local roads, and will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls."*

Furthermore, a project ecologist will report to the Environmental Clerk of Works (ECoW) at construction stage, and will be responsible for the protection of sensitive habitats and species encountered during the construction phase of the Proposed Development. In summary, it is concluded that significant effects on ecological receptors, including mammals, are not likely to occur following the implementation of the mitigation measures set out in the EIAR.

Badgers

Dedicated badger surveys were carried out to inform the EIAR as per best practice guidance. These surveys recorded two badger sett entrances within the Site, both of which were avoided by the layout of the Proposed Development. Where setts were identified, these were monitored using remote motion-sensitive cameras to establish usage by badgers and levels of activity, with only a single individual badger recorded entering one of the setts. Given that all setts have been avoided by the Proposed Development, and minimal intermittent use of one of the setts was recorded, potential for disturbance to badgers was assessed as slight at the local geographic scale in the absence of mitigation.

The EIAR fully assessed potential impacts on badgers; risk of collision with slow moving turbine delivery vehicles en route to turbine T4 was not judged to represent a risk of significant effects on the local badger population, and no specific mitigation was therefore prescribed in this regard. A pre-construction survey was specified in order to ensure that any new setts or sett entrances created in the intervening period prior to construction commencing, together with any notable increase in badger activity at setts can be identified and additional mitigation prescribed if necessary.

Other Faunal Species

Other faunal species including pine marten, Irish hare and hedgehog, as specifically mentioned in a single third party submission, were considered within the EIAR. A full rationale for the classification of ecological receptors as Key Ecological Receptors was provided in Section 6.6.4 of the EIAR. In relation to delivery traffic, traffic movements for delivery vehicles will be limited to 07.00 to 19.00 Monday to Friday and 08.00 to 13.00 on Saturdays with no movements on Sundays or public holidays. It may be occasionally necessary to undertake works outside of these hours to avail of favourable weather conditions, during extended concrete pours, or in the event of an emergency. As assessed within Chapter 14 of the EIAR, the increase in vehicles on public roads due to delivery traffic would be ‘negligible’, and strict speed limits are to be enforced within the Proposed Development Site for all construction vehicles. No potential significant effects on any fauna species has been identified associated with delivery traffic during the construction phase of the Proposed Development.

Habitat within the site was not optimal for pine marten and no potential den features for the species were identified. No potential for significant effects on populations of other fauna species in addition to those classified as KERs and brought forward for further detailed consideration, was identified and no specific mitigation for these species was therefore judged to be required or prescribed within the biodiversity chapter.

2.2.4 Hydrology

As noted earlier, Hydro-Environmental Services (HES) were requested to respond to hydrological and hydrogeological matters raised in prescribed bodies and third-party submissions in relation to the Proposed Development. HES have applied all of their knowledge and experience to the project, through the project development phase, the constraints mapping phase, and EIAR preparation work, including the cumulative impact assessment.

This section presents responses to reoccurring themes included in various non-statutory third-party submissions:

- Private Well Supplies;
- Extent and flooding of turloughs in the vicinity of proposed Seven Hills windfarm;
- Karstified landscape;
- Flood Risk; and,
- Formation Level of T4 (Flooding).

Private Well Supplies

As outlined in the EIAR (Section 9.3.1.3), groundwater (and the underlying aquifer) at and below the site is considered very sensitive to pollution and the primary risks to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources will be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.

The potential risk to local wells was also assessed in the EIAR based on the 2 no. surveys of local groundwater wells which have been carried out, by Waterwise Environmental in June 2010 (refer to EIAR Section 9.3.7.8.1) and more recently by HES in 2019/2020 (refer to EIAR Section 9.3.7.8.2) and the known groundwater levels which have been monitored over an 18 month period.

> *"Of the 110 private residences visited in 2010, only 7 no. active wells were identified".*
>
> *"Known winter groundwater levels are significantly below the proposed formation levels of all turbines, and as such we can confirm there will be no groundwater dewatering requirements during turbine base construction".*

The hydrogeological conceptual model of the site was described as follows:

> *"The bedrock has been classified as a Regionally Important aquifer by the GSI, however the site data from HES boreholes and IGSL boreholes indicates that where groundwater has been met in site investigation wells, groundwater inflows are slow, i.e. relatively low permeability in the bedrock and not ubiquitously karstified as has been suggested."*
> *"No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations (as proven by the site investigation drilling);*
>
> *Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited seepage from localised permeable subsoils;*
>
> *As such any shallow groundwater seepage (within the subsoils) will be small in comparison to the expected surface water flows following any heavy rainfall events".*
>
> *"The implementation of the drainage design measures, ensures that recharge to the aquifer will not be altered, thus downgradient water levels will not be altered. As such, there are no well supplies down-gradient of the Northern or Southern Clusters that can be affected by temporary dewatering during turbine base construction".*

The potential impact on local groundwater wells was thoroughly assessed in the EIAR. This assessment was based on the properties of the underlying bedrock aquifer, the recorded thickness of overburden/subsoil deposits, the recorded depth to groundwater levels, and the location of the nearest wells.

To summarise, the purpose of the EIAR is to assess likely significant effects. We are satisfied, based on the prevailing hydrogeological conditions at the Proposed Development site, that the assessment of potential impacts to groundwater quality and quantity (groundwater levels and flows) remote from the Proposed Development site, is negligible. HES is satisfied that this assessment is valid and underpinned by a comprehensive geological and hydrogeological dataset.

Extent and flooding of Turloughs in the vicinity of Windfarm

Turloughs missing from assessment, flooding from turloughs

As outlined in Section 9.3.7.6 of the EIAR and shown on Figure 9-13, 15 no. annually occurring, mapped turloughs have been identified as proximal to the Proposed Development site. Groundwater loggers were installed at 8 no. turloughs to monitor groundwater levels over an 18-month period, providing data on maximum and minimum water levels and the seasonal variation in these water levels. Further maximum and minimum water levels were attained from aerial photography, where access to the turloughs was not possible/permitted.

HES has built up a large dataset of information on the turloughs in the area, which have been a key aspect of the EIAR assessment of the water environment from the inception of the project. These data have provided a widescale baseline understanding of the behaviour of the turloughs over a large geographical area (~150km^2). All waterbodies that have been historically noted as turloughs or are designated as turloughs have been carefully assessed. The overall behaviour of water levels within the turloughs proximal to the Proposed Development Site has been conceptualised and understood.

From this baseline data, a concise impact assessment on the potential effects of the Proposed Development on turloughs (designated and non-designated) has been completed within Section 9.4.2.8 and 9.4.2.10.1 of the EIAR.

Extensive site investigations have been undertaken within the Proposed Development Site, particularly near the proposed turbine locations. These site investigations, listed in detail in Section 9.3.7.2 including 285.7m of borehole drilling within the Northern cluster and 394.6m of borehole drilling within the Southern cluster. Along with the borehole drilling, an extensive program of 112 no. trial pit excavations have been completed across the Northern and Southern Cluster (refer to Sections 8.3.3.1 and 8.3.3.2 of Chapter 8 of the EIAR). The construction works associated with the Proposed Development are near surface works, with no deep excavations.

This extensive set of geological site data and monitored turlough water level data have informed our assessment of potential effects on turloughs. Based on all collected scientific data, we reaffirm our conclusion within Sections 9.4.2.8 and 9.4.2.10.1 of the EIAR, that there will be no significant effects on turloughs (designated and non-designated) as a result of the Proposed Development.

Feacle South turlough not monitored, potential impacts on Feacle/Killeglan Spring.

Feacle South is situated 0.9km south of Feacle Lough. Feacle South is not identified as a turlough within the GSI karst database and is a much smaller body of water in comparison to Feacle Lough, however Feacle South is identified and shown within Figure 9-13 (Mapped turloughs near the Proposed Development). HES has conducted water level observations and data collection within Feacle Lough (21st January -18th June 2020 and 22nd October 2020-13th July 2021), which is situated north of Feacle South and thus closer to the proposed Southern Cluster of the Wind Farm Site.

The baseline data relating to recorded water levels in Feacle Lough, the hydrogeology of Feacle Lough including its traced karst line to Killeglan Spring and its status as a designated site (pNHA) have been detailed in Section 9.3.4, 9.3.5, 9.3.7, 9.3.12 and 9.3.13 of the EIAR.

Potential impacts on Feacle Lough have been identified within Sections 9.4.2.1, 9.4.2.2, 9.4.2.8 and 9.4.2.10 of the EIAR. In each case, following the implementation of the proposed mitigation measures, the conclusion was that there would be no residual effect on Feacle Lough turlough.

The impact assessment considers the significant volume of site investigation data we have within the Proposed Development site, particularly near T16-T18 in this case, which are situated north of Feacle Lough and Feacle South. The considerations of the impact assessment, namely the thickness of the overburden, the competent bedrock underlying T16-T18 and the data on groundwater levels and permeability in this area are applicable when considering Feacle South also. As Feacle South is situated 0.9km south and hydraulically downgradient of Feacle Lough, it holds that any impact assessment (in terms of the water environment) on the hydraulically upgradient Feacle Lough are applicable to the hydraulically downgradient and distal Feacle South. Therefore, there will be no residual effects on Feacle South as a result of the Proposed Development.

The potential impacts on Killeglan Spring have been assessed in Section 9.4.2.11 of the EIAR. The impact assessment considers all site data recorded near T16-T18, particularly those data pertinent to the area of the Southern Cluster situated within the Killeglan Spring ZOC. Section 9.4.2.11 states:

> *"Winter groundwater levels near T17 measure ~69.5 m OD, while the ground elevation measures~90 m OD. There is ~4.5 - 4.8m of overburden (COBBLES and GRAVEL) at T17 overlying Strong to very Strong fine to medium grained Limestone with no water strikes recorded during the drilling of the site investigation boreholes. This provides a good depth of subsoil protection over an unproductive aquifer zone, where maximum water levels are at least 20m below ground during Winter.*
>
> *Winter groundwater levels near T18 were dipped by IGSL at ~83 m OD following the initial drilling of rotary core boreholes (this only an indicative water level as water level dipping straight after drilling can be slightly erroneous). The subsoils at T18 are logged as 4.1 - 4.5m of sandy gravelly COBBLES and sandy GRAVEL. The underlying bedrock is logged as Limestone with no fractures noted or groundwater strikes recorded.*
>
> *The area of Proposed Development site which is located within the mapped Zone of Contribution is negligible (1.53 Ha) within the scale of the overall catchment (4218.5 Ha) to the Spring. (0.36 %)."*

The Killeglan Spring has been clearly identified within the impact assessment contained within Chapter 9 of the EIAR. The impact assessment within Section 9.4.2.11 states no significant effects on the Killeglan Spring PWS will occur and the significant database of site-specific data justifies this conclusion.

Karstified landscape

HES accepts that the area is mapped within an area of karstified limestone bedrock. This mapping is identified within the EIAR chapter, as well as the mapped karst formations within the area.

Section 9.3.4 of the EIAR states:

> *"There is a clear relationship between the topography and the mapped karst hydrology. The majority of mapped enclosed depressions, swallow holes and springs are on low lying lands which are generally under grassland. The hills in the area [*i.e. *Wind Farm Site], generally at 70 – 100m OD are more often under rough grazing land and devoid of any hydrological or karst-type features."*

The volume of site data collected on borehole drilling (285.7m of borehole drilling within the Northern cluster and 394.6m of borehole drilling within the Southern cluster) clearly shows that bedrock is not significantly karstified below the Proposed Development site.

The site-specific geological logs are summarised within Section 8.3.4.1 and 8.3.4.2 of the EIAR which details the observed geology at the Southern Cluster and Northern Cluster of the Proposed Development Site. These data show that rather than being a high permeability karstified bedrock, the geology of the Proposed Development site is characterised as Limestone bedrock overlain by a substantial thickness of overburden with the bedrock typically a strong, dark grey bioclastic Limestone with weathered zones and intermittent clay infilled fractures. Water supplies from the underlying limestone are difficult to obtain (hence the widespread use of rainwater harvesting in local farms).

In addition, using the comprehensive site investigation dataset for the site the wind farm infrastructure has been purposefully located to avoid underlying karst.

Potential effects on Flood Risk

Thomas Street turlough is known to flood, as outlined in Section 9.3.5, which states:

> *"The Thomas Street turlough at Dysart (flood record I.D-1772) floods every 2-3 years, with the R357 being liable to flooding from this turlough approximately every 10 years".*

A detailed Flood Risk Assessment for the Proposed Development is included as Appendix 9-1 to the EIAR. The maximum Winter Water Level is identified as being 57.5mOD with the nearest proposed turbine at 72mOD. There will be no impact on flooding at Thomas Street Turlough as a result of the Proposed Development. There will be no impact on potential flooding at Thomas Street Turlough on the Proposed Development.

Formation Level of Turbine T4

The submission from the Wind Turbine Action Group South Roscommon states:

> *"Section 4.4.2 of the EIAR examines more closely the relationship between T4 and the nearby Gortaphuill turlough and concludes that "groundwater flooding at T4 is therefore highly unlikely". Section 4.4.2 conflicts with Table 8-6 in Section 8 of the EIAR. The formation level of T4 is 67.5mOD according to Table 8-6 which is approx. the same Winter Water Level of Gortaphuill."*

For reference, Section 4.4.2 of the EIAR refers to Appendix 9-1 (Flood Risk Assessment).

A detailed flood risk assessment on the Gortaphuill turlough and the proposed turbine T4 is included in this section. The maximum Winter groundwater level recorded was 67.34mOD.

A cross-section indicating the maximum recorded flood level in relation to the proposed turbine T4 is given in Figure H of Appendix 9-1.

Table 8-6 of Chapter 8 within the EIAR details the ground conditions at the turbine locations, the proposed foundation type as well as the formation level and the proposed stone upfill depth. This is the formation level of the base of the excavation (4.5mbgl), with a stone upfill of 1.5mbgl, i.e. base of the turbine foundation will be 3.0mbgl. The current ground elevation at T4 is 72 mOD and with a base of turbine foundation at 3.0mbgl, the final turbine base formation level is 69mOD, as outlined within Appendix 9-1. This is the level considered within the Flood Risk Assessment and concludes that the formation level is ~1.6m above the maximum recorded winter water level.

Notwithstanding the above, it is important to reiterate the following:

- T4 is not located within the footprint of Gortaphuill turlough;
- T4 is located 58.99m southwest of the maximum flood extent of the Gortaphuill turlough;
- The current ground level at the location of the proposed turbine T4 is 72mOD;
- The proposed turbine base formation level at T4 is 69mOD;
- The highest water level recorded in Gortaphuill turlough is 67.34mOD;
- The highest water level recorded in Gortaphuill is therefore ~1.6m below the formation level of turbine T4;
- The placement of proposed turbine T4 will not create any potential for volume change within the existing Turlough and therefore there is no potential for impact on flooding in Gortaphuill;

- Also, in relation to protection of water quality in Gortaphuill turlough, the following mitigation measures will be implemented, as outlined within the EIAR:
    - The closest turbine to a surface water feature is Turbine T4, within the Northern Cluster which is situated adjacent to Gortaphuill turlough. Gortaphuill is a temporary surface water body present throughout certain months of the year, and as with all turloughs near the site, does not exist between ~May-November, thus construction proposed between May - November will not impact on the turlough;
    - Buffer zones have been applied to turloughs to ensure adequate space for drainage management and control during the construction phase; and,
    - Where a proposed turbine location is near an existing turlough (as is the case at T4), 3 no. lines of Terrastop silt fence will be erected to provide a physical separation, which will trap any suspended sediment entrained in water flowing downhill from the works area Seasonal working constraints will also be applied at T4, whereby no earthworks will occur on the access track to T4 or at T4 when there is water in Gortaphuill turlough.

The Flood Risk Assessment at Appendix 9-1 of the EIAR defines the turbine base formation level at turbine T4 and the maximum water levels recorded at Gortaphuill turlough. The assessment concludes, and we maintain, that there will be no effects on flooding at the Gortaphuill turlough and the annual water level fluctuations within Gortaphuill turlough will not result in flooding of any part of the Proposed Development.

The mitigation measures, which will be implemented during the construction phase of the Proposed Development, will ensure that there will be no residual effects on Gortaphuill turlough as a result of the Proposed Development.

Response Summary

Submissions have been made by Statutory Bodies, the Local Authority, and third-parties relating to potential impacts on the Water Environment and the Land, Soils and Geological Environment. Our responses to those submissions are summarised as follows:

- The issues raised by the GSI were known at EIAR stage and were considered carefully during the design process for the wind farm layout. Where possible design by avoidance has already been adopted. Where overlaps with the CGSs occur we consider that potential impacts are small, and they will not effect the integrity of the CGSs. A series of mitigation and monitoring are proposed in-line with the GSIs suggestions. The issues raised by the GSI in respect of "groundwater" are comprehensively addressed in the submitted EIAR;

- The issues raised by the DAU (NPWS) in respect of "designated sites and other wetlands"
  are comprehensively addressed in the EIAR. Updated mapping at a larger scale is provided for clarity. We also note that Commons and Gortaphuill turloughs do not overlap with the development footprint of the Northern Cluster, and there are no turbines located within any mapped turlough area. Karst features (dolines and turloughs) have been comprehensively mapped and assessed within the EIAR;

- Roscommon County Council was concerned about groundwater vulnerability and potential impacts from hydrocarbons. Our assessment of groundwater vulnerability in the EIAR is underpinned by the dense dataset of geological investigation points we have amassed across the proposed site. Detailed mitigation measures with respect to hydrocarbons are referenced from the EIAR. Clarifications in respect of issues raised relating to the Killeglan PWS are provided. The impact assessment within Section 9.4.2.11 of the EIAR states no significant effects on the Killeglan Spring PWS will occur and we are confident that our significant database of site-specific data justifies this conclusion;

In respect of third-party submissions:

- The potential for the proposed development to impact remote groundwater wells is negligible. Our comprehensive geological and hydrogeological dataset is used in our assessment to inform this conclusion.
- We are satisfied that our assessment of turloughs and flooding as presented in the EIAR is comprehensive, and it is underpinned by significant volumes of geological and hydrogeological data. There will be no significant effects on turloughs (designated and non-designated) as a result of the Proposed Development.
- We are satisfied that no significant effects on the Killeglan Spring PWS will occur as a result of the Proposed Development and the significant database of site-specific data supports this conclusion.
- A detailed flood risk assessment was submitted with the application. The Proposed Development will not effect the existing flooding regime at Thomas Street turlough.
- It is clearly explained why there will be no effect (in terms of water level, flooding, and potential water quality impacts) from T4 on Gortaphuill turlough.

2.2.5 Noise

Two third party submissions raise matters pertaining to noise. Noise has been fully considered in the EIAR as lodged – Chapter 11 refers.

Noise impact assessments have been prepared for both the construction, operational and decommissioning phases of the Proposed Development to the nearest Noise Sensitive Locations (NSLs). To inform this assessment, background noise levels have been measured at several locations, representative of the nearest NSLs in the vicinity of the site to assess the potential impacts associated with the operation of the Proposed Development. The current Wind Energy Development Guidelines for Planning Authorities, published by the Department of the Environment, Heritage and Local Government in 2006, defines a noise sensitive location as any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. In this instance, all of the NSLs are dwellings.

Existing, under construction, permitted and proposed wind farm developments have been identified in the wider study area and it was found the nearest existing wind farm is the Skrine Wind Farm which lies at c. 9km to north of the Proposed Development. Therefore, a cumulative assessment is required. This is in line with guidance set out in the Institute of Acoustics (IoA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG).

Full detail of the approach to the noise modelling undertaken is set out in the EIAR at Section 11.3.7 The predicted cumulative turbine noise level from the Proposed Development and other wind farms is set out at Section 11.6.5 of the EIAR. It concludes:

> *"There is no other wind farm development, existing or proposed within 5km of the Proposed Development. The nearest operating wind farm is Skrine at a distance of 8.5km.*
>
> *It is therefore considered that a significant effect is not associated with the Proposed Development in combination with other wind farm developments."*

The Chapter finds that:

Seven Hills Wind Farm (ABP-313750-22)

"Based on detailed information on the site layout, turbine noise emission levels and turbine height, worst-case turbine noise levels have been predicted at NSLs for a range of operational wind speeds.

The predicted noise levels associated with the Proposed Development will be within adopted noise limits recommended in Irish guidance, therefore it is not considered that a significant effect is associated with the development.

Noise from the proposed onsite electrical substation has also been assessed and found to be within the adopted criteria.

No significant vibration effects are associated with the operation of the site.

In summary, the noise and vibration impact of the Proposed Development is not significant in the context of current national guidance."

With regards human health and environmental noise, Section 11.3.2.2.5 of the Chapter discusses in detail the World Health Organisations Noise Guidelines for the European Region (2018). Health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise,

are set within the Guidelines. In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

*"For average noise exposure, the GDG **conditionally recommends** reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects.*

No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.

*To reduce health effects, the GDG **conditionally recommends** that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

[Emphasis added]

The quality of evidence used for the WHO research is stated within the WHO document itself as being 'Low', the recommendations are therefore conditional.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

"Even though correlations between noise indicators tend to be high (especially between LAeqlike indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This

can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...

...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

Low frequency noise/infrasound is also addressed in the EIAR Chapter at Section 11.3.3.1. It states:

"Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011) is noted here:

"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."

With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document Community Noise (WHO, 1995) has stated that:

"There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects."

In summary, considering the modernisation of wind turbines and the conclusions of the studies quoted in the Chapter, infrasound associated with wind turbines is insignificant in comparison to typical prevailing levels of infrasound and is below the threshold of hearing for humans even in proximity to turbines before set-back distances of hundreds of metres are taken into account.

One submission makes reference to the northern cluster of turbines being "*in close proximity to a local primary school.*" While no precise name or location is offered up, we presume this to be Ballintleva National School. The school lies more than 800m east/southeast from the nearest turbine (T4). The school was included in the Noise Sensitive Locations as NSL H220 (Appendix 11-5 refers). Any locations that fell inside the predicted 35 dB LA90 noise contour were considered for noise monitoring in line with current best practice guidance outlined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits, discussions with locals and supplemented by reviewing of aerial images of the study area and other online sources of information (e.g. Google Earth). Those locations selected for noise monitoring are set out in the EIAR Chapter at Table 11-4.

The information before the Board is robust and has been carried out in line with current standards and best practice guidelines. The submitted EIAR assessment demonstrates that the Proposed Development can operate without significant effects on the amenity of any sensitive receptors.

2.2.6 Traffic and Transport

Concerns were raised in third party submissions regarding the delivery of material and turbine components to site via the R363, with reference to commuter traffic and fatalities along this route. As set out at Section 4.4.4 (Chapter 4) of the EIAR, procedures for the delivery of turbine components are well established. In general, these deliveries will be undertaken during night-time hours when levels of road usage are significantly diminished to minimise disruption to road users. Additionally, such deliveries will be accompanied by escort vehicles, to warn oncoming traffic, and An Garda Síochana, as required, to ensure that road safety is maintained.

Section 14.1.5.1 (Chapter 14) also commits to the agreement of a Traffic/Transport Management Plan with Roscommon County Council prior to the commencement of development which will provide further detail and clarity on specific traffic management procedures.

Overall, it is assessed that the construction, operation or decommissioning of the Proposed Development does not pose a significant risk to roads, traffic, transport or access; and that any road safety concerns can be appropriately managed through traffic management procedures. Indeed, this is acknowledged by the Roscommon County Council Roads Department who state, at page 41 of their observation, that the delivery of materials "*…is a matter which can be adequately planned for and managed with minimum levels of disruption to the general road user…*".

In relation to concerns raised in third party submissions regarding interactions between biodiversity and construction traffic, specifically the crossing of the R363 by nocturnal wildlife, the Board should refer to Section 2.2.3 of this response document.

One comment has been made by a third party regarding the proximity of a proposed access track to a residential dwelling and the likelihood of noise and air quality effects questioned. The likely air quality effects and noise effects and arising from the construction, operation and decommissioning of the proposed development have been assessed at Chapter 10 and Chapter 11 of the EIAR respectively. During the construction phase, air quality effects are, following the implementation of appropriate mitigation, assessed to be short-term, imperceptible and negative. During the operational phase (Section 10.1.5.3.1 [Chapter 10]), site maintenance activities are assessed as likely to result in a long-term, imperceptible, and negative effect; however, the operation of the Proposed Development (wind turbines) is assessed as resulting in a long-term, significant and positive effect (Section 10.1.5.3.2 (Chapter 10)) due to the generation of electricity from renewable sources and the displacement of fossil-fuel generated electricity. During the construction phase, associated traffic noise is assessed, at Section 11.5.2.2 (Chapter 11), as likely to result in a short-term, slight-to-moderate and negative effect. During the operational phase (Section 11.5.3.2 [Chapter 11]), no significant noise levels are assessed as likely to occur. In conclusion, therefore, it can be confirmed that the Proposed Development is not assessed as likely to give rise to any significant adverse noise or air quality effects.

2.2.7 Telecoms

Matters on telecommunication were raised in one third party submission. Telecommunications is addressed in full at Section 14.3 of Chapter 14: Material Assets of the EIAR as lodged. The submission raises no new issue not already addressed within the Chapter. The methodology employed in assessing the likelihood of significant effects on telecommunication networks consisted of desk-based research and consultation with various telecommunication providers and relevant authorities. Scoping was also undertaken, as detailed out in Table 14-5 of the Chapter. The constraints presented are incorporated into the project design. The EIAR addresses in full the potential for interference to occur with electromagnetic transmissions as well as mobile phone and broadband signals and no significant affects are assessed as likely to occur from the construction, operation or decommissioning phase notwithstanding that, the operation of the wind farm may result in some localised interference to television signals in the aera. As is standard practice in the industry, the Applicant has entered into a

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protocol agreement with 2rn to ensure that any complaints received from the local public concerned are appropriate remedied. Appendix 14-5 of the EIAR provides full detail in this regard.

2.2.8 Property Values

A single third-party submission, expressed concern about the potential loss of property value as a result of the Proposed Development. Chapter 5 section 5.6 of the EIAR provides evidence in the absence of any Irish studies on the effect of wind farms on property values and provides a summary of the largest and most recent studies from the United States and Scotland. Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described demonstrates that at an international level, wind farms have not impacted property values in the local areas. Based on the available international literature, that the provision of the Proposed Development, at the proposed location, would not impact on the property values in the area.

2.2.9 Cultural Heritage

It is noted that matters relating to cultural heritage/archaeology have been raised in third party submissions. Dermot Nelis Archaeology prepared Chapter 13 of the EIAR which assessed and defined any likely significant environmental impacts or effects which the construction, operation and decommissioning of the Proposed Development may have on the archaeological, architectural and cultural heritage resource. The Chapter includes an identification of likely significant impacts or effects which may arise and outlines mitigation measures, based on current information, which may be used to avoid, reduce or offset any likely significant adverse effects.

Reference was made in a submission to An Bord Pleanála to the refusal on archaeological grounds by Wicklow County Council and An Bord Pleanála for Kilranelagh Wind Farm in County Wicklow (Pl. Ref: 2160 and ABP ref: ABP-309955-21). The Proposed Development however and the refused Kilranelagh Wind Farm cannot be compared on archaeological grounds, as the wind farms are in very different archaeological landscapes.

Archaeological Landscape

The landscape surrounding the Proposed Development contains monuments which can be considered to be of local or regional significance. In contrast, the landscape surrounding Kilranelagh Wind Farm contains monuments of National and International significance.

The difference in the significance of the archaeological landscapes between the Proposed Development and the refused Kilranelagh Wind Farm is confirmed by the Submissions made to Wicklow County Council and An Bord Pleanála for Kilranelagh Wind Farm. It was noted by the Kilranelagh Wind Farm An Bord Pleanála Inspector (Inspector's Report 8.16.25, page 103) that "*a significant number of the observations came from outside of Ireland and this suggests that the site* (the Baltinglass area) *is of importance on a European level*".

During consideration of the Kilranelagh Wind Farm application, several submissions were received which require to be noted here:

- The Heritage Council in a Submission to Wicklow County Council noted that *"what is clear from this work (archaeological fieldwork and research) is that the Baltinglass landscape is critical for the understanding of hillforts in Ireland and this is of international significance".* The Submission from the Heritage Council to Wicklow County Council goes on to state "*while previously this complex was assumed to be of national significance, it can now be stated that this complex is of international significance based on the occupation sequence identified through archaeological excavation".* The Submission from the Heritage Council to Wicklow County Council

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concludes by stating *"We will also suggest that given its international significance and value in due course consideration should be given to making a submission to Ireland's UNESCO World Heritage Site (WHS) Tentative List for the Baltinglass Hills hillfort complex".*

- The An Bord Pleanála Inspector noted (page 11 of the Inspector's Report) that the Department of Tourism, Culture, Arts, Gaeltacht, Sports and Media recommended refusal of permission for Kilranelagh Wind Farm "*due to the potential impact of the development on archaeology in the area. The area is considered to be a sensitive landscape in terms of archaeological remains in the area. The construction phase, which includes access track widening, tree removal and the provision of hardstanding would have a significant negative impact. The development would have a negative visual impact through the proposed wind turbines and the need to clear trees/provide for areas of hardstanding. Also, there are potential negative impacts from noise and the development of the heritage trail".*
- Professor Joanna Brück, University College Dublin School of Archaeology, noted in a Submission to Wicklow County Council that the Kilranelagh Wind Farm development area "*is a core element of one of the most important clusters of Neolithic and Bronze Age monuments in Ireland, including hillforts, passage tombs and stone circles. The hillforts in this region, which includes some of the largest such monuments in Ireland, are particularly unusual for their number and density, and they have been the subject of longstanding and internationally-recognised fieldwork by the Department of Archaeology, University College Cork. Across Europe, hillforts are viewed as an Iron Age phenomenon, but UCC have demonstrated through excavation that several of the hillforts in this group have origins in the Neolithic. The hillfort on Kilranelagh Hill lies immediately adjacent to the location of the proposed wind farm. In addition to hillforts, West Wicklow boasts one of the main concentrations of stone circles outside of Cork and Kerry, and the stone circle at Boleycarigeen lies at the heart of the development. This is a fine example of an embanked stone circle, a category of monument about which very little is currently understood".*
- A submission to Wicklow County Council regarding Kilranelagh Wind Farm from Professor William O'Brien, University College Cork Department of Archaeology, who is an acknowledged expert on the prehistory of the Baltinglass area and who has carried out large-scale fieldwork and research there, noted that "*along with other important monuments in the area, Baltinglass is emerging as one of the great archaeological landscapes in Ireland, up there with Tara, Loughcrew and the Boyne Valley".*
- A Submission to An Bord Pleanála regarding the Proposed Development states that County Roscommon has 18 hillforts and County Wicklow has 16 hillforts. This is incorrect as there is one hillfort recorded in County Roscommon (www.archaeology.ie), whereas there are eight hillforts recorded in the Baltinglass area and 13 in total in County Wicklow (www.archaeology.ie). The Submission from the Department of Tourism, Culture, Arts, Gaeltacht, Sports and Media for Kilranelagh Wind Farm to Wicklow County Council states that "*nine of the largest hillforts in the country are located in this Baltinglass area, the only place with more than two such sites".*

The above clearly demonstrates that the Proposed Development and the refused Kilranelagh Wind Farm cannot be compared, as the Kilranelagh Wind Farm would have been located in an archaeological landscape of international significance. Direct and indirect effects of Kilranelagh Wind Farm would have resulted in significant negative impacts on highly visible monuments of international importance. By contrast, the Proposed Development will be located in a landscape of local or regional significance which does not contain any archaeological monuments of national importance.

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Development Plan

Kilranelagh Wind Farm was also refused planning permission by Wicklow County Council and An Bord Pleanála as it would have contravened stated Objectives of the Council in the Wicklow County Development Plan 2016-2022 in relation to protection of the archaeological heritage. Unlike Kilranelagh Wind Farm, the Proposed Development does not contravene any Built Heritage Policy Objectives of Roscommon County Council in the Roscommon County Development Plan 2022-2028. In fact the proposed Seven Hills Wind Farm satisfies Built Heritage Policy Objective BH 9.13 (archaeological heritage) of the Roscommon County Development Plan (2022), as BH 9.13 allows for preservation by record of monuments that may be impacted by permitted development. In addition, Built Heritage Policy Objective BH 9.13 of the Roscommon County Development Plan (2022) states "*Roscommon County Council will have regard to the advice and recommendations of the National Monuments Section of the Department of Housing, Local Government and Heritage*". It is important to note that, unlike with Kilranelagh Wind Farm, the Department of Housing, Local Government and Heritage did not raise any objections to the Proposed Development.

Protected Structures

Reference was made in a submission to the Board regarding Protected Structures in the vicinity of the Proposed Development. All Protected Structures referenced in the Submission to An Bord Pleanála within 5km of the EIAR site boundary were assessed in the Cultural Heritage chapter of the EIAR. It was confirmed in the Cultural Heritage chapter of the EIAR (Section 13.3.3.1) that there are no Protected Structures recorded in the Roscommon County Development Plan (2022) within the EIAR Site Boundary. It was confirmed in the Cultural Heritage chapter of the EIAR (Section 13.3.3.2) that there are 19 Protected Structures recorded in the Roscommon County Development Plan (2022) within 5km of the EIAR Site Boundary, with the closest (Mountsandford Lodge) being located 1km from the EIAR site boundary. It was confirmed in the Cultural Heritage chapter of the EIAR (Section 13.4.4.6) that the construction phase of the Proposed Development will have no direct impact on any Protected Structures. It was assessed in the Cultural Heritage chapter of the EIAR (Section 13.4.6.7) that the Proposed Development will have a long-term, reversible and slight operational phase negative visual impact on the setting of Protected Structures within 5km of the EIAR Site Boundary. Following decommissioning, any slight impacts on the setting of Protected Structures will be reversed.

2.2.10 Community Engagement

Appendix 2-2 of the EIAR submitted with the Strategic Infrastructure Development application comprises a *Community Consultation Report.* This community consultation report consists of a full and detailed account of consultations undertaken preluding the lodgement of the wind farm application.

A dedicated project Community Liaison Officer (CLO) began engaging with local residents in the vicinity of the development lands in early 2020. The CLO provided project updates using a number of strategic communications channels to keep both the immediate and wider community informed and updated about the project throughout the different stages of the development. Information and data on the numerous community consultations carried out is summarised in Appendix 2-2 of the EIAR.

For ease of reference, this report is summarised again here in this section of this response to submissions.

Community Engagement Strategy

- **Dedicated project Community Liaison Officer (CLO)**
  - The CLO contacted households and businesses directly within a 2km radius by post and on door-to-door visits, providing project information with contact details and responding to queries in person, by phone or via email. The project CLO is on hand to respond to queries and keep households,

businesses, locally elected representatives, and community groups updated on project developments and activities throughout the development, construction and operational phases of the project.

- **Freepost card**
  - Households within a 2km radius of the project received a freepost comment card, inviting residents to send any questions or highlight any concerns about the project to the SHWFL team.

- **Freephone service**
  - The freephone number 1800140232 was included in all communications, allowing members of the community to contact the SHWFL team free of charge and receive a call back from the project team.

- **Responding to queries**
  - Project queries were acknowledged in a timely fashion with follow-up information provided. Contact details were provided on all communications, including email addresses, mobile numbers and freephone service, in the event that any correspondent or consultee felt their query had not been answered or had further questions.
- **Project website**
  - A stand-alone project website was created and updated with new information when it became available, including photomontages and final site layout. Contact details were made available, including the project freephone number. Presentation slides and the information brochure were also available to view on the site.

<u>Covid</u>

The Covid-19 pandemic led to necessary changes in the pre-application community consultation process. In light of the official lockdown in early 2020, the first scheduled public meeting was postponed. Instead, the dedicated project CLO carried out two further mail drops within 2km of the Proposed Development site and organised individual or household consultation meetings, or clinics, by appointment in July 2020 and again in July 2021. This was to ensure that members of the community were able to meet the team in person to discuss project updates.

- **Public information events**
  - A series of information clinics were held in three locations in July 2020. Members of the public who made appointments and attended the sessions were told that the SHWFL team would organise a further series of information events to discuss the final site layout. These clinics took place in July 2021.

  - Photomontages of turbines from key vantage points were made available for viewing on a TV screen during the in-person clinics. Internet connections in all three venues were generally good throughout the day.

  - The same images, along with a draft and then final site layout, were also available to view in detail on the project website for anyone not attending the clinics or wanting follow-up information.

- **Virtual exhibition**
  - A virtual exhibition was made available to view on the SHWFL project website at the same time as the in-person information clinics were taking place in July 2020. This online exhibition allowed anyone not attending the

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    - clinics to view the same information pull-up banners, photomontages and site layout. A brochure which had been posted to properties within a 2km radius of the project was also made available for download and viewing.
    - In light of poor broadband coverage in some areas, the SHWFL team informed anyone wanting to view the virtual exhibition that it could take time to load.

- **Feedback forms**
    - Feedback from consultees is welcomed and the CLO would normally provide forms to collect written comments for the community consultation report. However, Covid-19 protective measures made this more difficult.

    - When the first clinics commenced in July 2020, the CLO was unable to hand out forms and initially attempted to complete a form together with the first consultee. It was realised that this was an inappropriate process and the consultee was later informed by email, explaining that any information written on that form would not be included in the consultation report. It was requested that they fill out a new blank form which could be returned via email. All other consultees on the first day were emailed blank forms. At subsequent clinics consultees were requested to fill out forms on the day with fresh pens, which were not shared. Comments were followed up in response to requests for further information and categorised and logged by topic for the purposes of the Community Consultation Report.

    - As soon as the CLO was made aware that a mistake had been made on the first consultee's form, apologies were offered for any anxiety caused.

    - SHWFL take their responsibility to safeguarding members of the public, community hall staff and the team during the continuing Covid-19 pandemic very seriously. SHWFL are committed to a genuine and transparent consultation process with the community and consider, and respect all views.

- **Photomontages**
    - A number of residents requested additional photomontages from viewpoints at their homes. As many of these requests as possible were accommodated, while the photomontage team were on the ground and available to complete this work.

Community Benefit Fund

- **Funding**
    - SHWFL has committed to the operation of a community benefit fund, based on a minimum of €16,000 per turbine per annum for the lifetime of the project. The allocation of grants will commence one year after the start of commercial operation.

- **Pre-application needs scoping research**
    - SHWFL commissioned needs scoping research carried out by an independent charity consultant as an initial step to encourage community discussion about the proposed SHWFL benefit fund. Research was based on phone conversations following an agreed set of questions with over 30 individuals – all representatives of local community groups.

- This research was not designed to be comprehensive, but rather a first step in a process which will tailor the wind farm benefit fund to meet the needs of the local area.

The dedicated Community Liaison Officer remains available to members of the public to answer queries regarding the project and to provide project updates. The CLO will be the first point of contact throughout development, construction and operation should planning permission be granted for the Proposed Development. The team are committed to following wind industry best practice and Wind Energy Ireland (WEI) community engagement guidelines. Contact details for the community liaison team are available on the Seven Hills Wind Farm stand-alone website. Since the submission of the SID planning application to An Bord Pleanála in June 2022 the team and CLO have responded to more than 15 no. requests from members of the local community seeking further information, as well as telephone inquiries regarding project timelines.

In conclusion, comments made to the application by members of the public are noted, however, it remains clear that the applicant has undertaken significant and appropriate community consultation and engagement, at detailed in the previously submitted *Community Consultation Report.*

2.2.11 Planning

Development Plan Policy

It must be emphasized that at the time the EIAR was prepared and the application lodged, the newly adopted Roscommon County Development Plan 2022-2028 (including the associated Renewable Energy Strategy) was in force. Within that Plan, The Roscommon County Development Plan 2022-2028 was adopted on the 8th of March 2022 and came into force on the 19th April 2022, the planning application was lodged with An Bord Pleanála on the 7th of June 2022. The Proposed Development site was partially zoned for wind energy development, with the majority of the site in an area deemed 'Most Favoured' for wind energy under the terms of the adopted Development Plan. A small portion of the site was not however zoned for wind energy development. It is the case that Map 7: Wind Energy which was included in the Plan adopted in March 2022 contained an error on the Council's behalf in respect of a portion of the site zoning in the Proposed Development site.

In a letter to the applicant dated the 28th July 2022, Roscommon County Council committed to inserting the correct map into the Renewable Energy Strategy. This was translated to An Bord Pleanála by Roscommon County Council in relation to the current planning application under Section 37E of the Planning and Development Act 2000, as amended. The Council confirmed to the Board in that correspondence that the **entirety** of the lands on which the turbine clusters are proposed are lands deemed 'Most Favoured' for wind energy development in the adopted Roscommon County Development Plan. For completeness, we include here at **Appendix 4** the correspondence from Roscommon County Council to the applicant with regards this error, along with the corrected Map from the adopted Development Plan.

2.2.12 Application Drawings

Turbine Foundation Design

Queries were raised in the third-party submissions regarding the design of wind turbine that is proposed and the lack of detail concerning the design of the turbine foundation proposed.

Response: Malachy Walsh & Partners Consulting Engineers ("Malachy Walsh & Partners") restate that the drawings and design submitted are bespoke, in that they are sized correctly and accurately being 29 metres (m) in diameter Please refer specifically to drawing 21337-MWP-ZZ-00-DR-C-0104 rev P01 which illustrates the turbine foundation detail. The wind turbine foundations have been designed specifically for this site and using the proposed loading documentation by Malachy Walsh and Partners, which is not generic in nature. It is acknowledged that there are some drawing drafting errors noted in that the background layout originally showed a 15-metre diameter foundation, as is also included in drawing 190907-54 Wind Turbine Elevation & Plan. As such, the applicant has taken this opportunity to revise the drawings as follows, including a turbine foundation diameter of 29m:

Table 2: Updated Drawing Schedule

Drawing No.	Drawing Title	Scale
190907 – 01 RevA	Location Context Map	1: 50,000 @A3
190907 – 02 RevA	Site Location Map	1: 50,000 @A3
190907 – 02f RevA	Site Notice Location Map F	1:5,000 @A3
190907 – 03 RevA	Site Layout Key Plan (1:5,000)	1: 25,000 @A1
190907 – 04 RevA	Site Layout Sheet 1 of 6	1: 5,000 @A1
190907 – 05 RevA	Site Layout Sheet 2 of 6	1: 5,000 @A1
190907 – 06 RevA	Site Layout Sheet 3 of 6	1: 5,000@A1
190907 – 10 RevA	Site Layout Key Plan (1:2,500)	1: 25,000@A1
190907 – 11 RevA	Site Layout Sheet 1 of 18	1: 2,500@A1
190907 – 12 RevA	Site Layout Sheet 2 of 18	1: 2,500@A1
190907 – 13 RevA	Site Layout Sheet 3 of 18	1: 2,500@A1
190907 – 14 RevA	Site Layout Sheet 4 of 18	1: 2,500@A1
190907 – 15 RevA	Site Layout Sheet 5 of 18	1: 2,500@A1
190907 – 16 RevA	Site Layout Sheet 6 of 18	1: 2,500@A1
190907 – 17 RevA	Site Layout Sheet 7 of 18	1: 2,500@A1
190907 – 18 RevA	Site Layout Sheet 8 of 18	1: 2,500@A1
190907 – 20 RevA	Site Layout Sheet 10 of 18	1: 2,500@A1
190907 – 21 RevA	Site Layout Sheet 11 of 18	1: 2,500@A1
190907 – 29 RevA	Turbine 1 Layout	1: 500 @A3
190907 – 30 RevA	Turbine 2 Layout	1: 500@A3
190907 – 31 RevA	Turbine 3 Layout	1: 500@A3
190907 – 32 RevA	Turbine 4 Layout	1: 500@A3
190907 – 33 RevA	Turbine 5 Layout	1: 500@A3
190907 – 34 RevA	Turbine 6 Layout	1: 500@A3
190907 – 35 RevA	Turbine 7 Layout	1: 500@A3
190907 – 36 RevA	Turbine 8 Layout	1: 500@A3
190907 – 37 RevA	Turbine 9 Layout	1: 500@A3
190907 - 38 RevA	Turbine 10 Layout	1: 500@A3
190907 – 39 RevA	Turbine 11 Layout	1: 500@A3
190907 – 40 RevA	Turbine 12 Layout	1: 500@A3
190907 – 41 RevA	Turbine 13 Layout	1: 500@A3
190907 – 42 RevA	Turbine 14 Layout	1: 500@A3
190907 – 43 RevA	Turbine 15 Layout	1: 500@A3
190907 – 44 RevA	Turbine 16 Layout	1: 500@A3
190907 – 45 RevA	Turbine 17 Layout	1: 500@A3
190907 – 46 RevA	Turbine 18 Layout	1: 500@A3
190907 – 47 RevA	Turbine 19 Layout	1: 500@A3
190907 – 48 RevA	Turbine 20 Layout	1: 500@A3
190907 – 49 RevA	Turbine 1, 2 & 3 Spoil Storage Sections	1: 200@A3
190907 – 50 RevA	Turbine 4, 5, & 6 Spoil Storage Sections	1: 200@A3
190907 – 51 RevA	Turbine 7, 8, & 10 Spoil Storage Sections	1: 200@A3
190907 – 52 RevA	Turbine 11, 13, & 14 Spoil Storage Sections	1: 200@A3
190907 – 53 RevA	Turbine 17, 19, & 20 Spoil Storage Sections	1: 200@A3
190907 – 54 RevA	Wind Turbine Elevations and Plan	1:500 @ A1

21337-MWP-ZZ-00-DR-C-1400	Spoil Storage Sections - North	As Shown @A1
21337-MWP-ZZ-00-DR-C-1401	Spoil Storage Sections - South – Sheet 1	As Shown @A1
21337-MWP-ZZ-00-DR-C-1402	Spoil Storage Sections - South – Sheet 2	As Shown @A1
21337-MWP-ZZ-00-DR-C-0103	Temporary Construction Compound 1 &2	NTS @A1
21337-MWP-00-00-DR-C-2125	Drainage & Cable Route Layout - North Drawing Location Plan	1:5000 @A1
21337-MWP-00-00-DR-C-2126	Drainage & Cable Route Layout - South Drawing Location Plan	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2105	Proposed Drainage Layout Sheet 05	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2106	Proposed Drainage Layout Sheet 06	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2107	Proposed Drainage Layout Sheet 07	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2108	Proposed Drainage Layout Sheet 08	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2109	Proposed Drainage Layout Sheet 09	1:1000 @A1
21337-MWP-ZZ-00-DR-C-2110	Proposed Drainage Layout Sheet 10	1:1000 @A1
21337-MWP-00-00-DR-C-2111	Proposed Drainage Layout Sheet 11	1:1000 @A1
21337-MWP-00-00-DR-C-2112	Proposed Drainage Layout Sheet 12	1:1000 @A1
21337-MWP-00-00-DR-C-2114	Proposed Drainage Layout Sheet 14	1:1000 @A1
21337-MWP-00-00-DR-C-2116	Proposed Drainage Layout Sheet 16	1:1000 @A1
21337-MWP-00-00-DR-C-2117	Proposed Drainage Layout Sheet 17	1:1000 @A1
21337-MWP-00-00-DR-C-2119	Proposed Drainage Layout Sheet 19	1:1000 @A1
21337-MWP-00-00-DR-C-2120	Proposed Drainage Layout Sheet 20	1:1000 @A1
21337-MWP-00-00-DR-C-2122	Proposed Drainage Layout Sheet 22	1:1000 @A1
21337-MWP-00-00-DR-C-2123	Proposed Drainage Layout Sheet 23	1:1000 @A1
21337-MWP-00-00-DR-C-2124	Proposed Drainage Layout Sheet 24	1:1000 @A1

In addition, a thorough review of the submitted EIAR was completed to determine whether the revised turbine foundation could potentially materially alter the findings of the submitted EIAR. The provision of the amended turbine foundation will alter the footprint of the Proposed Development. The below sections detail the potential additional environmental impacts that may arise as a result of this change in turbine foundation. In this regard, the next sections follow the headings of the submitted EIAR.

- Chapter 4 – Description of the Proposed Development

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Chapter 4 describes in detail the Proposed Development, information on infrastructure design and the associated construction methodology.

As detailed in Section 4.3.1.2, the design process for the Proposed Development involved numerous intrusive site investigations across the Northern and Southern Clusters, to provide detail on the nature and extent of subsoils and bedrock as a means to characterise the site. With the increase in size to the turbine foundation, there has been no movement in turbine locations and therefore all investigations completed remain representative of the Proposed Development layout.

The increase in foundation size does however increase the overall development footprint. As detailed in Section 4.3.1.4, the turbine foundation diameter is noted as being 29m in diameter, which is accurate when considering the revised foundation size. Further to this, an engineering assessment was completed, based on this 29m foundation size. This assessment quantified the volume of stone and spoil generated during construction. These are outlined below:

- As per Section 4.3.3.1, the volume of stone required to build the site, as detailed in Table 4-3 is 167,450m^3; and
- As per Section 4.3.4, the volume of spoil generated on site as detailed in Table 4-4, is 126,500m^3.

These volumes were based on a 29m foundation and therefore remain accurate for the assessment.

In addition, with the increase in foundations size on the drawings, there has been an update in the size of the turbine infrastructure spoil storage areas. Section 4.3.4 detailed the below:

- 1,500 m^3 of the spoil volume will be stored local to each turbine foundation and hardstand in allowable areas (16 of 20 turbines), totalling 24,000 m^3.

It can be confirmed that these volumes will remain the same and there will be no additional spoil stored within the infrastructure spoil storage areas.

Section 4.6 of the EIAR refers to Site Drainage. It is noted that where there has been an update in drawings, these have been include in the associated revised drawing pack submitted with this submission. The proposed drainage design at the site has been amended to consider the increase in foundation size. All drainage design and principles remain the same as per Section 4.6 of the EIAR.

Section 4.8 of the EIAR details construction methodologies for the Proposed Development. It is also confirmed that the turbine foundation construction methodology detailed in Section 4.8.1 remains accurate and relevant to the revised foundation.

- Chapter 5 – Population and Human Health

Chapter 5 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Population and Human Health.

It is concluded that no additional impacts from population and human health will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR.

- Chapter 6 – Ecology

Chapter 6 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Flora and Fauna. The assessment determined that potential residual effects impacts were not significant.

As noted in Section 6.7.3.1 of the EIAR, there will be a loss of 2.7ha Annex 1 Dry Calcareous grassland at the Proposed Development site due to the infrastructure footprint. Section 6.7.3.1.1 details the proposed mitigation measures that were put in place for this loss, where it is proposed to undertake enhancement of this area of semi-natural dry grasslands equating to between approximately 9-12 hectares.

The increase in foundation size does however increase the overall development footprint. With this, there will be an increased loss of Annex 1 Dry Calcareous grassland at the Proposed Development site which equates to an additional loss of 0.35ha. In total, there will therefore now be a loss of 3.05ha of Annex 1 Dry Calcareous grassland.

A Biodiversity Habitat Enhancement Plan (BMEP) was submitted as part of the EIAR and was included as Appendix 6-4. It is proposed to undertake enhancement of an area of semi-natural dry grasslands equating to between approximately 9-12 hectares. The management actions are fully described in the BMEP, and the measures set out will ensure that there will be no net loss of species rich semi-natural dry grassland habitat associated with the Proposed Development.

As such, the EIAR notes that following the implementation of mitigation and land management measures/offsetting, there will be no significant residual effect on Annex I listed semi-natural dry grasslands [6210/6210*] habitat at any geographic scale. It is further noted that no additional impacts on Annex 1 Dry Calcareous grassland within the site will occur or arise from the use of the preferred turbine foundation.

- Chapter 7 – Ornithology

Chapter 7 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Ornithology. The assessment determined that with the implementation of good practice measures and project design, no significant residual individual or cumulative effects are likely for valued ornithological receptors from any phase of the Proposed Development.

The increase in foundation size will not have an impact on ornithological receptors. Therefore, it can be concluded that no additional impacts on ornithology will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR.

- Chapter 8 – Land, Soils and Geology

Chapter 8 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Land, Soils and Geology. An assessment of the construction stage, operational stage and decommissioning stage was completed. Based on the assessment and with implementation of the outlined mitigation measures, no likely significant effects on the soils and geology environment are predicted to occur.

The increase in foundation size does increase the overall development footprint. As a result, there should be additional volumes of soil/subsoil and bedrock associated with the Proposed Development. However, it should be noted, that the volumes of soil/subsoil and bedrock detailed in Section 8.5.2.2 of the EIAR are as per Chapter 4 of the EIAR and are based on a 29m foundation. As such, there are no additional impacts associated with the excavation of soil/subsoil and bedrock.

Therefore, it can be concluded that no additional impacts on land, soils and geology will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR.

- Chapter 9 – Water

Chapter 9 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Water. An assessment of the construction stage, operational stage and decommissioning stage was completed. Based on the assessment and with implementation of the outlined mitigation measures, no likely significant effects on surface water and groundwater quality are predicted to occur.

The increase in foundation size does increase the overall development footprint. As a result, the drainage design associated with the Proposed Development will be amended. This has been completed and included in the appended updated drawing package. All drainage design and principles remain the same as detailed in Section 4.6 of the EIAR.

Therefore, it can be concluded that no additional impacts on surface water and groundwater quality will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR.

- Chapter 10 – Air and Climate

Chapter 10 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Air and Climate.

The increase in foundation size does increase the overall development footprint. As a result, the results provided as part of Section 10.2.4 of the EIAR relating to carbon loss will be altered. Section 10.2.4.3.1 of the EIAR notes that the Proposed Development will give rise to 179,095 tonnes of CO_2 equivalent losses over its 30-year life. It is noted that a 15m turbine foundation was included in these calculations. With the change in foundation size to 29m, it is now calculated that the Proposed Development will give rise to 179,202 tonnes of CO_2 equivalent losses over its 30-year life. This additional 107 tonnes of CO_2 is due to the additional footprint. The additional carbon loss as a result of the increased foundation footprint will be imperceptible.

Therefore, it can be concluded that no additional impacts on air quality and climate will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR. In addition, as detailed in Section 10.2.4.3.2, there will be 160,634 tonnes of CO_2 displaced per annum from the largely carbon-based traditional energy mix by the Proposed Development.

- Chapter 11 – Noise and Vibration

Chapter 11 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Noise and Vibration.

It is concluded that no additional impacts from noise and vibration will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR. As the position of the turbines on site remain the same and the location of the foundations remain unchanged, there is no change in the conclusions of the assessment of the potential range of impacts from noise and vibration.

- Chapter 12 – Landscape and Visual

Chapter 12 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Landscape and Visual.

It is concluded that no additional impacts on landscape and visual receptors will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR. As the position of the turbines on site remain the same and the location of the foundations remain unchanged, there is no change in the conclusions of the assessment of the potential range of impacts on landscape and visual receptors.

- Chapter 13 – Archaeology and Cultural Heritage

Chapter 13 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Archaeology and Cultural Heritage.

The increase in foundation size does increase the overall development footprint. As detailed in Section 13.4.4, of the 38 Recorded Monuments located within the EIAR Site Boundary, eight Recorded Monuments are located within the Proposed Development infrastructure locations. On review of the increased footprint of the foundation, the below monuments have additional impacts associated with them:

1. RO048-097001 (field system)
2. RO048-097002 (field system)

Both these monuments have been assessed within Sections 13.4.4.3.7 and 13.4.4.3.8 of the EIAR, with both noting a slight residual impact with no significance once mitigation was implemented. The additional impact on these monuments as a result of the increased foundation footprint will be imperceptible.

It is therefore concluded that no additional impacts on archaeology and cultural heritage will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR. As the position of the turbines on site remain the same and the location of the foundations remain unchanged, there is no change in the conclusions of the assessment of the potential range of impacts on archaeology and cultural heritage.

- Chapter 14 – Material Assets

Chapter 14 of the EIAR for the Proposed Development provided an assessment of likely significant effects on Material Assets, particularly on Traffic and Transport.

The increase in foundation size does increase the overall development footprint. As a result, there should be additional volumes of stone required to build the Proposed Development, which would in turn mean more deliveries required. However, it should be noted, that the volumes of stone detailed in Section 4.3.3.1 in Chapter 4 of the EIAR are based on a 29m foundation. As such, there is no requirement for additional stone deliveries over that assessed in Section 14.1.4.2.2 of the EIAR.

It is concluded that no additional impacts from traffic and transport will occur or arise from the increase in foundation size beyond those that were previously considered acceptable in the previously submitted EIAR. As the volume of stone required remained the same as detailed in the EIAR, there is no change in the conclusions of the assessment of the potential range of impacts from traffic and transport.

Third-party submission

A third-party submission notes a discrepancy in terms of unit of measurement on the turbine foundation drawing as included with the application.

Response: The drawing in question (ref: 2137-MWP-ZZ-00-DR-C-0104 Rev P01) states in the notes column that all dimensions are in millimetres unless noted otherwise. As is customary on engineering drawings distances are shown in millimetres and levels are shown in meters. The reference in the observation to some number being followed by 'm 'being 'presumably meters' is correct and refers to the level of the top of foundation relative to existing ground level. There is no confusing information here if the drawing is read correctly and there is no oversight, as suggested. The 100mm minimum reference is to the depth of concrete blinding to be provided under the base to ensure a sound platform on which to construct the foundation. This thickness could be thicker without any risk but it is not economically advantageous to do so, so this is very unlikely to happen, and if it were it would only be to fill localised pockets that may be slightly deeper than adjacent ground.

Turbine Foundation Summary

In respect to the above, the findings presented within this response demonstrate that the proposed amendment to the turbine foundations will not give rise to additional significant impacts on the environment nor would its provision alter the conclusions presented in the EIAR.

Geophysical Turbine Foundation

A third-party submission raises queries around the structural and geotechnical elements of the proposed foundations.

Response: The structural and geotechnical elements of the proposed foundations have been designed by Malachy Walsh and Partners Consulting Engineers. MWP have considerable experience in this regard and are considered leaders in the field in Ireland on foundation design and construction. As the structural engineers of this project, MWP's opinion is that it is not necessary to form the foundations of rock. The details that are provided in drawing 'Ground Bearing Details on 21337-MWP-ZZ-00-DR-C-2127' enclosed with the application show that the concrete lining to drains to limit water percolating downwards. In addition, Table 2-2 below sets out the foundation type, formation material, stone upfill depth and minimum hardstand excavation depth at each of the proposed turbines.

Table 2-3: Materials Table

Turbine Ref	Foundation Type	Formation Material	Stone Upfill Depth	Min. Hardstand Excavation Depth
T1	Ground-Bearing Gravity	Rock	0.1	0.25
T2	Ground-Bearing Gravity	Clay/Sand	0	0.25
T3	Ground-Bearing Gravity	Clay/Gravel	0	0.3
T4	Ground-Bearing Gravity	Clay	1.5	0.7
T5	Ground-Bearing Gravity	Rock	0	0.15
T6	Ground-Bearing Gravity	Rock	0	0.2
T7	Ground-Bearing Gravity	Gravel/Rock	0	0.3
T8	Ground-Bearing Gravity	Gravel/Cobbles	0	0.2
T9	Ground-Bearing Gravity	Gravel/Cobbles	0	0.25
T10	Ground-Bearing Gravity	Rock	0	0.2
T11	Ground-Bearing Gravity	Rock	0	0.4
T12	Ground-Bearing Gravity	Cobbles	2	0.25
T13	Ground-Bearing Gravity	Gravel	0	0.25
T14	Ground-Bearing Gravity	Gravel/Cobbles	0	0.45
T15	Ground-Bearing Gravity	Clay/Cobbles	0	0.4
T16	Ground-Bearing Gravity	Cobbles	0	0.25
T17	Ground-Bearing Gravity	Gravel/Sand	0	0.2
T18	Ground-Bearing Gravity	Gravel	0	0.25
T19	Ground-Bearing Gravity	Clay/Gravel	0	0.2
T20	Ground-Bearing Gravity	Clay	0	0.2

Spoil Storage Areas

A third-party submission considers the spoil storage areas included with the application drawing pack fail to provide all necessary dimensions.

Response:

The spoil areas as shown on drawings ref: 21337-MWP-ZZ-00-DR-C-1400 rev P01, - -1401 rev P01, and -1402 rev P01 have been updated to include full dimensions as part of this response and are enclosed.

Seven Hills Wind Farm (ABP-313750-22)

Spoil management requires the spoil to be stored in a geotechnically sound manner on geotechnically sound ground. The locations of the spoil storage areas are deemed geotechnically sound by a suitably qualified Engineer. The spoil itself is mounded as shown on the relevant drawings with an angle of batter of 30 degrees, which is considered stable for the type of material expected to be excavated. The stand-up time for this material type at 30 degrees is indefinite and it can be considered perfectly stable if managed properly. Proper management requires the mounds to be smoothened off and no cracks left that would encourage infiltration of water. Once this is completed the mounds will naturally revegetate over time. They will not attract vermin as they will consist of clay and gravels predominantly.

Site Investigation

A third-party submission takes issue with site investigations already taken place on site.

Response:

All site investigation contractors provide an interpretative report with the logs of the investigation carried out (the factual report). This is provided at a very early stage to assist developers with formulating an approach going forward as to how the foundations may be constructed. Site investigation contractors are not structural or geotechnical designers and have an extremely limited knowledge on the intricacies of the design process needed to adequately produce a compliant foundation design from a structural or geotechnical perspective. Wind farm design engineers such as Malachy Walsh and Partners always interpret the information for themselves, as they know how the information provided will inform the specialised checks required to show compliance with the wind turbine manufacturer's requirements. Very often the final solution is at odds with the recommendations of the site investigation contractor's opinion. It is not required of IGSL[7] to provide an interpretative report to assist Malachy Walsh and Partners in this process.

[7] *IGSL undertook some Site Investigation work within the Proposed Development site on behalf of MWP – Chapter 8 of the EIAR refers.*

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3. CONCLUSIONS

This submission, associated appendices and updated planning application drawings have been prepared to address the submissions/observations made in relation to the Proposed Development at Seven Hills, County Roscommon. The information provided here will directly assist the Board in their ongoing consideration of the planning application. The information constitutes a full and robust response to the matters raised. It is recognised that in their consideration of the Proposed Development the Planning Authority have noted:

- The principle of the Proposed Development is considered acceptable.
- The Proposed Development is of a significant scale.
- The Proposed Development would reduce dependency on non-renewable resources and improve energy security.
- The Planning Authority are content that the Proposed Development can be undertaken to avoid environmental effects and in accordance with the principles of proper planning and sustainable development.

Seven Hills Wind Farm (ABP-313750-22)

APPENDIX 1

UPDATED COLLISION RISK MONITORING REPORT WINTER 2021-2022

SEVEN HILLS WIND FARM

Avian Collision Risk Modelling Report, Winter 2021-2022

SLR Ref: 501.00501.00004
Version No: 1
March 2023

SLR

BASIS OF REPORT

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DOCUMENT REFERENCES

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APPENDICES

1.0 Introduction

A planning application (including an Environmental Impact Assessment Report or 'EIAR' and Natura Impact Statement or 'NIS') for the proposed Seven Hills Wind Farm in County Roscommon was submitted to An Bord Pleanála (ABP) in June 2022. The ornithological assessments included in the EIAR and NIS were informed by three years of breeding and non-breeding season bird surveys between October 2018 and September 2021. Avian Collision Risk Modelling (CRM) was also undertaken to inform the assessments with the results provided in Appendix 7.7 to the EIAR (SLR, 2021[1]).

Further non-breeding season bird surveys were also carried out during the winter period 2021/22 (SLR, 2022[2]), although the survey results were not available in time to be included within the EIAR and NIS. In light of the further survey information, the previous CRM required updating to inform an updated assessment of impacts for important non-breeding bird species.

This report presents the results of CRM undertaken for nine bird species based on survey data collected during the 2021-22 non-breeding season (October 2021 to March 2022 inclusive). In addition, this report updates the previous non-breeding season CRM for all survey years combined and therefore supersedes the previous CRM report (SLR, 2021) in respect of the non-breeding season (the previous CRM report remains valid in respect of the breeding season). This report also updates Table 7-10 from the EIAR (which summarises the results of the CRM in relation to SPA qualifying species) in respect of the non-breeding season (Table 7-10 in the EIAR remains valid in respect of the breeding season).

The proposed Seven Hills Wind Farm comprises two separate turbine clusters within the wind farm design, hereafter referred to as Wind Farm 1 (WF1) (North) and Wind Farm 2 (WF2) (South). For the purposes of this report, these two clusters are treated individually and in combination.

Modelling was based on the use of Vestas V162 6MW turbines, each with a rotor diameter of 162m, tip height of 180m and hub height of 99m, which is consistent with the information outlined in the EIAR and SLR (2021).

As in the previous CRM report, where there was sufficient bird flight activity within the respective Collision Risk Zones (CRZs) (i.e., within the respective Wind Farm Polygon (WP[3])) at Potential Collision Height (PCH), CRM was used to predict the number of individuals per primary target species (see Section 1.1) that might collide with the wind turbine rotors.

As in the previous CRM report, sufficient flight activity was defined as a minimum total of five flights or minimum ten individuals of each primary target species recorded in each CRZ during each season of analysis[4].

The CRM was undertaken in accordance with current NatureScot (NS) (formerly SNH) guidance, which is recognised as standard best practice guidance through the UK and Ireland to inform impact assessment for onshore wind farms. Further details regarding the methodology used, including details of assumptions used and any corrections applied, are provided in Section 2. The monitoring results are presented in Section 3 and copies of the modelling calculations for each species modelled are included in Appendices 01-03.

1.1 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 terms, thereby enabling recording to focus on the species of greatest importance.

[1] SLR 2021. Seven Hills Wind Farm. Avian Collision Risk Modelling Report.
2 SLR 2022. Seven Hills Wind Farm. Bird Survey Report Non-breeding Season 2021-22.
[3] The Wind Farm Polygon for each phase includes the area within 500m of the outermost turbine blades in the respective layouts.
[4] Numbers below these thresholds are likely to result in negligible predicted mortality.

NatureScot guidelines state that "*in most circumstances the target species will be limited to those species which are afforded a higher level of legislative protection*."

Furthermore, primary target species were specifically limited to species upon which effects are most likely to be potentially significant in EIA terms, e.g. breeding and non-breeding species forming qualifying features for nearby SPAs or species listed on Annex I of the Birds Directive. 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.

1.1.1 Non-breeding Season Surveys 2021-22

The primary target species included the following bird species during this period:

- Whooper swan *Cygnus cygnus*;
- Greenland white-fronted goose *Anser albifrons flavirostris;*
- Eurasian wigeon *Mareca penelope;*
- Eurasian teal *Anas crecca;*
- Mallard *Anas platyrhynchos;*
- Northern shoveler *Spatula clypeata*;
- Peregrine falcon *Falco peregrinus*;
- Kestrel *Falco tinnunculus;*
- Hen harrier *Circus cyaneus;*
- Merlin *Falco columbarius;*
- Northern lapwing *Vanellus vanellus;*
- European golden plover *Pluvialis apricaria;*
- Common snipe *Gallinago gallinago;*
- Eurasian curlew *Numenius arquata;* and
- Black-headed gull *Chroicocephalus ridibundus*.

1.2 Secondary Target Species

Secondary target species included the following and were not subject to CRM:

- Any other wildfowl and wader species not recorded as primary target species;
- Buzzard *Buteo buteo;*
- Sparrowhawk *Accipiter nisus*;
- Raven *Corvus corax*;
- Grey heron *Ardea cinerea;*
- Cormorant *Phalacrocorax carbo;* and
- Gulls *Larus sp*. (where not recorded as primary target species).

2.0 Methods

The standard Band CRM (Band *et al.* 2007[5]) was used to estimate collision risk based on recorded 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 CRM is a two-stage process. Stage 1 estimates the number of birds that fly through the rotor swept disc. Stage 2 predicts the proportion of these birds that have the potential to be hit by a rotor blade. Combining both stages produces an estimate of collision mortality in the absence of any avoidance action/behaviour by birds. Avoidance rates are then applied to generate predicted rates of collision mortality.

2.1 Prediction of Rotor Transits from Vantage Point Survey Data

The number of birds that fly through the rotor swept area was estimated using flight data gathered during baseline surveys carried out between October 2021 and March 2022 inclusive, with the update to the previous non-breeding season CRM for all survey years combined using flight data collected during the period September 2018 to March 2021[6]. These surveys gathered data from the two wind farm clusters using vantage points (VPs). Two VPs were used at WF1 and four VPs were used at WF2.

In order 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 WP – defined by a 500m buffer (generated from the turbine blades) around the proposed outermost turbine locations (see Figure 1 in SLR (2021)). The size of buffer follows NS (formerly SNH) 2017 guidance[7], in order to take into account rotor blade length and potential spatial errors in flight recording accuracy[8]. It is known that bird detection rates vary between species. To ensure the CRM used robust measures of flight activity, a 2km distance truncation was used in the viewshed (i.e., the area visible) from each VP (as per NS guidance).

Analysis in MS Excel and GIS identified those flights that were at PCH and over the WP. Flight times that were used in the CRM were derived from field data for each flight. Where only part of the relevant flight line occurred within the WP, the flight time was calculated based on the proportion of the flight recorded within the WP, assuming a constant speed for each flight. Time spent at different flight heights was estimated in a database from interval data for flights that entered the WP. Flying time estimated to occur within the survey recording height bands (see Section 2.1.1) was used to determine the period that target species were at risk of collision with the rotors.

2.1.1 Correcting Survey PCH to Actual PCH

The baseline surveys utilised the following height bands in 2021-2022, which is consistent with the surveys undertaken during November 2020 to March 2021 (although previous surveys used slightly different height bands – see SLR (2021)):

[5] Band, W., Madders, M. and Whitfield, D.P. (2007) Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farms. In: De Lucas, M., Janss, G. and Ferrer, M., Eds., *Birds and Wind Power*, Quercus Editions, Madrid, 259-275.
[6] SLR Consulting. (2021). Seven Hills Wind Farm Phase I and II Bird Survey Reports (x5): Winter 2018/19; Breeding Season 2019; Winter 2019/20; Breeding Season 2020; and Winter 2020/21.
[7] Scottish Natural Heritage (SNH) (2017). *Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. Version 2*.
[8] Note that the inclusion of all flights within 500m is a necessarily precautionary approach, primarily to allow for mapping inaccuracies. However, at Seven Hills many of the flights within the 500m buffer occurred close to VPs and are therefore known to be mapped accurately. The inclusion of these flights is therefore likely to result in collision risk being overestimated in some cases, e.g. by the inclusion of flights around Feacle Turlough near WF2 VP3, most of which did enter the rotor swept area.

- Height Band 1: 0-15m;
- Height Band 2: 15-30m;
- Height Band 3: 30-150m;
- Height Band 4: 150-200m; and
- Height Band 5: >200m.

As such, the height bands used to record flight activity do not correspond precisely to PCH for the proposed development (18-180m), i.e.:

- Height band 2 overlaps with the lower limit of the actual PCH (18-30m of the 15-30m survey height band); and
- Height band 4 overlaps with the upper limit of the actual PCH (150-180m of the 150-200m survey height band).

Assuming an equal distribution of heights within all height bands, the proportion of flights included within the CRM in height bands 2, 3 and 4 was 162/185 (87.6%), i.e., 12/15 flights in height band 1, 120/120 flights in height band 2 and 30/50 flights in height band 4.

2.1.2 Seasonal Definitions

For each species modelled, CRMs were constructed using data consistent with the survey design, i.e., between October 2021 and March 2022 inclusive, which is defined as the non-breeding season. These results were then combined with survey data for the same period from previous years to produce updated mortality estimates for all survey years combined.

With the exception of waders and wildfowl (see below), the theoretical time that birds could be active with potential for turbine collisions was assumed to be the period between sunrise and sunset within each survey period using the latitude of the Site[9].

For waders and wildfowl, which could be active nocturnally, an additional 25% of nocturnal hours were added to the daylight hours to give a more accurate representation of the available hours for these species (as per Band *et al.*, 2007)[10].

2.1.3 Undertaking CRM

Collision risk modelling employs an estimated three-dimensional risk volume, in keeping with the assumption that flight directions are random in space. For species with non-directional (e.g., random, circling and foraging) flights, as at Seven Hills, the occupancy data are derived by multiplying the numbers of a particular species flying through the survey risk area by the total time spent within the survey risk area.

The following parameters were entered into a bespoke modelling spreadsheet:

- The total observation effort within the risk volume (V_w) visible from each VP;
- The occupancy total: the total time spent by a particular species flying within the risk volume (V_w) visible from each VP;

[9] https://www.timeanddate.com [Accessed in March 2023].
[10] In previously collision risk modelling undertaken to inform the EIA civil twilight data for the site were used. For the updated modelling, CRMs have been re-calculated where appropriate using daylight hours only or daylight hours + 25% nocturnal hours for wildfowl and waders (see Section 3.2.1 for further details).

- The volume of Vw (m^3) visible from each VP (this is area covered by the outermost turbines with the 500m buffer);
- A calculation of daylight hours (and additional nocturnal hours where relevant) within the season of analysis;
- Species-specific bird parameters (Section 2.1.4); and
- Wind farm parameters (Section 2.1.5).

VP locations, viewsheds (the area visible from each VP at the lowest rotor swept height (18m)) and the 500m buffer around the outermost turbine blades are shown in Figure 1 in SLR (2021).

The NatureScot CRM spreadsheet[11] calculates the probability of collision for each particular species. The model then combines this probability of collision with the observed flight activity per unit area (hours per hectare) weighted for observation effort from each VP to produce an estimate of the number of transits through the rotor blades. Mortality estimates are then derived by applying species-specific avoidance rates (Section 2.1.4).

2.1.4 Bird Biometrics and Avoidance Rates

Measurements and flight speeds for the species for which CRM was undertaken were derived from British Trust for Ornithology (BTO)[12], SNH (2014[13]), Provan & Whitfield (2006[14]), Bruderer & Boldt (2001[15]) and McDuie *et al.* (2019)[16]. These are detailed in Table 2-1 below, along with the avoidance rate for these species per current NS guidance (SNH 2018[17]).

Table 2-1
Bird biometrics and avoidance rates used in CRM

Species name	Bird length (m)	Wingspan (m)	Flight speed (m/s)	Avoidance rate (%)
Whooper swan	1.52	2.3	17.3	99.5
Eurasian wigeon	0.48	0.8	10.3	98.0
Mallard	0.60	0.9	21.4	98.0
Common kestrel	0.34	0.8	12.7	95.0
Peregrine falcon	0.45	1.1	14.0	98.0
European golden plover	0.28	0.72	17.5	98.0

[11]https://www.nature.scot/wind-farm-impacts-birds-calculating-probability-collision [Accessed in March 2023].
[12] https://www.bto.org/understanding-birds/birdfacts [Accessed in May 2021].
[13] SNH (2014) Flight speeds and biometrics for collision risk modelling. Scottish Natural Heritage, Inverness.
[14] Provan, S. and Whitfield, D.P. (2006) Avian flight speeds and biometrics for use in collision risk modelling. Unpublished report to Scottish Natural Heritage.
[15] Bruderer, B. and Bolt, A. (2001) Flight characteristics of birds: 1. Radar measurements of speeds, *Ibis*, **143**. 178 – 204.
[16] McDuie, F; Casazza, M.L.; Keiter, D; Overton, C.T.; Herzog, M.P.; Feldheim, C.L. and Ackerman, J.T. (2019). Moving at the speed of flight: dabbling duck-movement rates and the relationship with electronic tracking interval. *Wildlife Research*, **46**, 533-543.
[17] SNH (2018) Avoidance rates for the onshore SNH wind farm collision risk model. https://www.nature.scot/doc/wind-farm-impacts-birds-use-avoidance-rates-naturescot-wind-farm-collision-risk-model#:~:text=2.%20Recommended%20avoidance%20rates%20%20%20Species%20,%20SNH%20%282013%29%20%207%20more%20rows%20

Species name	Bird length (m)	Wingspan (m)	Flight speed (m/s)	Avoidance rate (%)
Northern lapwing	0.30	0.84	12.3	98.0
Eurasian curlew	0.55	0.9	13.2	98.0
Black-headed gull	0.36	1.05	11.2	98.0

2.1.5 Wind Farm and Turbine Parameters

The north and south wind farm layouts (shown on Figure 1 in SLR, 2021) and wind turbine parameters used in the CRM are detailed in Table 2-2 and are based on the use of Vestas V162 turbines, which are considered likely to represent a reasonable worst-case (in terms of representing the turbine with the longest blade length of the various turbines under consideration).

Table 2-2
Wind farm & turbine parameters

Parameter	Value
Size of wind farm polygons (WP) (ha)	Wind Farm 1 (North): 455.3ha
	Wind Farm 2 (South): 1036.6ha
Wind farm areas (ha) visible within viewshed (v)	Wind Farm 1 (North): 449.6ha
	Wind Farm 2 (South): 914.6ha
Number of turbines	Wind Farm 1 (North): 7
	Wind Farm 2 (South): 13
Rotor diameter	162m
Hub height	99m
Max. chord	4.3m
Pitch	Variable - 6° for modelling purposes
Rotation period	4.96s (max 12.1rpm)
Turbine operation time	95% (estimated by Seven Hills Wind Farm Ltd.) upper limit considering down-time for maintenance, weather conditions etc.

2.2 Summary Flightline Data

The following section summarises the primary target species flightline data from VP surveys conducted at Seven Hills WF1 (north) and WF2 (south), presented for October 2021 to March 2022 (Table 2-3 and Table 2-4).

2.2.1 Wind Farm 1 (North)

Table 2-3
Number of target species flights and individuals observed passing through the CRZ during non-breeding season VP surveys (October 2021- March 2022), WF1

Species name	Cumulative number of birds recorded in flight	Flights through WP		Flights through WP at PCH[18]	
		Flights	Individuals	Flights	Individuals
Whooper swan	44	2	21	2	21
Eurasian wigeon	43	1	43	1	43
Mallard	8	0	0	0	0
Common kestrel	9	6	6	4	4
Merlin	7	6	6	1	1
Peregrine falcon	4	4	4	2	2
European golden plover	138	3	132	2	114
Northern lapwing	10	0	0	0	0
Common snipe	1	0	0	0	0
Black-headed gull	637	10	224	10	224

2.2.2 Wind Farm 2 (South)

Table 2-4
Number of target species flights and individuals observed passing through the CRZ during non-breeding season VP surveys (October 2021- March 2022), WF1

Species name	Cumulative number of birds recorded in flight	Flights through WP		Flights through WP at PCH[18]	
		Flights	Individuals	Flights	Individuals
Whooper swan	69	5	24	5	24
Eurasian wigeon	248	5	248	4	230
Eurasian teal	2	1	2	1	2
Mallard	20	2	20	2	20

[18] For the purposes of Table 2-4 and Table 2-5 PCH refers to all height bands which include the area at PCH, whether in full or in part.

Species name	Cumulative number of birds recorded in flight	Flights through WP		Flights through WP at PCH[18]	
		Flights	Individuals	Flights	Individuals
Northern shoveler	9	2	9	2	9
Common kestrel	24	21	21	10	10
Peregrine falcon	10	8	8	7	7
Northern lapwing	260	10	189	3	69
Common snipe	2	0	0	0	0
Eurasian curlew	225	16	225	7	91
Black-headed gull	2153	78	1493	53	1027

2.3 Species Input Data

2.3.1 Wind Farm 1 (North)

Species input data are detailed in Table 2-5 to Table 2-10 inclusive.

Table 2-5
Whooper Swan Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	630	630
2	174.6	36	840	420
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-6
Eurasian Wigeon Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	0	0
2	174.6	36	4515	4515
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-7
Common Kestrel Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	345	240
2	174.6	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

Table 2-8
Peregrine Falcon Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	150	105
2	174.6	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

Table 2-9
European Golden Plover Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2019-20		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	0	0
2	174.6	36	8910	8640
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-10
Black-headed Gull Input Data, Non-breeding Season 2021-22 WF1

VP/ Viewshed		Non-breeding season 2019-20		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	330.5	36	12525	7125
2	174.6	36	16245	14415
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

2.3.2 Wind Farm 2 (South)

Species input data are detailed in

Table 2-11 to Table 2-18 inclusive.

Table 2-11
Whooper Swan Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	0	0
2	371.1	39	1185	1110
3	415.0	36	600	600
4	154.2	36	60	60
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-12
Eurasian Wigeon Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	0	0
2	371.1	39	0	0
3	415.0	36	37260	36285
4	154.2	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-13
Mallard Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	0	0
2	371.1	39	0	0
3	415.0	36	3390	3300
4	154.2	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-14
Common Kestrel Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	375	210
2	371.1	39	225	195
3	415.0	36	675	525
4	154.2	36	90	45
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

Table 2-15
Peregrine Falcon Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	150	90
2	371.1	39	0	0
3	415.0	36	225	225
4	154.2	36	120	105
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

Table 2-16
Northern Lapwing Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	0	0
2	371.1	39	0	0
3	415.0	36	16440	11656
4	154.2	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-17
Eurasian Curlew Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Non-breeding season 2021-22		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	0	0
2	371.1	39	0	0
3	415.0	36	18330	8175
4	154.2	36	0	0
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1 Daylight hours + 25% nocturnal hours = 2390.3		

Table 2-18
Black-headed Gull Input Data, Non-breeding Season 2021-22 WF2

VP/ Viewshed		Breeding season 2020		
VP ID	Area of CRZ visible from VP (ha)	Survey effort (hrs)	Bird flight occupancy data	
			Total (s)	Risk height (s)
1	489.4	36	2025	1800
2	371.1	39	28440	20970
3	415.0	36	41145	25875
4	154.2	36	57000	46980
		Non-breeding season = 01 October – 31 March (182 days) Daylight hours = 1729.1		

3.0 Collision Risk Modelling Results

3.1 Wind Farm 1 & 2, Non-breeding Season 2021-2022

Results of modelling for the non-breeding season 2021-22, where sufficient data are available, are summarised in Table 3-1 (WF1), Table 3-2 (WF2) and

Table 3-3 (WF1 & WF2 combined). The modelling calculations are included in Appendices 01-03.

Table 3-1
CRM Output, WF1 Non-breeding Season 2021-22

Species	Modelled Collisions per Year	Years per Collision
Whooper Swan	0.0775	12.91
Eurasian Wigeon	0.5484	1.82
Common Kestrel	0.0517	19.33
Peregrine Falcon	0.0110	90.98
European golden plover	1.2698	0.79
Black-headed Gull	1.7977	0.56

Table 3-2
CRM Output, WF2 Non-breeding Season 2021-22

Species	Modelled Collisions per Year	Years per Collision
Whooper Swan	0.0810	12.34
Eurasian Wigeon	2.8303	0.35
Mallard	0.4430	2.26
Common Kestrel	0.1287	7.77
Peregrine Falcon	0.0212	47.22
Northern Lapwing	0.8533	1.17
Eurasian Curlew	0.7808	1.28
Black-headed Gull	2.6074	0.38

Table 3-3
CRM Output, WF1 & WF2 Combined, Non-Breeding Season 2021-22

Species	Modelled Collisions	Years per Collision
Whooper Swan	0.1585	6.31
Eurasian Wigeon	3.3787	0.30
Mallard	0.4430	2.26
Common Kestrel	0.1804	5.54
Peregrine Falcon	0.0322	31.06
Northern Lapwing	0.8533	1.17
European Golden Plover	1.2698	0.79
Eurasian Curlew	0.7808	1.28
Black-headed Gull	4.4051	0.23

3.1.1 Notes on Distribution of Flightlines

As stated in Section 2.1, and in SLR (2021), the inclusion of all flights within 500m is a necessarily precautionary approach (to take into account spatial errors in mapping), but at Seven Hills, many flights occurred close to VPs and are therefore known to be mapped accurately. Collision risk for some species is therefore likely to be overestimated here, e.g., by the inclusion of flights around landscape features such as Feacle Turlough near WF2 VP3 (where birds gather for roosting and foraging), most of which were not recorded entering the rotor swept area. The result of this is that collision risk for some species is likely to have been over-estimated. Specific examples are as follows:

- Eurasian curlew and Northern lapwing: the majority of flightlines were concentrated around Feacle Turlough (2021/22 survey report Figure 2.4); and
- Black-headed gull: activity was focussed at Feacle Turlough and Four Roads Turlough (2021/22 survey report Figure 2.5). Although flights entered the 500m buffer, the main focus of flight activity was away from the turbine locations.

3.2 Wind Farms 1 & 2 All Years Combined

3.2.1 CRM Outputs

The non-breeding season CRM outputs for WF1 and WF2 combined for all survey years are summarised in Table 3-4. Where CRM was conducted for more than one season the outputs were calculated by combining the occupancy data along with the survey effort data for all years (October to March inclusive[19], where flight data were used in the model) using daylight and nocturnal hours data for October to March[20] (as per Band *et al.* 2007[5]).

[19] August and September hours for previous years were removed for consistency.
[20] This replaced the civil twilight data used in previous modelling to more accurately reflect potential occupancy. Including civil twilight hours for species which are not active during dawn and dusk is likely to produce over-estimates of occupancy, and for wildfowl and waders 25% nocturnal hours have now been included.

Table 3-4
Mean of CRM Outputs 2018-19 to 2021-22, WF1 & WF2 Combined, Non-Breeding Season

Species	Modelled Collisions per Year	Years per Collision
Whooper Swan	0.1141	8.76
Greenland White-fronted Goose[21]	0.054	18.5
Eurasian Wigeon	1.1694	0.86
Mallard[22]	0.4430	2.26
Common Kestrel[22]	0.1804	5.54
Peregrine Falcon	0.0128	78.125
Northern Lapwing	0.785	1.27
European Golden Plover	0.8185	1.22
Eurasian Curlew	0.345	2.90
Black-headed Gull[22]	4.4051	0.23

3.3 Effects on Designated Site Bird Populations

Using the non-breeding season CRM outputs for WF1 and WF2 combined, for all four survey years combined, the predicted mortality for non-breeding season qualifying features for each Special Protection Area (SPA) within the core foraging range for the relevant species are presented in context of the site population and potential increase on background mortality in

[21] Greenland white-fronted goose flights were recorded in 2018-19 only.
[22] Recorded as a primary target species in 2021-22 only.

Table 3-5. Table 3-5 updates Table 7-10 in the EIAR for species for which collision risk has been modelled. For qualifying features for which collision risk has not been assessed (due to insufficient flights) the information within Table 7-10 in the EIAR remains valid.

Table 3-5
Predicted Mortality in Context of SPA Reference Populations

Designated Site	Distance from Seven Hills (km)	Qualifying Feature	Core Foraging Range (km)	Background Mortality (%)	Qualifying Feature Population	Predicted Mortality	Potential Increase on background mortality (%)
Lough Croan Turlough SPA	1.5	European golden plover	15	27.0	2,025 (at time of designation in 2010) 3,625 (Southern Roscommon Lakes population 2008/09 – 2017/18)	0.8185	0.08-0.15
		Greenland white-fronted goose	5 to 8	27.6	164 (at time of designation in 2010) 41 (Southern Roscommon Lakes population 2008/09 – 2017/18)	0.054	0.12-0.4
River Suck Callows SPA	1.7	Whooper swan	<5	19.9	124 (at time of designation in 1995) 200 (2014/15 – 2017/18)	0.1141	0.29-0.46
		Eurasian wigeon	15	47.0	1,203 (at time of designation in 1996) 1,311 (2014/15 – 2017/18)	1.1694	0.19-0.21
		European golden plover	15	27.0	2,241 (at time of designation in 1996) 835 (2014/15 – 2017/18)	0.8185	0.14-0.36
		Northern lapwing	15	29.5	3,640 (at time of designation in 1996) 1,431 (2014/15 – 2017/18)	0.785	0.07-0.19
		Greenland white-fronted goose	5 to 8	27.6	386 (at time of designation in 1996) 28 (2014/15 – 2017/18)	0.054	0.1-0.7
Four Roads Turlough SPA	1.9	European golden plover	15	27.0	3,717 (at time of designation in 2010) 3,625 (Southern Roscommon Lakes population 2008/09 – 2017/18)	0.8185	0.08
		Greenland white-fronted goose	5 to 8	27.6	93 (at time of designation in 2010) 41 (Southern Roscommon Lakes population 2008/09 – 2017/18)	0.054	0.2-0.4

Designated Site	Distance from Seven Hills (km)	Qualifying Feature	Core Foraging Range (km)	Background Mortality (%)	Qualifying Feature Population	Predicted Mortality	Potential Increase on background mortality (%)
Lough Ree SPA	8.0	Whooper swan	<5	Not assessed (beyond core foraging range)			
		Eurasian wigeon	15	47.0	1,475 (at time of designation in 1995) 17 (2013/14 – 2017/18)	1.1694	0.17 (comparison with 2013/14–2017/18 data not applicable – see Section 7.5.4.2.4 of the EIAR)
		Mallard	15	37.3	675	0.443	0.18
		European golden plover	15	27.0	2,035 (at time of designation in 1995) 1,127 (2013/14 – 2017/18)	0.8185	0.15-0.27
		Northern lapwing	15	29.5	3,870 (at time of designation in 1995) 608 (2013/14 – 2017/18)	0.785	0.07-0.44
Middle Shannon Callows SPA	11.4	Whooper swan	<5	Not assessed (beyond core foraging range)			
		Eurasian wigeon	15	47.0	2,972 (at time of designation in 1995) 405 (2010/11 – 2017/18)	1.1694	0.08-0.61
		European golden plover	15	27.0	4,254 (at time of designation in 1995) 576 (2010/11 – 2017/18)	0.8185	0.07-0.53
		Black-headed gull	15	10.0	1,209	4.4051	3.64

As stated in Section 7.5.4.2.1 of the EIAR, it has been assumed, (as recommended by Percival 2003[23]), that any impact not increasing adult mortality by more than 1% of the existing background mortality rate can be considered to be insignificant. Whilst the 1% threshold is not a definitive measure of likely significance, and in many cases is highly precautionary, it is widely used as an initial filter to identify potentially significant effects of turbine collisions on the avian population under consideration.

With the exception of non-breeding black-headed gull at Middle Shannon Callows SPA, predicted mortality rates would not increase existing background mortality rates by >1% for any SPA qualifying features for which collision risk has been modelled. As such, for all species except black-headed gull, the assessment presented in Section 7.5.4.3 of the EIAR and within Sections 6.1.5-6.19 of the NIS remains unchanged by the inclusion of additional survey data collected in winter 2021/22, i.e., no significant effects are predicted.

For non-breeding black-headed gull at Middle Shannon Callows SPA, predicted mortality rates would increase existing background mortality rates by 3.64% meaning that under the Percival (2003) criteria they could be considered potentially significant. However, in this case the modelled collision risk for non-breeding black-headed gull is likely to represent a substantial overestimate with actual levels of collision likely to be much lower. The main reasons for the overestimate are as follows:

- As noted in Section 3.1.1, black-headed gull flight activity was focussed at Feacle Turlough and Four Roads Turlough. Although flights entered the 500m buffer, the main focus of flight activity was away from the proposed turbine locations. Including all flights within the 500m buffer within the model is therefore likely to have artificially increased the predicted collision risk, as in reality many of the flights included in the model are not likely to pass through the rotor swept area.
- Use of the 1% threshold (as per Percival, 2003) is highly precautionary when applying to non-breeding populations, as it uses the highest survival rates (i.e., for adult birds) for context. Where survival rates are high, a smaller number of collisions with turbines are needed for the excess mortality to be >1% of the background levels, i.e., the threshold for a potentially significant effect. The background mortality rate for black-headed gulls less than two years old is 55.3%[24], which compares with a background mortality rate of 10% for adults. Black-headed gull populations are made up of approximately 50% adults and 50% birds <2 years old (Forrester *et al*., 2007[25]) and on that basis a more realistic background mortality rate would be around 32.6%. Use of a more realistic background mortality rate would substantially reduce the effect of excess mortality on the background mortality rate for the SPA population.
- Non-breeding black-headed gulls recorded at Seven Hills are unlikely to contain a high proportion of individuals from Middle Shannon Callows SPA population, given the intervening distance (11.4 km at the closest point), as this species is common and widespread in the non-breeding season. This means that only a small proportion of any birds potentially colliding with turbines are likely to form part of the SPA population.

On the basis of the above, collision is considered unlikely to result in a significant effect on the Middle Shannon Callows SPA non-breeding black-headed gull population. It is noted also that Section 7.7 of the EIAR proposes post-construction monitoring for collisions, and the development and implementation of mitigation measures if monitoring indicates potentially significant levels of collision mortality. As such, in the unlikely event that potentially significant levels of black-headed gull collisions did occur, mitigation measures would be implemented accordingly.

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[23] Percival, S.M. (2003). *Birds and wind farms in Ireland: A review of potential issues and impact assessment*. Ecological Consulting.
[24] https://www.bto.org/understanding-birds/birdfacts/black-headed-gull
[25] Forrester, R. W., Andrews, l. J., Mclnerny. C. J., Murray, R. D., McGowan, R. Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. & Grundy, D.S. (eds) (2007). *The Birds of Scotland*. The Scottish Ornithologists' Club, Aberlady.

APPENDIX 01

Collision Probability Calculations

Whooper Swan

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	1.52	m	0.025	0.575	6.74	32.35	1.00	0.00125	31.84	1.00	0.00125
Wingspan	2.3	m	0.075	0.575	2.25	10.96	0.38	0.00287	10.44	0.36	0.00274
F: Flapping (0) or gliding (-	0		0.125	0.702	1.35	7.46	0.26	0.00326	6.83	0.24	0.00299
			0.175	0.860	0.96	6.15	0.21	0.00376	5.37	0.19	0.00329
Bird speed	17.3	m/sec	0.225	0.994	0.75	5.36	0.19	0.00421	4.46	0.16	0.00351
RotorDiam	162	m	0.275	0.947	0.61	4.43	0.15	0.00426	3.58	0.13	0.00344
RotationPeriod	4.96	sec	0.325	0.899	0.52	3.92	0.14	0.00445	3.11	0.11	0.00353
			0.375	0.851	0.45	3.54	0.12	0.00464	2.77	0.10	0.00364
			0.425	0.804	0.40	3.24	0.11	0.00482	2.52	0.09	0.00375
			0.475	0.756	0.35	3.01	0.11	0.00499	2.33	0.08	0.00387
Bird aspect ratioo: β	0.66		0.525	0.708	0.32	2.81	0.10	0.00516	2.17	0.08	0.00399
			0.575	0.660	0.29	2.65	0.09	0.00532	2.05	0.07	0.00412
			0.625	0.613	0.27	2.50	0.09	0.00547	1.95	0.07	0.00426
			0.675	0.565	0.25	2.38	0.08	0.00561	1.87	0.07	0.00441
			0.725	0.517	0.23	2.27	0.08	0.00575	1.80	0.06	0.00457
			0.775	0.470	0.22	2.17	0.08	0.00587	1.75	0.06	0.00473
			0.825	0.422	0.20	2.08	0.07	0.00599	1.70	0.06	0.00490
			0.875	0.374	0.19	2.00	0.07	0.00611	1.66	0.06	0.00508
			0.925	0.327	0.18	1.92	0.07	0.00621	1.63	0.06	0.00526
			0.975	0.279	0.17	1.85	0.06	0.00631	1.60	0.06	0.00546
				Overall p(collision) =			**Upwind**	**9.6%**		**Downwind**	**7.9%**
								Average	**8.8%**		

Eurasian Wigeon

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.48	m	0.025	0.575	4.02	13.34	0.78	0.00098	12.83	0.75	0.00094
Wingspan	0.8	m	0.075	0.575	1.34	4.62	0.27	0.00203	4.10	0.24	0.00181
F: Flapping (0) or gliding (-	0		0.125	0.702	0.80	3.37	0.20	0.00247	2.74	0.16	0.00201
			0.175	0.860	0.57	2.98	0.17	0.00306	2.20	0.13	0.00226
Bird speed	10.3	m/sec	0.225	0.994	0.45	2.82	0.17	0.00373	1.93	0.11	0.00255
RotorDiam	162	m	0.275	0.947	0.37	2.38	0.14	0.00385	1.53	0.09	0.00247
RotationPeriod	4.96	sec	0.325	0.899	0.31	2.07	0.12	0.00395	1.26	0.07	0.00241
			0.375	0.851	0.27	1.84	0.11	0.00405	1.07	0.06	0.00236
			0.425	0.804	0.24	1.65	0.10	0.00412	0.93	0.05	0.00232
			0.475	0.756	0.21	1.50	0.09	0.00419	0.82	0.05	0.00230
Bird aspect ratioo: β	0.60		0.525	0.708	0.19	1.38	0.08	0.00425	0.74	0.04	0.00228
			0.575	0.660	0.17	1.27	0.07	0.00429	0.68	0.04	0.00228
			0.625	0.613	0.16	1.18	0.07	0.00432	0.63	0.04	0.00230
			0.675	0.565	0.15	1.09	0.06	0.00433	0.59	0.03	0.00232
			0.725	0.517	0.14	1.02	0.06	0.00434	0.55	0.03	0.00236
			0.775	0.470	0.13	0.95	0.06	0.00433	0.53	0.03	0.00241
			0.825	0.422	0.12	0.89	0.05	0.00431	0.51	0.03	0.00247
			0.875	0.374	0.11	0.83	0.05	0.00427	0.50	0.03	0.00255
			0.925	0.327	0.11	0.78	0.05	0.00423	0.48	0.03	0.00263
			0.975	0.279	0.10	0.73	0.04	0.00417	0.48	0.03	0.00276
				Overall p(collision) =			**Upwind**	**7.5%**		**Downwind**	**4.6%**
								Average	**6.1%**		

Mallard

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3					Upwind:			Downwind:		
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.6	m	0.025	0.575	8.34	28.28	0.80	0.00100	27.76	0.78	0.00098
Wingspan	0.9	m	0.075	0.575	2.78	9.60	0.27	0.00203	9.08	0.26	0.00193
F: Flapping (0) or gliding (-	0		0.125	0.702	1.67	6.82	0.19	0.00241	6.19	0.17	0.00219
			0.175	0.860	1.19	5.84	0.17	0.00289	5.07	0.14	0.00251
Bird speed	21.4	m/sec	0.225	0.994	0.93	5.22	0.15	0.00332	4.33	0.12	0.00275
RotorDiam	162	m	0.275	0.947	0.76	4.18	0.12	0.00325	3.33	0.09	0.00259
RotationPeriod	4.96	sec	0.325	0.899	0.64	3.47	0.10	0.00319	2.66	0.08	0.00245
			0.375	0.851	0.56	3.01	0.08	0.00319	2.24	0.06	0.00238
			0.425	0.804	0.49	2.65	0.07	0.00318	1.93	0.05	0.00231
			0.475	0.756	0.44	2.36	0.07	0.00317	1.68	0.05	0.00225
Bird aspect ratioo: β	0.67		0.525	0.708	0.40	2.12	0.06	0.00315	1.48	0.04	0.00220
			0.575	0.660	0.36	1.92	0.05	0.00312	1.33	0.04	0.00216
			0.625	0.613	0.33	1.75	0.05	0.00309	1.20	0.03	0.00212
			0.675	0.565	0.31	1.60	0.05	0.00305	1.09	0.03	0.00208
			0.725	0.517	0.29	1.47	0.04	0.00301	1.00	0.03	0.00206
			0.775	0.470	0.27	1.35	0.04	0.00296	0.93	0.03	0.00204
			0.825	0.422	0.25	1.25	0.04	0.00290	0.87	0.02	0.00202
			0.875	0.374	0.24	1.15	0.03	0.00284	0.81	0.02	0.00201
			0.925	0.327	0.23	1.06	0.03	0.00278	0.77	0.02	0.00201
			0.975	0.279	0.21	0.98	0.03	0.00270	0.73	0.02	0.00201
				Overall p(collision) =			**Upwind**	**5.7%**		**Downwind**	**4.3%**
								Average	**5.0%**		

Common Kestrel

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3						Upwind:			Downwind:	
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.34	m	0.025	0.575	4.95	14.95	0.71	0.00089	14.44	0.69	0.00086
Wingspan	0.8	m	0.075	0.575	1.65	5.16	0.25	0.00184	4.64	0.22	0.00166
F: Flapping (0) or gliding (-	1		0.125	0.702	0.99	3.79	0.18	0.00226	3.16	0.15	0.00188
			0.175	0.860	0.71	3.35	0.16	0.00279	2.58	0.12	0.00215
Bird speed	12.7	m/sec	0.225	0.994	0.55	3.07	0.15	0.00329	2.17	0.10	0.00233
RotorDiam	162	m	0.275	0.947	0.45	2.48	0.12	0.00324	1.63	0.08	0.00213
RotationPeriod	4.96	sec	0.325	0.899	0.38	2.21	0.11	0.00342	1.40	0.07	0.00217
			0.375	0.851	0.33	1.92	0.09	0.00344	1.16	0.06	0.00207
			0.425	0.804	0.29	1.70	0.08	0.00344	0.98	0.05	0.00198
			0.475	0.756	0.26	1.52	0.07	0.00344	0.84	0.04	0.00191
Bird aspect ratioo: β	0.43		0.525	0.708	0.24	1.37	0.07	0.00343	0.74	0.04	0.00184
			0.575	0.660	0.22	1.24	0.06	0.00341	0.65	0.03	0.00178
			0.625	0.613	0.20	1.13	0.05	0.00338	0.58	0.03	0.00174
			0.675	0.565	0.18	1.04	0.05	0.00333	0.53	0.03	0.00170
			0.725	0.517	0.17	0.95	0.05	0.00328	0.49	0.02	0.00168
			0.775	0.470	0.16	0.87	0.04	0.00322	0.45	0.02	0.00166
			0.825	0.422	0.15	0.80	0.04	0.00314	0.42	0.02	0.00165
			0.875	0.374	0.14	0.73	0.03	0.00306	0.40	0.02	0.00166
			0.925	0.327	0.13	0.67	0.03	0.00297	0.38	0.02	0.00167
			0.975	0.279	0.13	0.62	0.03	0.00286	0.37	0.02	0.00170
				Overall p(collision) =			**Upwind**	**6.0%**		**Downwind**	**3.6%**
								Average	**4.8%**		

Peregrine Falcon

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3						Upwind:			Downwind:	
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.45	m	0.025	0.575	5.46	19.68	0.85	0.00106	19.17	0.83	0.00103
Wingspan	1.1	m	0.075	0.575	1.82	6.73	0.29	0.00218	6.22	0.27	0.00201
F: Flapping (0) or gliding (-	0		0.125	0.702	1.09	4.79	0.21	0.00259	4.16	0.18	0.00225
			0.175	0.860	0.78	4.11	0.18	0.00311	3.34	0.14	0.00252
Bird speed	14	m/sec	0.225	0.994	0.61	3.69	0.16	0.00359	2.80	0.12	0.00272
RotorDiam	162	m	0.275	0.947	0.50	2.98	0.13	0.00354	2.13	0.09	0.00253
RotationPeriod	4.96	sec	0.325	0.899	0.42	2.48	0.11	0.00348	1.67	0.07	0.00235
			0.375	0.851	0.36	2.16	0.09	0.00349	1.39	0.06	0.00226
			0.425	0.804	0.32	1.91	0.08	0.00352	1.19	0.05	0.00219
			0.475	0.756	0.29	1.72	0.07	0.00353	1.04	0.04	0.00213
Bird aspect ratioo: β	0.41		0.525	0.708	0.26	1.56	0.07	0.00353	0.92	0.04	0.00208
			0.575	0.660	0.24	1.42	0.06	0.00352	0.82	0.04	0.00205
			0.625	0.613	0.22	1.30	0.06	0.00350	0.75	0.03	0.00202
			0.675	0.565	0.20	1.19	0.05	0.00348	0.68	0.03	0.00200
			0.725	0.517	0.19	1.10	0.05	0.00344	0.63	0.03	0.00199
			0.775	0.470	0.18	1.01	0.04	0.00340	0.59	0.03	0.00198
			0.825	0.422	0.17	0.94	0.04	0.00334	0.56	0.02	0.00199
			0.875	0.374	0.16	0.87	0.04	0.00328	0.53	0.02	0.00201
			0.925	0.327	0.15	0.80	0.03	0.00321	0.51	0.02	0.00203
			0.975	0.279	0.14	0.74	0.03	0.00313	0.49	0.02	0.00207
				Overall p(collision) =			**Upwind**	**6.4%**		**Downwind**	**4.2%**
								Average	**5.3%**		

Northern Lapwing

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3					Upwind:			Downwind:		
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.3	m	0.025	0.575	4.79	16.08	0.79	0.00099	15.56	0.77	0.00096
Wingspan	0.84	m	0.075	0.575	1.60	5.53	0.27	0.00204	5.01	0.25	0.00185
F: Flapping (0) or gliding (-	0		0.125	0.702	0.96	4.00	0.20	0.00246	3.37	0.17	0.00207
			0.175	0.860	0.68	3.48	0.17	0.00300	2.71	0.13	0.00233
Bird speed	12.3	m/sec	0.225	0.994	0.53	3.16	0.16	0.00350	2.27	0.11	0.00251
RotorDiam	162	m	0.275	0.947	0.44	2.56	0.13	0.00346	1.71	0.08	0.00231
RotationPeriod	4.96	sec	0.325	0.899	0.37	2.13	0.10	0.00341	1.32	0.07	0.00212
			0.375	0.851	0.32	1.85	0.09	0.00340	1.08	0.05	0.00199
			0.425	0.804	0.28	1.63	0.08	0.00341	0.91	0.04	0.00190
			0.475	0.756	0.25	1.46	0.07	0.00340	0.78	0.04	0.00181
Bird aspect ratioo: β	0.36		0.525	0.708	0.23	1.31	0.06	0.00338	0.67	0.03	0.00174
			0.575	0.660	0.21	1.19	0.06	0.00335	0.59	0.03	0.00167
			0.625	0.613	0.19	1.08	0.05	0.00331	0.53	0.03	0.00162
			0.675	0.565	0.18	0.98	0.05	0.00326	0.48	0.02	0.00158
			0.725	0.517	0.17	0.90	0.04	0.00320	0.43	0.02	0.00154
			0.775	0.470	0.15	0.82	0.04	0.00313	0.40	0.02	0.00152
			0.825	0.422	0.15	0.75	0.04	0.00305	0.37	0.02	0.00151
			0.875	0.374	0.14	0.69	0.03	0.00296	0.35	0.02	0.00151
			0.925	0.327	0.13	0.63	0.03	0.00286	0.33	0.02	0.00152
			0.975	0.279	0.12	0.57	0.03	0.00274	0.32	0.02	0.00154
				Overall p(collision) =			**Upwind**	**6.0%**		**Downwind**	**3.6%**
								Average	**4.8%**		

European Golden Plover

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3					Upwind:			Downwind:		
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.28	m	0.025	0.575	6.82	21.95	0.76	0.00095	21.43	0.74	0.00093
Wingspan	0.72	m	0.075	0.575	2.27	7.49	0.26	0.00194	6.97	0.24	0.00181
F: Flapping (0) or gliding (-	0		0.125	0.702	1.36	5.39	0.19	0.00233	4.76	0.16	0.00206
			0.175	0.860	0.97	4.67	0.16	0.00283	3.90	0.13	0.00236
Bird speed	17.5	m/sec	0.225	0.994	0.76	4.22	0.15	0.00328	3.32	0.11	0.00258
RotorDiam	162	m	0.275	0.947	0.62	3.38	0.12	0.00322	2.53	0.09	0.00241
RotationPeriod	4.96	sec	0.325	0.899	0.52	2.80	0.10	0.00314	1.99	0.07	0.00224
			0.375	0.851	0.45	2.37	0.08	0.00307	1.60	0.06	0.00207
			0.425	0.804	0.40	2.03	0.07	0.00298	1.31	0.05	0.00192
			0.475	0.756	0.36	1.78	0.06	0.00292	1.10	0.04	0.00181
Bird aspect ratioo: β	0.39		0.525	0.708	0.32	1.58	0.05	0.00287	0.95	0.03	0.00172
			0.575	0.660	0.30	1.41	0.05	0.00281	0.82	0.03	0.00163
			0.625	0.613	0.27	1.27	0.04	0.00274	0.72	0.02	0.00155
			0.675	0.565	0.25	1.14	0.04	0.00267	0.64	0.02	0.00149
			0.725	0.517	0.24	1.03	0.04	0.00259	0.57	0.02	0.00142
			0.775	0.470	0.22	0.93	0.03	0.00250	0.51	0.02	0.00137
			0.825	0.422	0.21	0.84	0.03	0.00240	0.46	0.02	0.00132
			0.875	0.374	0.19	0.76	0.03	0.00230	0.42	0.01	0.00128
			0.925	0.327	0.18	0.68	0.02	0.00219	0.39	0.01	0.00125
			0.975	0.279	0.17	0.61	0.02	0.00207	0.36	0.01	0.00122
				Overall p(collision) =			**Upwind**	**5.2%**		**Downwind**	**3.4%**
								Average	**4.3%**		

Eurasian Curlew

K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3						Upwind:			Downwind:	
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.55	m	0.025	0.575	5.15	17.54	0.80	0.00100	17.03	0.78	0.00098
Wingspan	0.9	m	0.075	0.575	1.72	6.02	0.28	0.00207	5.50	0.25	0.00189
F: Flapping (0) or gliding (-	0		0.125	0.702	1.03	4.33	0.20	0.00248	3.70	0.17	0.00212
			0.175	0.860	0.74	3.75	0.17	0.00301	2.98	0.14	0.00239
Bird speed	13.2	m/sec	0.225	0.994	0.57	3.43	0.16	0.00353	2.53	0.12	0.00261
RotorDiam	162	m	0.275	0.947	0.47	2.87	0.13	0.00362	2.02	0.09	0.00254
RotationPeriod	4.96	sec	0.325	0.899	0.40	2.48	0.11	0.00369	1.67	0.08	0.00248
			0.375	0.851	0.34	2.18	0.10	0.00375	1.42	0.06	0.00243
			0.425	0.804	0.30	1.95	0.09	0.00380	1.23	0.06	0.00239
			0.475	0.756	0.27	1.77	0.08	0.00384	1.09	0.05	0.00236
Bird aspect ratioo: β	0.61		0.525	0.708	0.25	1.61	0.07	0.00387	0.97	0.04	0.00234
			0.575	0.660	0.22	1.48	0.07	0.00390	0.89	0.04	0.00233
			0.625	0.613	0.21	1.36	0.06	0.00391	0.81	0.04	0.00233
			0.675	0.565	0.19	1.26	0.06	0.00391	0.76	0.03	0.00234
			0.725	0.517	0.18	1.18	0.05	0.00390	0.71	0.03	0.00236
			0.775	0.470	0.17	1.09	0.05	0.00389	0.67	0.03	0.00239
			0.825	0.422	0.16	1.02	0.05	0.00386	0.64	0.03	0.00243
			0.875	0.374	0.15	0.95	0.04	0.00382	0.62	0.03	0.00247
			0.925	0.327	0.14	0.89	0.04	0.00378	0.60	0.03	0.00253
			0.975	0.279	0.13	0.83	0.04	0.00372	0.58	0.03	0.00260
				Overall p(collision) =			**Upwind**	**6.9%**		**Downwind**	**4.6%**
								Average	**5.8%**		

Black-headed Gull

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**								
NoBlades	3					Upwind:			Downwind:		
MaxChord	4.3	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	6		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.36	m	0.025	0.575	4.37	15.58	0.84	0.00105	15.06	0.81	0.00102
Wingspan	1.05	m	0.075	0.575	1.46	5.37	0.29	0.00217	4.85	0.26	0.00196
F: Flapping (0) or gliding (-	0		0.125	0.702	0.87	3.85	0.21	0.00260	3.22	0.17	0.00217
			0.175	0.860	0.62	3.34	0.18	0.00315	2.56	0.14	0.00242
Bird speed	11.2	m/sec	0.225	0.994	0.49	3.02	0.16	0.00367	2.13	0.11	0.00258
RotorDiam	162	m	0.275	0.947	0.40	2.45	0.13	0.00364	1.60	0.09	0.00237
RotationPeriod	4.96	sec	0.325	0.899	0.34	2.06	0.11	0.00361	1.25	0.07	0.00219
			0.375	0.851	0.29	1.80	0.10	0.00365	1.04	0.06	0.00210
			0.425	0.804	0.26	1.60	0.09	0.00368	0.88	0.05	0.00202
			0.475	0.756	0.23	1.44	0.08	0.00370	0.76	0.04	0.00196
Bird aspect ratioo: β	0.34		0.525	0.708	0.21	1.31	0.07	0.00371	0.67	0.04	0.00190
			0.575	0.660	0.19	1.19	0.06	0.00370	0.60	0.03	0.00186
			0.625	0.613	0.17	1.09	0.06	0.00369	0.54	0.03	0.00183
			0.675	0.565	0.16	1.00	0.05	0.00366	0.50	0.03	0.00181
			0.725	0.517	0.15	0.93	0.05	0.00362	0.46	0.02	0.00180
			0.775	0.470	0.14	0.85	0.05	0.00357	0.43	0.02	0.00181
			0.825	0.422	0.13	0.79	0.04	0.00351	0.41	0.02	0.00182
			0.875	0.374	0.12	0.73	0.04	0.00344	0.39	0.02	0.00185
			0.925	0.327	0.12	0.67	0.04	0.00335	0.38	0.02	0.00189
			0.975	0.279	0.11	0.62	0.03	0.00326	0.37	0.02	0.00194
				Overall p(collision) =			**Upwind**	**6.6%**		**Downwind**	**3.9%**
								Average	**5.3%**		

APPENDIX 02

Wind Farm 1 (North) CRM Calculations

Whooper Swan 2021-2022

	Viewsheds								
	1	**2**							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	630	420							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=$T_wV/HaHr$	1.47E-05	1.86E-05							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	9.62E-06	6.42E-06							
Total weighted occupancy rate	0.000016					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.730%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.640%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	15.29	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	1.52	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	839,732.45	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	62.65	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.3	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	186	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.088	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	15.491	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
99.50%	**0.0775**	**approx one collision every**	**12.91**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=1.52m, wingspan 2.3m, flight speed= 17.3m/sec

Whooper Swan All Years

	Viewsheds								
	1	2							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	900	1,702							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	144	141							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	47592.00	24618.60							
T_wV rate=$T_wV/HaHr$	5.25E-06	1.92E-05							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.659	0.341							
Weighted T_wV rate (T_wV rate * weight)	3.46E-06	6.55E-06							
Total weighted occupancy rate	0.000010				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	0.456%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.399%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	9.54	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	1.52	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	839,732.45	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	39.10	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.3	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	116	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.088	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	9.666	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
99.50%	**0.0483**	**approx one collision every**	**20.69**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=1.52m, wingspan 2.3m, flight speed= 17.3m/sec

Eurasian Wigeon 2021-2022

	Viewsheds								
	1	2							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	4,515							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=$T_wV/HaHr$	0.00E+00	2.00E-04							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	6.90E-05							
Total weighted occupancy rate	0.000069					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	3.140%								
Mean activity hr^-1 in wind farm at rotor height (z)	2.750%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	65.73	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.48	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	689,677.17	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	221.26	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	10.3	m/sec
$t_r=(d+L)/s$	0.46	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	477	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.061	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	27.418	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.5484**	**approx one collision every**	**1.82**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.48m, wingspan 0.8m, flight speed= 10.3m/sec

Eurasian Wigeon All Years

	Viewsheds								
	1	**2**							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	4,515							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	144	141							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	47592.00	24618.60							
T_wV rate=$T_wV/HaHr$	0.00E+00	5.09E-05							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.659	0.341							
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	1.74E-05							
Total weighted occupancy rate	0.000017					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.791%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.692%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	16.55	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.48	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	689,677.17	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	55.72	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	10.3	m/sec
$t_r=(d+L)/s$	0.46	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	120	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.061	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	6.904	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.1381**	**approx one collision every**	**7.24**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.48m, wingspan 0.8m, flight speed= 10.3m/sec

Common Kestrel 2021/ 2022

	Viewsheds								
	1	2							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	240	0							
Step 1.2: Unweighted occupancy rate each viewshed (T_wVrate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=$T_wV/HaHr$	5.60E-06	0.00E+00							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	3.67E-06	0.00E+00							
Total weighted occupancy rate	0.000004					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.167%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.146%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	2.53	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w = A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.34	m
Rotor-swept volume: $V_r = N*\pi*r^2*(d+L)$	669,477.42	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r = T_w*(V_r/Vw)$	8.26	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	12.7	m/sec
$t_r = (d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N = T_r/t$	23	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.048	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	1.034	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
95.00%	**0.0517**	**approx one collision every**	**19.33**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.34m, wingspan 0.8m, flight speed= 12.7m/sec

Peregrine Falcon 2021/ 2022

	Viewsheds								
	1	**2**							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	105	0							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=$T_wV/HaHr$	2.45E-06	0.00E+00							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	1.60E-06	0.00E+00							
Total weighted occupancy rate	0.000002					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.073%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.064%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	1.11	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.45	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	685,348.65	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	3.70	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	14	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	11	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	0.550	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.0110**	**approx one collision every**	**90.98**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.45m, wingspan 1.1m, flight speed= 14.0m/sec

Peregrine Falcon All Years

	Viewsheds								
	1	**2**							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	105	0							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	144	141							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	47592.00	24618.60							
T_wV rate=$T_wV/HaHr$	6.13E-07	0.00E+00							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.659	0.341							
Weighted T_wV rate (T_wV rate * weight)	4.04E-07	0.00E+00							
Total weighted occupancy rate	0.000000				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	0.018%								
Mean activity hr^-1 in wind farm at rotor height (z)	0.016%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	0.28	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w = A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.45	m
Rotor-swept volume: $V_r = N*\pi*r^2*(d+L)$	685,348.65	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r = T_w*(V_r/Vw)$	0.93	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	14	m/sec
$t_r = (d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N = T_r/t$	3	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	0.138	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.0028**	**approx one collision every**	**361.32**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.45m, wingspan 1.1m, flight speed= 14.0m/sec

Northern Lapwing All Years

	Viewsheds									
	1	**2**								
STAGE 1: Estimation of rotor transits										
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	450	0								
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)										
Hours of survey effort (*e*)	144	141								
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60								
Observation effort (HaHr)	47592.00	24618.60								
T_wV rate=$T_wV/HaHr$	2.63E-06	0.00E+00								
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]										
Weight: proportion of total effort made at the VP	0.659	0.341								
Weighted T_wV rate (T_wV rate * weight)	1.73E-06	0.00E+00								
Total weighted occupancy rate	0.000002					birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	0.079%									
Mean activity hr^-1 in wind farm at rotor height (z)	0.069%									

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	1.65	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.3	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	663,706.06	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	5.34	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	12.3	m/sec
$t_r=(d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	14	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.048	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	0.651	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.0130**	**approx one collision every**	**76.81**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.3m, wingspan 0.84m, flight speed= 12.3m/sec

European Golden Plover 2021/ 2022

	Viewsheds								
	1	2							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	8,640							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=$T_wV/HaHr$	0.00E+00	3.82E-04							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	1.32E-04							
Total weighted occupancy rate	0.000132					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	6.009%								
Mean activity hr^-1 in wind farm at rotor height (z)	5.262%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	125.79	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.28	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	660,820.38	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	405.70	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.5	m/sec
$t_r=(d+L)/s$	0.26	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	1,550	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.043	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	63.489	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**1.2698**	**approx one collision every**	**0.79**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.28m, wingspan 0.72m, flight speed= 17.5m/sec

European Golden Plover All Years

	Viewsheds								
	1	**2**							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	8,640							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	144	141							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	47592.00	24618.60							
T_wV rate=$T_wV/HaHr$	0.00E+00	9.75E-05							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.659	0.341							
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	3.32E-05							
Total weighted occupancy rate	0.000033					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	1.513%								
Mean activity hr^-1 in wind farm at rotor height (z)	1.325%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	31.67	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.28	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	660,820.38	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	102.16	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.5	m/sec
$t_r=(d+L)/s$	0.26	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	390	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.043	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	15.987	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.3197**	**approx one collision every**	**3.13**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.28m, wingspan 0.72m, flight speed= 17.5m/sec

Black-headed Gull 2021/ 2022

	Viewsheds								
	1	2							
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	7125	14,415							
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	36							
Windfarm area (ha) visible within viewshed (*v*)	330.50	174.60							
Observation effort (HaHr)	11898.00	6285.60							
T_wV rate=T_wV/*HaHr*	1.66E-04	6.37E-04							
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.654	0.346							
Weighted T_wV rate (T_wV rate * weight)	1.09E-04	2.20E-04							
Total weighted occupancy rate	0.000329					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	14.982%								
Mean activity hr^-1 in wind farm at rotor height (z)	13.119%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	226.84	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w = A*h$	737,586,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.36	m
Rotor-swept volume: $V_r = N*\pi*r^2*(d+L)$	672,363.09	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r = T_w*(V_r/Vw)$	744.42	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	11.2	m/sec
$t_r = (d+L)/s$	0.42	seconds
Step 1.10: Number of rotor transits (N)		
$N = T_r/t$	1,789	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	89.884	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**1.7977**	**approx one collision every**	**0.56**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.36m, wingspan 1.05m, flight speed= 11.2m/sec

APPENDIX 03

Wind Farm 2 (South) CRM Calculations

Whooper Swan 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	1,110	600	60					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	0.00E+00	2.13E-05	1.12E-05	3.00E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	5.86E-06	3.17E-06	3.17E-07					
Total weighted occupancy rate	0.000009					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.936%								

Mean activity hr^-1 in wind farm at rotor height (z)	0.820%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	19.60	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	1.52	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,559,503.12	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	65.53	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.3	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	195	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.088	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	16.202	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
99.50%	**0.0810**	**approx one collision every**	**12.34**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=1.52m, wingspan 2.3m, flight speed= 17.3m/sec

Whooper Swan All Years

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	67	2,571	2,681	267					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	2.70E-07	1.31E-05	1.33E-05	3.41E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	9.24E-08	3.55E-06	3.70E-06	3.68E-07					
Total weighted occupancy rate	0.000007					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.761%								

Mean activity hr^-1 in wind farm at rotor height (z)	0.666%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	15.92	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	1.52	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,559,503.12	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	53.24	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.3	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	158	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.088	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	13.163	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
99.50%	**0.0658**	**approx one collision every**	**15.19**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=1.52m, wingspan 2.3m, flight speed= 17.3m/sec

Eurasian Wigeon 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	36,285	0					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	6.75E-04	0.00E+00					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	1.92E-04	0.00E+00					
Total weighted occupancy rate	0.000192				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	19.871%								

Mean activity hr^-1 in wind farm at rotor height (z)	17.400%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	415.92	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.48	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,280,829.02	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	1142.03	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	10.3	m/sec
$t_r=(d+L)/s$	0.46	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	2,461	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.061	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	141.515	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**2.8303**	**approx one collision every**	**0.35**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.48m, wingspan 0.8m, flight speed= 10.3m/sec

Eurasian Wigeon All Years

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	50,622	0					
Step 1.2: Unweighted occupancy rate each viewshed (T_wVrate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	2.51E-04	0.00E+00					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	6.98E-05	0.00E+00					
Total weighted occupancy rate	0.000070				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	7.241%								

Mean activity hr^-1 in wind farm at rotor height (z)	6.340%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	151.55	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.48	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,280,829.02	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	416.14	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	10.3	m/sec
$t_r=(d+L)/s$	0.46	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	897	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.061	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	51.565	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**1.0313**	**approx one collision every**	**0.97**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.48m, wingspan 0.8m, flight speed= 10.3m/sec

Mallard 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	3,300	0					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	6.14E-05	0.00E+00					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	1.74E-05	0.00E+00					
Total weighted occupancy rate	0.000017				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	1.807%								

Mean activity hr^-1 in wind farm at rotor height (z)	1.582%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	37.83	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.6	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,312,983.72	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	106.47	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	21.4	m/sec
$t_r=(d+L)/s$	0.23	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	465	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.050	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	22.148	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.4430**	**approx one collision every**	**2.26**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.45m, wingspan 1.1m, flight speed= 21.4m/sec

Common Kestrel 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	210	195	525	45					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	3.31E-06	3.74E-06	9.76E-06	2.25E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	1.11E-06	1.03E-06	2.77E-06	2.38E-07					
Total weighted occupancy rate	0.000005				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	0.509%								

Mean activity hr^-1 in wind farm at rotor height (z)	0.446%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	7.71	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.34	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,243,315.20	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	20.55	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	12.7	m/sec
$t_r=(d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	56	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.048	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	2.575	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
95.00%	**0.1287**	**approx one collision every**	**7.77**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours during the period

[4]Assumes bird length=0.34m, wingspan 0.8m, flight speed= 12.7m/sec

Peregrine Falcon 2021/2022

	Viewsheds								
	1	2	3	4					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	90	0	225	105					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	1.42E-06	0.00E+00	4.18E-06	5.26E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	4.75E-07	0.00E+00	1.19E-06	5.55E-07					
Total weighted occupancy rate	0.000002					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	0.173%								

Mean activity hr^-1 in wind farm at rotor height (z)	0.151%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	2.61	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.45	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,272,790.35	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	7.13	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	14	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	21	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	1.059	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.0212**	**approx one collision every**	**47.22**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours

[4]Assumes bird length=0.45m, wingspan 1.1m, flight speed= 14.0m/sec

Peregrine Falcon All Years

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	325	15	231	128					
Step 1.2: Unweighted occupancy rate each viewshed (T_wVrate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	1.31E-06	7.64E-08	1.15E-06	1.64E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	4.48E-07	2.07E-08	3.19E-07	1.77E-07					
Total weighted occupancy rate	0.000001				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	0.082%								

Mean activity hr^-1 in wind farm at rotor height (z)	0.072%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	1.24	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.45	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,272,790.35	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	3.37	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	14	m/sec
$t_r=(d+L)/s$	0.34	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	10	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	0.501	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.0100**	**approx one collision every**	**99.74**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours

[4]Assumes bird length=0.45m, wingspan 1.1m, flight speed= 14.0m/sec

Northern Lapwing 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	11,565	0					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	2.15E-04	0.00E+00					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	6.11E-05	0.00E+00					
Total weighted occupancy rate	0.000061					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	6.333%								

Mean activity hr^-1 in wind farm at rotor height (z)	5.546%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	132.57	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.3	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,232,596.97	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	350.29	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	12.3	m/sec
$t_r=(d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	937	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.048	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	42.667	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.8533**	**approx one collision every**	**1.17**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.3m, wingspan 0.84m, flight speed= 12.3m/sec

Northern Lapwing All Years

	Viewsheds								
	1	2	3	4					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	1588	24,579	13,893	8					
Step 1.2: Unweighted occupancy rate each viewshed (T_wVrate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	6.39E-06	1.25E-04	6.89E-05	1.02E-07					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	2.19E-06	3.39E-05	1.92E-05	1.10E-08					
Total weighted occupancy rate	0.000055				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	5.730%								

Mean activity hr^-1 in wind farm at rotor height (z)	5.017%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	119.93	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w = A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.3	m
Rotor-swept volume: $V_r = N*\pi*r^2*(d+L)$	1,232,596.97	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r = T_w*(V_r/Vw)$	316.91	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	12.3	m/sec
$t_r = (d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N = T_r/t$	847	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.048	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	38.601	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.7720**	**approx one collision every**	**1.30**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.3m, wingspan 0.84m, flight speed= 12.3m/sec

Eurasian Golden Plover All Years

	Viewsheds								
	1	2	3	4					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	549	15,448	8					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	0.00E+00	2.80E-06	7.66E-05	1.02E-07					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	7.58E-07	2.13E-05	1.10E-08					
Total weighted occupancy rate	0.000022					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	2.288%								
Mean activity hr^-1 in wind farm at rotor height (z)	2.004%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	47.89	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.28	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,227,237.85	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	126.00	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	17.5	m/sec
$t_r=(d+L)/s$	0.26	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	481	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.043	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	19.718	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.3944**	**approx one collision every**	**2.54**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.28m, wingspan 0.72m, flight speed= 17.5m/sec

Eurasian Curlew 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	8,175	0					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	1.52E-04	0.00E+00					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	4.32E-05	0.00E+00					
Total weighted occupancy rate	0.000043				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	4.477%								

Mean activity hr^-1 in wind farm at rotor height (z)	3.920%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	93.71	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.55	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,299,585.93	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	261.07	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	13.2	m/sec
$t_r=(d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	711	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.058	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	39.040	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.7808**	**approx one collision every**	**1.28**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.55m, wingspan 0.9m, flight speed= 13.2m/sec

Eurasian Curlew All Years

	Viewsheds								
	1	2	3	4					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	0	0	13,831	405					
Step 1.2: Unweighted occupancy rate each viewshed (T_wVrate)									
Hours of survey effort (*e*)	141	147	135	141					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	69001.88	54553.91	56024.87	21735.71					
T_wV rate=$T_wV/HaHr$	0.00E+00	0.00E+00	6.86E-05	5.18E-06					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.343	0.271	0.278	0.108					
Weighted T_wV rate (T_wV rate * weight)	0.00E+00	0.00E+00	1.91E-05	5.59E-07					
Total weighted occupancy rate	0.000019					birds seconds per ha/hour			
Mean activity hr^-1 in wind farm at risk height	1.978%								

Mean activity hr^-1 in wind farm at rotor height (z)	1.732%	
Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	2,390	hours
Tw=z*a	41.41	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.55	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,299,585.93	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	115.36	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	13.2	m/sec
$t_r=(d+L)/s$	0.37	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	314	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.058	
STAGE 3: Predicted mortality (birds per year)		

Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	17.251	collisions		
Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**0.3450**	**approx one collision every**	**2.90**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours + 25% nocturnal hours during the period

[4]Assumes bird length=0.55m, wingspan 0.9m, flight speed= 13.2m/sec

Black-headed Gull 2021/ 2022

	Viewsheds								
	1	**2**	**3**	**4**					
STAGE 1: Estimation of rotor transits									
Step 1.1: Seconds occupancy of the survey risk volume (T_w)[1] recorded within each viewshed (T_wV)	1800	20,970	25,875	46980					
Step 1.2: Unweighted occupancy rate each viewshed ($T_wV$rate)									
Hours of survey effort (*e*)	36	39	36	36					
Windfarm area (ha) visible within viewshed (*v*)	489.38	371.12	414.999	154.154					
Observation effort (HaHr)	17617.50	14473.49	14939.96	5549.54					
T_wV rate=$T_wV/HaHr$	2.84E-05	4.02E-04	4.81E-04	2.35E-03					
Step 1.3: Weighted occupancy rate *(weighted T_wV rate)*[1]									
Weight: proportion of total effort made at the VP	0.335	0.275	0.284	0.106					
Weighted T_wV rate (T_wV rate * weight)	9.51E-06	1.11E-04	1.37E-04	2.48E-04					
Total weighted occupancy rate	0.000257				birds seconds per ha/hour				
Mean activity hr^-1 in wind farm at risk height	26.639%								
Mean activity hr^-1 in wind farm at rotor height (z)	23.327%								

Step 1.4: Total occupancy of risk volume during surveys (T_w)		
Hours potentially active: non-breeding season (a)[2]	1,729	hours
Tw=z*a	403.35	hours
Step 1.6: Flight risk volume (V_w)		
Risk volume: $V_w=A*h$	1,679,292,000	m^3
Step 1.7: Volume swept by windfarm rotors (V_r)		
Bird length (L)	0.36	m
Rotor-swept volume: $V_r=N*\pi*r^2*(d+L)$	1,248,674.32	m^3
Step 1.8: Bird occupancy of rotor-swept volume (Tr)		
$T_r=T_w*(V_r/Vw)$	1079.72	seconds
Step 1.9: Time taken to transit rotor *(t)*		
Flight speed *(s)*	11.2	m/sec
$t_r=(d+L)/s$	0.42	seconds
Step 1.10: Number of rotor transits (N)		
$N=T_r/t$	2,595	rotor transits
STAGE 2: Probability of Collision for a bird flying through rotors (*p*(collision)) from SNH spreadsheet[4]	0.053	
STAGE 3: Predicted mortality (birds per year)		
Step 3.1: With no avoidance, turbines operational 95% of the time N*p(collision)*0.95	130.370	collisions

Step 3.2: Adjusted using a range of avoidance rates:				
98.00%	**2.6074**	**approx one collision every**	**0.38**	**years**

[1] The survey risk volume was derived from the windfarm polygon including a precautionary 500m buffer around the turbine rotors.

[2] The total number of daylight hours

[4]Assumes bird length=0.36m, wingspan 1.05m, flight speed= 11.2m/sec

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Seven Hills Wind Farm (ABP-313750-22)

APPENDIX 2

BIRD SURVEY REPORT NON-BREDDING SEASON 2021-2022

BIRD SURVEY REPORT NON-BREEDING SEASON 2021/22

Seven Hills Wind Farm

Prepared for: Seven Hills Wind Farm Ltd

SLR Ref: 501.00501.00004
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16/11/22	1	Alice Magee	Dr Jonathon Dunn	Duncan Watson	Issue01	For Client Review
21/03/23	2	Dr Jonathon Dunn	Dr Jonathon Dunn	Duncan Watson	Issue02	Updated cumulative number of curlew flight lines

BASIS OF REPORT

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1.0 Introduction

SLR Consulting Ireland (SLR) was commissioned by Seven Hills Wind Farm Ltd to carry out a baseline bird survey programme for the proposed Seven Hills Wind Farm, Co. Roscommon (hereafter 'the Project') during the non-breeding period 2021/21. There are two clusters within the wind farm design, hereafter referred to as the northern cluster and southern cluster with the collective referred to as 'the Project Site'.

1.1 Background

Planning permission was originally granted by An Bord Pleanála (ABP) for both clusters (Phase 1 ABP Planning Ref: PL 20.244346 / 20.239759 and Phase 2 ABP Planning Ref: PL 20.244347 / 20.241069) but was subsequently refused following the appeal process. The main reasons for refusal of planning cited by An Bord Pleanála were issues relating to the lack of certainty in relation to the impact of the Project on European Sites in the vicinity of the Project Site and the qualifying interests for which those European Sites are designated.

Subsequently, SLR carried out three years of breeding and non-breeding season surveys between October 2018 to September 2021. 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 June 2022.

1.2 Site Description

The dominant habitat within the boundaries of the northern cluster is improved agricultural grassland.

The southern cluster is a slightly more diverse area in terms of habitat composition with the dominant habitats improved agricultural grassland, dry calcareous grassland and scrub.

The Project Site does not hold any designations 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) 2017 guidance. This 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. The scope of survey work undertaken during the 2021/22 non-breeding season is provided in **Table 1-1** and was the same as that conducted in winter 2020/21. Further details are provided in Sections 2.2.2 to 2.2.5.

Table 1-1
Scope of Ornithological Survey Work, Non-breeding Season 2021/22

Survey type	Summary methodology (see section 2 for further details)
Vantage Point (VP) surveys	Six hours of survey per month were carried out from each of the six VPs between October 2021 to March 2022 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 1 km of the wind farm boundary.

Survey type	Summary methodology (see section 2 for further details)
Greenland white-fronted goose *Anser albifrons flavirostris* roost watches	Dawn and dusk roost surveys were carried out on a twice-monthly basis at Lough Croan Turlough SPA, a known roost for Greenland white-fronted geese located c. 1 km north from the wind farm boundary.

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 Directive[1]. 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 SPAs[2]; and
- Other raptors, waders or wildfowl red-listed on the latest Birds of Conservation Concern in Ireland (BoCCI) 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;*
- Cormorant *Phalacrocorax carbo;* and
- Gulls *Larus sp*.

[1] Annex 1 of the Birds Directive (Directive 2009/147/EC)
[2] The relevant SPAs are listed in Section 3.1.

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 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 birds recorded in flight" reflects the occupancy of the study area by a particular species i.e. the total number of flights for all surveys in a given season added together. It does not equate to the total number of unique individuals and should not be used to infer abundance.

1.6 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 Project and the development of mitigation measures, if required, are beyond the scope of this report and may be used to update the previous EIAR, if required.

This report follows on from the bird survey reports for winter 2018/2019[3], 2019/20[4] and 2020/21[5]. As such, in order to obtain a comprehensive representation of winter bird activity at the Project Site across the four winter seasons, the three previous reports should be read alongside this report.

[3] SLR Consulting. 2022a. Seven Hills Wind Farm Bird Survey Report Winter 2018/19.
[4] SLR Consulting. 2022b. Seven Hills Wind Farm Bird Survey Report Winter 2019/20.
[5] SLR Consulting. 2022c. Seven Hills Wind Farm Bird Survey Report Winter 2020/21.

2.0 Methodology

2.1 Desk-based Review

The desk-based review collated available information collected to date on the wintering bird movements in and around the Project Site. This included a review of the following documents submitted as part of the previous planning applications in 2010 and 2012. For further information on these documents, see previous SLR winter season bird survey reports[3, 4 & 5].

The websites of the National Parks and Wildlife Service (NPWS) www.npws.ie, the National Biodiversity Data Centre (NBDC) http://maps.biodiversityireland.ie/#/Map and UK and Ireland Bird Atlas 2007-2011 https://app.bto.org/mapstore/StoreServlet were also accessed for information on sites designated for nature conservation (e.g. SPAs) and notable bird species in the vicinity of the site.

2.2 Field Surveys

2.2.1 Field Survey Team: Evidence of Technical Competence and Experience

Jonathon Dunn (JD) – Project Manager and Lead Ornithologist
Jonathon is a Senior Ecologist 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. He has conducted bird surveys for a large number of onshore wind farms in Ireland and has excellent habitat, mammal and bat survey skills. Jonathon has prepared a wide range of ecological reports through his career for diverse variety of energy, infrastructure and waste projects, including EIAR chapters, NIS reports, AA screenings, baseline bird, bat and marsh fritillary reports, collision risk modelling reports, shadow flicker reports and responses to further information requests. Jonathon managed this Project through liaison with the client, coordination of the survey team, supervision of the health and safety of the team, carrying out various bird surveys onsite, collating, quality controlling and assessing the survey data and writing this report. He also undertook flight activity and feeding distribution surveys for the winter 2021/22 survey season.

Aisling Kinsella (AK) BSc MSc – Lead Bird Surveyor
Aisling is a Senior Field Ecologist who joined SLR in September 2020. Aisling holds a BSc in Biological, Earth and Environmental Sciences (Zoology) from University College Cork and an MSc in Wildlife Management and Conservation from University College Dublin. Aisling's main interest is in ornithology. Since joining SLR, Aisling's field experience includes acting as ECoW on a large national road scheme, habitat survey mapping and classification, mammal survey, bird surveys, data collection and data input. Aisling has also helped prepare EIAR biodiversity chapters and AA screening reports and Natura Impact Statements for a range of different projects and plans. Aisling undertook the majority of bird surveys onsite during the winter 2021/22 survey season.

Sinéad Clifford (SC) BSc – Assistant Bird Surveyor
Sinéad is a Senior Ecologist with SLR. Sinéad holds a BSc (Hons) Wildlife Biology from Institute of Technology Tralee, and a Certificate in Ecological Consultancy (Distinction) from Ecology Training UK (formerly Acorn Ecology). Sinéad has worked in ecological consultancy since 2018. Sinéad's specialist areas are in bat ecology, mammal survey, Geographical Information Systems (GIS), habitat survey, mapping and classification. She also has an excellent understanding and experience in invasive species survey and has experience with a variety of bird survey techniques. Sinéad has prepared ecological reports for a wide range of diverse projects during her career. Sinéad undertook flight activity surveys and feeding distribution surveys for the winter 2021/22 season at the Project.

Faolán Linnane (FL) BSc MSc – Assistant Bird Surveyor

Faolán Linnane is a Graduate Ecologist with SLR and has worked in consultancy since June 2021. Faolán holds a BSc in Environmental Science (Zoology) from University College Cork and an MSc in Marine Biology from University College Cork. Faolán gained valuable and transferable bird survey skills with the Curlew Conservation Programme on completion of his MSc. His experience in consultancy includes ECoW on a large infrastructure development, habitat surveys and a variety of bird surveys including vantage point watches, breeding wader surveys, breeding raptor surveys and goose roost surveys. He has also helped prepare AA screening reports and EcIAs for a range of projects. Faolán undertook flight activity surveys and goose roost watch surveys for the winter 2021/22 season at the Project.

2.2.2 Flight Activity Surveys

Vantage point (VP) locations the same as those used for previous surveys in winter 2020/21. Following modelling of areas of potential visibility, six VPs were considered to provide sufficient coverage of possible turbine locations under consideration at the time of the survey, plus appropriate buffer zones. Additional details on modelling are available in previous SLR winter season bird survey reports[3, 4 & 5].

VP locations are shown in **Figure 1**, along with their associated areas of visibility (the viewsheds) at 18 m above ground level, i.e. the lowest likely rotor swept height.

A total of 36 hours of watches were undertaken at each of six vantage point (VP) locations during the winter season (monthly visits October – March inclusive)[6]. The VP survey effort undertaken during the winter of 2021/22 is summarised in **Table 2-1** with full details of survey dates, times and observers provided in Appendix 01 and details of weather conditions during the surveys provided in Appendix 02.

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.

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:

- The time spent flying over the site;
- The relative use by birds of different parts of the 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 flights observed;
- Time spent within each height band and;
- Notes on observation.

[6] With an extra three hours undertaken at southern cluster VP2.

Recording height bands were determined based on the likely turbine specifications under consideration at the time of survey (upper tip height 180 m and lower tip height 18 m). Flight heights were attributed to five distinct height bands as follows:

- 1 = < 15 m (below the likely rotor swept area);
- 2 = 15 m to 30 m (potentially within the likely rotor swept area, at least in part);
- 3 = 30 m to 150 m (within the likely rotor swept area);
- 4 = 150 m to 200 m (potentially within the likely rotor swept area, at least in part); and
- 5 = >200 m (above the likely rotor swept area).

These height bands did not match the proposed turbine specification exactly in order to provide some flexibility in case the turbine model changed and to provide consistency with previous surveys.

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 site, in accordance with current NS guidance.

Table 2-1
Summary of VP surveys undertaken, non-breeding season 2021/22

Cluster	VP number	Co-ordinates (ITM)	Hours of survey completed						
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Total**
Northern	1	587337 E 748665 N	6	6	6	6	6	6	36
	2	585834 E 746017 N	6	6	3	9	6	6	36
Southern	1	588967 E 745061 N	6	9	3	6	6	6	36
	2	587372 E 743512 N	6	3	6	12	6	6	39
	3	590643 E 743279 N	6	6	3	9	6	6	36
	4	592160 E 743701 N	6	6	3	9	6	6	36

2.2.3 Swan and Goose Feeding Distribution Surveys

Whooper swan *Cygnus cygnus* and Greenland white-fronted goose are features of interest of several SPAs within 20 km of the site boundary (refer to **Table 3-1**). The site boundary also lies within the core foraging range as measured from the relevant SPAs (SNH, 2016) for these species.

Feeding distribution surveys were therefore carried out on a fortnightly basis between October 2021 and March 2022 to search for swans and geese using the fields within 1 km of the Project Site. These were undertaken by driven transect, stopping on a regular basis to search for all fields for goose and swan feeding activity. The transect route and survey results are shown in **Figures 3.1** to **3.4**. These figures use heat maps to illustrate feeding activity as a measure of cumulative number of birds recorded per unit area. Thus, areas that are used most for feeding are those with the highest density of birds per unit area. The symbology of these heat maps is scaled relative to the highest and lowest densities recorded for each focal species.

Visibility from the survey route was sufficient to cover the vast majority (>99%) of potentially suitable foraging habitat within the survey area.

Details of survey dates, times and observers are provided in Appendix 01 and a record of weather conditions during surveys is provided in Appendix 02.

2.2.4 Greenland White-fronted Goose Roost Surveys

Lough Croan Turlough is a known roost site for Greenland white-fronted geese (Burke *et al*., 2014), which is c. 1 km north of the wind farm boundary.

Monthly watches were therefore carried out simultaneously from two vantage points on the local road north of Lough Croan between October 2021 and March 2022. The watches were carried out at dusk and the following dawn each month for a duration of up to 2 hours depending on the levels of light. The dawn watches began at civil twilight i.e., 30 minutes before the time of sunrise and continued for up to 1.5 hours after sunrise. The dusk watches ended at civil twilight i.e., starting up to 1.5 hours before the time of sunset and continuing for 30 minutes after sunset.

All flight lines of Greenland white-fronted geese to and from the turlough in addition to the direction of flight and the number of birds were recorded during watches. The survey results are shown in **Figure 4**.

Details of survey dates, times and observers are provided in Appendix 01 and a record of weather conditions during surveys is provided in Appendix 02.

2.3 Survey Limitations

Most vantage point surveys were undertaken in optimal weather conditions. However, during such an extensive series of surveys carried out over the winter period it was inevitable that some surveys were completed in suboptimal conditions. There were 28 hours out of the total of 219 during which the visibility was recorded as “moderate”, i.e. 1-3 km. This comprises 13% of the total survey effort but in all cases all of the relevant 2 km viewing arc was visible and this is not considered to significantly affect the validity of the data collected. There was also part of 1 hour (0.5% of the total survey effort) in which the visibility was recorded as “poor”, i.e. less than 1 km, at some point. However, in no cases did visibility fall below 500 m (when survey would have been suspended) and in many cases visibility was better than this for part of the relevant hour. As such, given the very low proportion of surveys affected this is not considered to significantly affect the validity of the data collected. Further details regarding weather conditions during surveys are provided in Appendix 02.

As shown in **Figure 1**, due to local topographical conditions a small area at the western end of the 500m buffer zone for the northern cluster and a very small area within the 500 m buffer zone for the southern cluster were not within the 2 km viewsheds from any of the VPs. All turbine locations and the vast majority of the 500 m buffer were visible from at least one VP, so the gaps in coverage are therefore not considered to represent a significant limitation.

In January 2022, one flock of 25 northern lapwing *Vanellus vanellus* was accidentally recorded as a secondary target species. The flight was below potential collision height and so will not affect any subsequent estimates of collision risk.

3.0 Results

3.1 Desk-based Review

3.1.1 Natura 2000 Sites

There are no Special Protection Areas (SPA) within or immediately adjacent to the Project Site. However, there are a total of six SPAs within a 20 km[7] radius of the survey area.

The six SPAs within 20 km are shown in **Table 3-1**, which also shows the qualifying interests for each site. For the purposes of this report, which deals specifically with wintering birds, qualifying interests which are only present during the breeding season have been excluded from **Table 3-1**. The wetlands and waterbirds qualifying interest has also been excluded to provide focus on the birds themselves.

Table 3-1
Spas Within 20 km of the Proposed Seven Hills Wind Farm Site and their Qualifying Interests (Species Present During the Non-Breeding Period Only)

Site name	Site code	Distance/direction from site boundary	Qualifying Interest species
Lough Croan Turlough SPA	004139	1.5 km north	• Northern shoveler *Anas clypeata* • European golden plover *Pluvialis apricaria* • Greenland white-fronted goose
River Suck Callows SPA	004097	1.7 km west	• Whooper swan • Eurasian wigeon *Mareca penelope* • European golden plover • Northern lapwing • Greenland white-fronted goose
Four Roads Turlough SPA	004140	1.9 km north	• European golden plover • Greenland white-fronted goose
Lough Ree SPA	004064	8 km east	• Little grebe *Tachybaptus ruficollis* • Whooper swan • Eurasian wigeon • Eurasian teal *Anas crecca* • Mallard *Anas platyrhynchos* • Northern shoveler • Common goldeneye *Bucephala clangula* • Eurasian coot *Fulica atra* • European golden plover • Northern lapwing • Tufted duck *Aythya fuligula*

[7]20 km represents the maximum core foraging distance of any special conservation interest (SCI) species in Ireland (greylag geese *Anser anser* and pink-footed geese *Anser brachyrhynchus*). This represents the largest foraging range of all SCI species (SNH, 2016), although it is acknowledged that information on core foraging ranges is not available for all SCI species.

Site name	Site code	Distance/direction from site boundary	Qualifying Interest species
Middle Shannon Callows SPA	004096	11.4 km southeast	• Whooper swan • Eurasian wigeon • European golden plover • Northern lapwing • Black-tailed godwit *Limosa limosa* • Black-headed gull *Chroicocephalus ridibundus*
Mongan Bog SPA	004017	17 km south	• Greenland white-fronted goose

3.2 Flight Activity Surveys

Flight lines of primary target species recorded at both wind farm clusters throughout the non-breeding season are presented in **Figures 2.1** to **2.5** and summaries 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 03.

3.2.1 Primary Target Species

Northern cluster

A total of 73 flight lines by ten primary target species were recorded during flight activity surveys at the northern cluster between October 2021 and March 2022.

Flight activity is summarised in **Table 3-2** and is followed by a summary of flight activity by primary target species below.

Table 3-2
Number of Primary Target Species Flights from Northern Cluster VP1 and VP2 Combined – October 2021 to March 2022

Species	Number of flight lines by month						Total number of flight lines	Time at risk height* (s)	Cumulative number of birds recorded in flight
	Oct	Nov	Dec	Jan	Feb	Mar			
Black-headed gull	0	4	2	17	13	2	38	4,200	637
European golden plover	0	0	0	2	2	0	4	465	138
Common kestrel	2	0	0	1	0	6	9	615	9
Northern lapwing	0	1	0	0	0	0	1	75	10
Mallard	0	0	0	0	1	0	1	0	8
Merlin	0	3	0	0	1	3	7	30	7

Species	Number of flight lines by month						Total number of flight lines	Time at risk height* (s)	Cumulative number of birds recorded in flight
	Oct	Nov	Dec	Jan	Feb	Mar			
Peregrine falcon	0	1	1	1	1	0	4	210	4
Common snipe	1	0	0	0	0	0	1	135	1
Eurasian wigeon	0	0	0	0	1	0	1	315	43
Whooper swan	0	0	0	0	3	2	5	255	44
Total	**3**	**9**	**3**	**21**	**22**	**13**	**71**	**6,300**	**901**
*precautionary risk height assumed to be between 15 m – 200 m									

Black-headed gull

Black-headed gull was the most frequently recorded primary target species, with a total of 637 flights across 38 flight lines. The majority of observations were from VP2; only three observations were recorded from VP1. Three flight lines were recorded on site and eight were recorded within the 500 m buffer. The rest were recorded beyond the 500 m buffer.

European golden plover

There were 465 flights of European golden plover, recorded across four flight lines, all of which were observed outside the Project Site. All observations were recorded from VP2. Three of the four flight lines were observed within the 500 m buffer, and of these, two were observed at potential collision risk height.

Common kestrel

Nine flight lines of common kestrel (single birds only) were recorded. Eight of these were recorded at VP1 in March 2022, and one at VP2 in January 2022. Five flight lines were observed at potential collision risk height and four of these were within 500 m buffer of the Project Site.

Northern lapwing

One flight line of lapwing, consisting of 10 individual flights, was observed in November 2021 at VP2. This flock was observed just outside the 500 m buffer to the south of the Project Site at potential collision risk height.

Mallard

One flight line of mallard, consisting of eight individual flights, was observed from VP2 off-site and below potential collision risk height near Thomas Street Turlough in February 2022.

Merlin

Eight flight lines of merlin (single birds only) were recorded from VP1. Only two flight lines were at potential collision risk height, with one inside and one outside of the 500 m buffer.

Peregrine falcon

There were four flight lines of peregrine falcon recorded (single birds only). Two flight lines were observed flying through the Project Site and one of these was observed within potential collision risk height. One other flight line was observed within the 500 m buffer at potential collision risk height and the remaining flight line was observed beyond the buffer and below potential collision risk height.

Common snipe

A single snipe was observed from VP2 flying off-site over Thomas Street Turlough in October 2021 within potential collision risk heights but outside the 500 m survey buffer.

Eurasian wigeon

One flight line of Eurasian wigeon, consisting of 43 individual flights, was observed in February 2022 at VP2. This flight line was observed to the south of the Project Site within the 500 m buffer at potential collision risk height.

Whooper swan

There were 44 whooper swan flights, recorded across five flight lines. One flight line was observed at VP1 at potential collision risk height through the Project Site in March 2022. Four flight lines were observed at VP2, but only one of these was observed at potential collision risk height and none were within 500 m of the Project Site.

Southern Cluster

In total, 11 primary target species were recorded flying within the study area on and around the southern cluster during the winter survey period. Flight activity recorded by primary target species is summarised in **Table 3-3** and is followed by a summary of flight activity by primary target species below.

Table 3-3
Number of Primary Target Species Flights from Southern Cluster VP1-VP4 Combined – October 2021 to March 2022

Species	Number of flight lines by month						Total number of flight lines	Time at risk height* (s)	Cumulative number of birds recorded in flight
	Oct	Nov	Dec	Jan	Feb	Mar			
Black-headed gull	1	0	8	47	28	20	104	11,595	2,153
Eurasian curlew	2	1	1	5	3	4	16	1,410	225
Northern lapwing	0	2	0	10	0	0	12	735	260
Common kestrel	5	3	2	5	4	5	24	2,775	24
Mallard	0	0	0	0	1	1	2	360	20
Peregrine falcon	1	0	1	4	1	2	9	1,020	10
Northern shoveler	0	0	0	0	1	1	2	360	9
Common snipe	1	0	0	0	1	0	2	0	2
Eurasian teal	0	0	0	1	0	0	1	120	2

Species	Number of flight lines by month						Total number of flight lines	Time at risk height* (s)	Cumulative number of birds recorded in flight
	Oct	Nov	Dec	Jan	Feb	Mar			
Eurasian wigeon	0	0	0	1	2	2	5	1,020	248
Whooper swan	1	1	1	4	1	3	11	1,200	69
Total	**11**	**7**	**13**	**77**	**42**	**38**	**188**	**20,595**	**2,953**
*precautionary risk height assumed to be between 15 m – 200 m									

Black-headed gull

A total 2,153 black-headed gull flights were recorded over 104 flights lines. No flight lines were recorded at VP1. There were 72 flight lines recorded within potential collision risk heights, which included 15 flight lines observed on site.

Eurasian curlew

A total of 225 Eurasian curlew flights were recorded over 16 flight lines. All flight lines were recorded from VP3 at Feacle Turlough, and the majority of flight lines were recorded over the turlough itself. Seven flights were recorded within potential collision risk height.

Northern lapwing

Twelve lapwing flight lines, with 260 individual flights, were recorded and all of these were from VP3 at Feacle Turlough. Eight flight lines were recorded in a single survey in January 2022, and five of these were of the same individual bird. Four flight lines were within potential collision risk heights and of these, only two were within 500 m of the Project Site.

Common kestrel

A total of 24 flight lines of common kestrel (single birds only) were recorded throughout the survey season. Flight lines were observed at all four VPs. There were 16 flight lines recorded within potential collision risk heights and of these, seven were observed within the Project Site.

Mallard

Two flight lines of mallard were recorded throughout the survey season. The first flight line was seen in February 2022, consisting of six flights (associated with Eurasian wigeon and northern shoveler) at VP3 over Feacle Turlough within potential collision risk heights. In March 2022, 14 flights were recorded within the same flight line, over the same location as in February, within potential collision risk heights. This species was disturbed by a gunshot, along with Eurasian curlew, Eurasian wigeon, northern shoveler and black-headed gull.

Peregrine falcon

A total of 10 peregrine falcon flights were recorded over nine flight lines. Seven flight lines were observed within potential collision risk heights. Three of these were observed within the Project Site and four were within the 500 m buffer.

Northern shoveler

Two flight lines of northern shoveler were recorded throughout the survey season, and both flight lines were associated with the aforementioned mallard flight lines. Two flights were observed in February and nine flights were observed in March 2022.

Common snipe

Two flight lines of common snipe were recorded throughout the survey season. One in October 2021 and one in February 2022; both were of single birds and were outside the 500 m buffer.

Eurasian teal

One observation of two female teal was recorded in January from VP3. They were recorded flying over Feacle Turlough within potential collision risk heights.

Eurasian wigeon

Five flocks of wigeon, with 248 individual flights, were observed throughout the survey season. All flight lines were observed from VP3 over Feacle Turlough. Although four of the flight lines were observed within potential collision risk heights, none were within 500 m of the Project Site.

Whooper swan

A total of 69 whooper swan flights were recorded over 11 flight lines. None of the flight lines were observed from VP1. Seven flight lines were observed at potential collision risk height; of these, two were recorded within the Project Site and three were recorded within the 500 m buffer.

3.2.2 Secondary Species

Northern cluster

Secondary species activity within the northern cluster is summarised in **Table 3-4**. There were seven secondary species recorded.

Northern raven was the most frequently recorded secondary species (in 53 five-minute periods out of possible 864). Lesser black-backed gull *Larus fuscus* had the highest peak count (34 birds).

Table 3-4
Secondary Species Activity Summary for Northern Cluster – October 2021 to March 2022

Species	Number of 5-min periods recorded	Peak count of birds recorded in any 5-min period	Comments
Common buzzard	23	3	Activity throughout all months except October. Eight flights were within the Project Site.
Common gull *Larus canus*	13	5	Activity throughout all months except January. Only three flights were within the Project Site.
Great cormorant	2	2	Recorded once in October and once in January. Both flights were within the Project Site.
Grey heron	3	1	Recorded twice in November and once in January. Only one flight was within the Project Site.

Species	Number of 5-min periods recorded	Peak count of birds recorded in any 5-min period	Comments
Greylag goose *Anser anser*	1	2	Recorded once in March outside the buffer near Thomas Street turlough.
Lesser black-backed gull	19	34	Recorded throughout all months except December and February. Eight flights were recorded within the Project Site.
Northern raven	53	6	Activity throughout all months. 18 flights were recorded within the Project Site.

Southern Cluster

Secondary species activity at the southern cluster is summarised in **Table 3-5**. There were nine secondary species recorded throughout the season at the southern cluster. Northern raven was the most frequently recorded secondary species (in 117 five-minute periods out of possible 1,728). It was also the second highest peak count of six birds. Eurasian coot had the highest peak count (seven birds) but was only recorded once throughout the survey season.

Table 3-5
Secondary Species Activity Summary for Southern Cluster – October 2021 to March 2022

Species	Number of 5-min periods recorded	Peak count of birds recorded in any 5-min period	Comments
Common buzzard	41	3	Activity throughout all months within the Project Site, survey buffer and beyond.
Common gull	6	3	Recorded in February and March only. Only one flight was recorded within the Project Site.
Great cormorant	2	1	Recorded once in October beyond the buffer and once in January on the Project Site.
Eurasian coot	1	7	One flight recorded in January within the survey buffer.
Eurasian sparrowhawk	9	2	Activity throughout all months except for October. Only one flight was recorded within the Project Site.
Grey heron	6	1	Activity throughout all months except November and March. Two flights were recorded within the Project Site.
Lesser black-backed gull	10	2	Recorded in October and March only. Two flights were recorded within the Project Site.
Northern raven	117	6	Activity throughout all months within the Project Site, survey buffer and beyond.

Species	Number of 5-min periods recorded	Peak count of birds recorded in any 5-min period	Comments
Mute swan	1	2	Recorded in March only outside the Project Site.

3.3 Swan and Goose Feeding Distribution Surveys

Whooper swan was by far the most abundant species recorded, with Greenland white fronted goose observed in December 2021 only. Mute swans were recorded across all months but in low numbers. A summary of results of the twice-monthly swan and goose feeding distribution surveys undertaken within a 1 km radius of the Project Site throughout the winter season is presented **Table 3-6**. This presents the peak count obtained for each species per fortnightly survey. Please see **Figure 3.1** to **3.4** for locations of all sightings.

Table 3-6
Peak counts of swans and geese within 1 km of the Project Site - October 2021 to March 2022

Month	Visit	Peak Count			
		Whooper swan	Greenland white-fronted goose	Greylag goose	Mute swan
October	1	0	0	0	4
	2	0	0	0	0
November	1	19	0	0	5
	2	37	49	0	1
December	1	63	39	29	9
	2	35	0	0	1
January	1	55	0	0	4
	2	172	0	0	0
February	1	77	0	0	4
	2	25	0	0	1
March	1	54	0	0	2
	2	37	0	1	1

3.3.1 Swan and Goose Species Accounts

Whooper Swan

Whooper swans were recorded within the survey area during ten feeding distribution surveys undertaken throughout the winter season. No whooper swans (or any other target species) were recorded during October's surveys. November 2021 had the lowest peak count of 19 birds, whilst January 2022 had the largest, with a peak count of 172 birds.

Within the survey area for the northern cluster, the fields surrounding Lough Croan Turlough SPA were the principal grazing areas (located to the north of the Project Site), with Lough Funshinagh and Coolagarry Lough to the east of the Project Site used less frequently. There was one observation in January 2022 recorded to the west of the survey area near Thomas Street Turlough. Within the survey area for the southern cluster, swans were recorded between January and March 2022 to the south at Feacle Turlough and west near the Ballyglass River.

There were no observations of whooper swan flocks feeding within 500 m of the Project Site (either cluster).

Greenland White-fronted Goose

Greenland white-fronted geese were recorded in November and December 2021 only, with one flock recorded in November (peak count 49 birds) and three separate flocks observed grazing in December (peak count 39 birds). In both months, the birds were grazing/resting in the fields surrounding Lough Croan Turlough SPA, beyond 1 km from the Project Site.

Greylag Goose

A flock of 29 greylag geese was recorded in December 2021 around Lough Croan Turlough SPA. A single greylag goose was also recorded at the same location in March 2022.

Mute Swan

Mute swan was recorded in all survey months, typically concentrated around the Ballyglass River or Lough Croan Turlough SPA in pairs or small groups.

Incidentals

The following incidental species were recorded during feeding distribution surveys:

- Waders: Eurasian curlew, grey heron, little egret *Egretta garzetta*, northern lapwing, European golden plover, and common snipe;
- Wildfowl: mallard, Eurasian wigeon, Eurasian coot, moorhen, tufted duck, northern pintail *Anas acuta*, Eurasian teal and northern shoveler;
- Gulls: black-headed gull and lesser black-backed gull; and
- Raptors: common kestrel, common buzzard and Eurasian sparrowhawk.

Peak counts of wader and wildfowl species are shown in **Table 3-7** below. Activity for these two groups was entirely focused on Lough Croan Turlough SPA, Ballyglass River, Thomas Street Turlough and Feacle Turlough.

Table 3-7
Peak counts of waders and wildfowl species recorded during feeding distribution surveys - October 2021 to March 2022

Month	Visit	Peak Count													
		Eurasian curlew	Grey heron	Northern lapwing	European golden plover	Common snipe	Mallard	Eurasian wigeon	Eurasian coot	Moorhen	Northern pintail	Eurasian teal	Northern shoveler	Tufted duck	Little egret
October	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0
	2	9	1	33	0	0	0	12	0	0	0	0	0	0	0
November	1	1	0	43	38	0	0	0	0	1	0	0	0	0	0
	2	0	1	50	0	0	9	71	0	0	0	0	7	0	0
December	1	0	1	200	0	0	0	180	0	0	2	20	2	0	0
	2	0	1	61	0	0	15	40	0	0	0	4	37	0	0
January	1	7	2	583	25	2	46	5	0	0	0	0	0	0	0
	2	0	0	35	0	0	5	0	6	0	30	9	0	0	0
February	1	6	0	410	0	0	0	275	5	0	0	0	0	0	0
	2	8	0	220	0	2	7	30	1	0	5	0	40	0	0
March	1	1	0	222	334	0	27	16	5	0	3	14	13	6	1
	2	0	0	6	0	0	12	50	2	0	0	14	10	0	0

3.4 Greenland White-fronted Goose Roost Surveys

Dawn and dusk Greenland white-fronted goose roost surveys were carried out at Lough Croan Turlough SPA on a monthly basis between October 2021 and March 2022. Please see **Figure 4** for flight-line results and flock sizes observed during these surveys.

Greenland white-fronted geese were recorded throughout the November 2021 – February 2022 surveys, with no sightings of geese in October 2021 or March 2022.

The November 2021 dusk survey recorded the greatest level of activity throughout the season, with five flight lines recorded. At the eastern section of Lough Croan Turlough SPA, 16 geese flew from the east over the turlough, followed by a single individual flying to the north. At the western section, one flock of 18 geese was recorded circling over the turlough, along with one flock of 16 geese and a single individual flying separately over the turlough landing in the fields immediately southwest of the SPA.

Across all surveys, there was no evidence of Greenland white-fronted geese flying to or from the direction of the Project Site, with all flight lines to and from Lough Croan Turlough SPA either from the west, east or north.

4.0 Summary and Conclusions

Flight activity surveys (VPs), feeding distribution surveys for geese and swans, and Greenland white-fronted goose roost surveys were carried out at or surrounding the Project Site during the non-breeding 2021/22 season.

The following primary target species were recorded during flight activity surveys at the Project Site:

- Whooper swan;
- European golden plover;
- Merlin;
- Peregrine falcon;
- Northern lapwing;
- Eurasian curlew;
- Black-headed gull;
- Common kestrel;
- Common snipe;
- Mallard;
- Eurasian wigeon;
- Northern shoveler; and
- Eurasian teal.

The most frequent primary target flight activity at both clusters was by black-headed gull, with other primary target species activity much less frequent. Most of the gull activity was associated with fertilising and ploughing agricultural fields in the northern cluster and at Feacle Turlough in the southern cluster. Black-headed gulls were not recorded as primary target species for previous winter season surveys and so a direct comparison of flight activity in previous winters is not possible; however, based on secondary species data, it is likely that the results of the present season are representative of previous winter surveys.

An additional 10 secondary target species were also recorded including: common buzzard, common gull, great cormorant, grey heron, greylag goose, lesser black-backed gull, northern raven, Eurasian coot, Eurasian sparrowhawk and mute swan.

16 whooper swan flight lines, involving 113 individual flights, were recorded during VP surveys at both clusters combined. Whooper swan flights were most associated with Thomas Street Turlough, with a few other flights near Ballyglass River and Feacle Turlough. There were no observations of whooper swan flocks feeding within the Project Site or 500 m buffer during the feeding distribution survey. During the surveys the principal grazing sites were agricultural fields immediately adjacent to Lough Croan Turlough SPA, with other locations used less frequently.

Greenland white-fronted geese were not recorded during VP watches. They were observed using Lough Croan Turlough SPA for roosting during the dawn/dusk goose roost surveys and twice at the same location during feeding distribution surveys in November and December 2022. This species was recorded using the SPA during four of the six months of surveys, which suggests that although Lough Croan Turlough SPA is an established roost site, it was only used in the middle of the winter season for this survey year.

Burke *et al.* (2014) suggested that Lough Croan Turlough SPA is suspected as having been used more as a roosting site in the past when water levels were suitably high but has been used less so in more recent years. This is unlikely to align with the use of the SPA recorded during this survey year, as turlough levels were very high in March 2022 when this species was absent. It is also not clear that this hypothesis is supported by the results of the 2019/20 and 2020/21 surveys.

In addition, almost all movements and flight paths of the flocks of Greenland white-fronted geese which were observed at Lough Croan during roost watches were on a lateral east/west or west/east plane, similar to 2019/20 and 2020/21. The only exception was one flight moving north from the SPA. These flight patterns suggest that these birds may be associated with the River Suck Callows SPA located approximately 5 km west of Lough Croan. This theory can be supported by the fact that there were no sightings of Greenland white-fronted geese recorded flying through either of the turbine cluster locations during the entire season of flight activity surveys. Similarly, no geese were recorded near the Project Site during feeding distribution surveys (with the only records of feeding birds made close to Lough Croan Turlough SPA itself).

Regarding other SPA qualifying interest species, all those listed in **Table 3-1** apart from little grebe, goldeneye and black-tailed godwit were recorded during the suite of winter bird surveys. Of those recorded, black-headed gulls had the largest number of flights at potential collision heights and within the collision risk zone. All other species were at considerably less risk. Some species, such as tufted duck and Eurasian coot were only recorded during feeding distribution surveys and were not recorded overlying either the northern or southern clusters themselves.

Overall, the results from this winter season are broadly similar to those recorded from previous winter season surveys in terms of the suite of species and abundance of birds recorded. Areas previously identified as of importance for foraging swans, geese, waders and other wildfowl remain the same (e.g. Lough Croan Turlough SPA, Feacle Turlough, Thomas Street Turlough and Ballyglass River).

5.0 References

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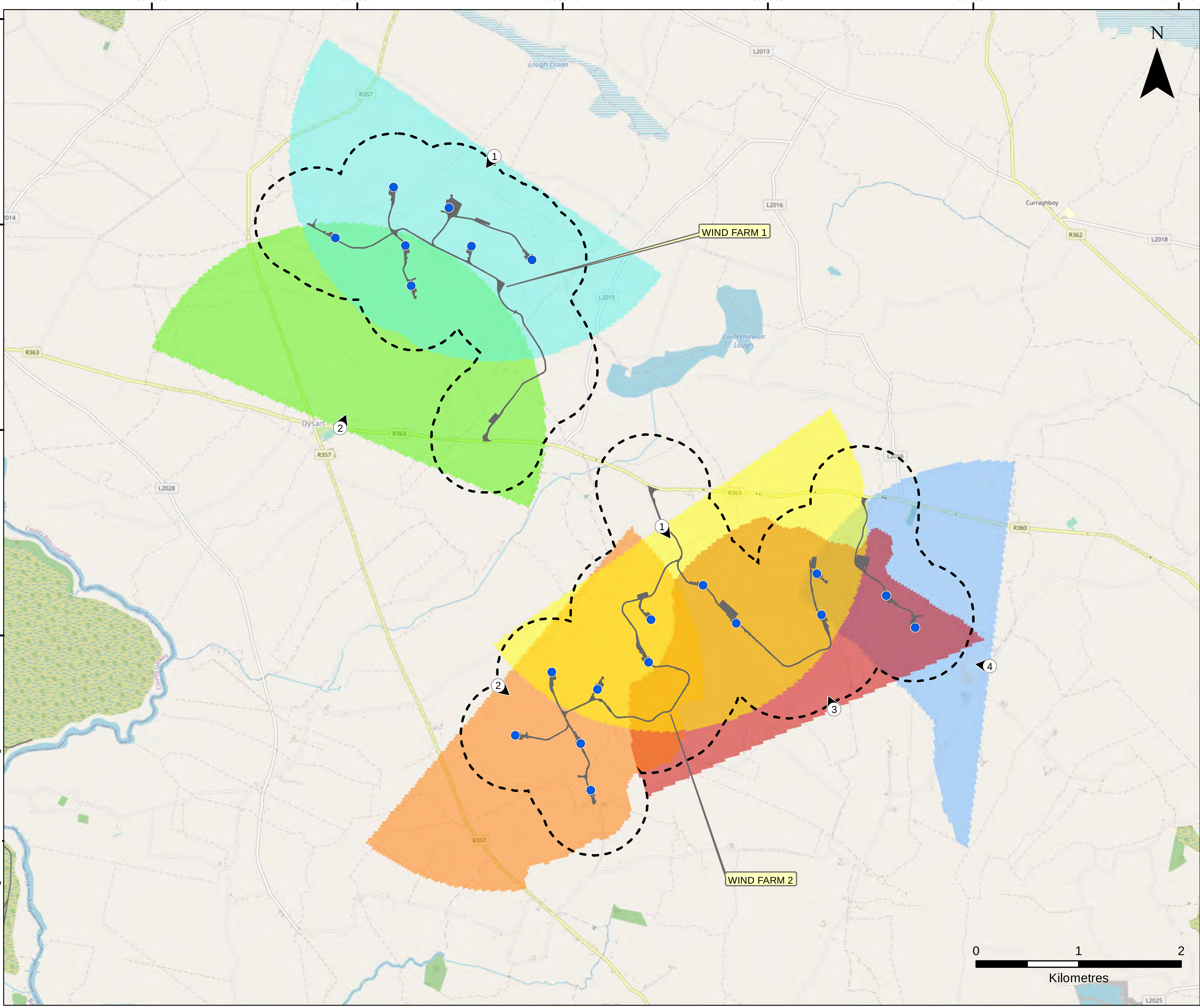
6.0 Figures



NOTES

1. The Zones of Theoretical Visibility (ZTV) was calculated using ArcMAP 10.5.1 Spatial Analyst. The ZTV is calculated with a surface offset 18m & from a viewing height of 1.8m above ground level. The terrain model is derived from EU-DEM data with a vertical accuracy of ± 7m.

LEGEND

- Site Infrastructure
- Site Infrastructure 500 m Buffer
- Turbine Location
- Vantage Point
- Area Visible from Wind Farm 1 Vantage Point 1
- Area Visible from Wind Farm 1 Vantage Point 2
- Area Visible from Wind Farm 2 Vantage Point 1
- Area Visible from Wind Farm 2 Vantage Point 2
- Area Visible from Wind Farm 2 Vantage Ponit 3
- Area Visible from Wind Farm 2 Vantage Point 4

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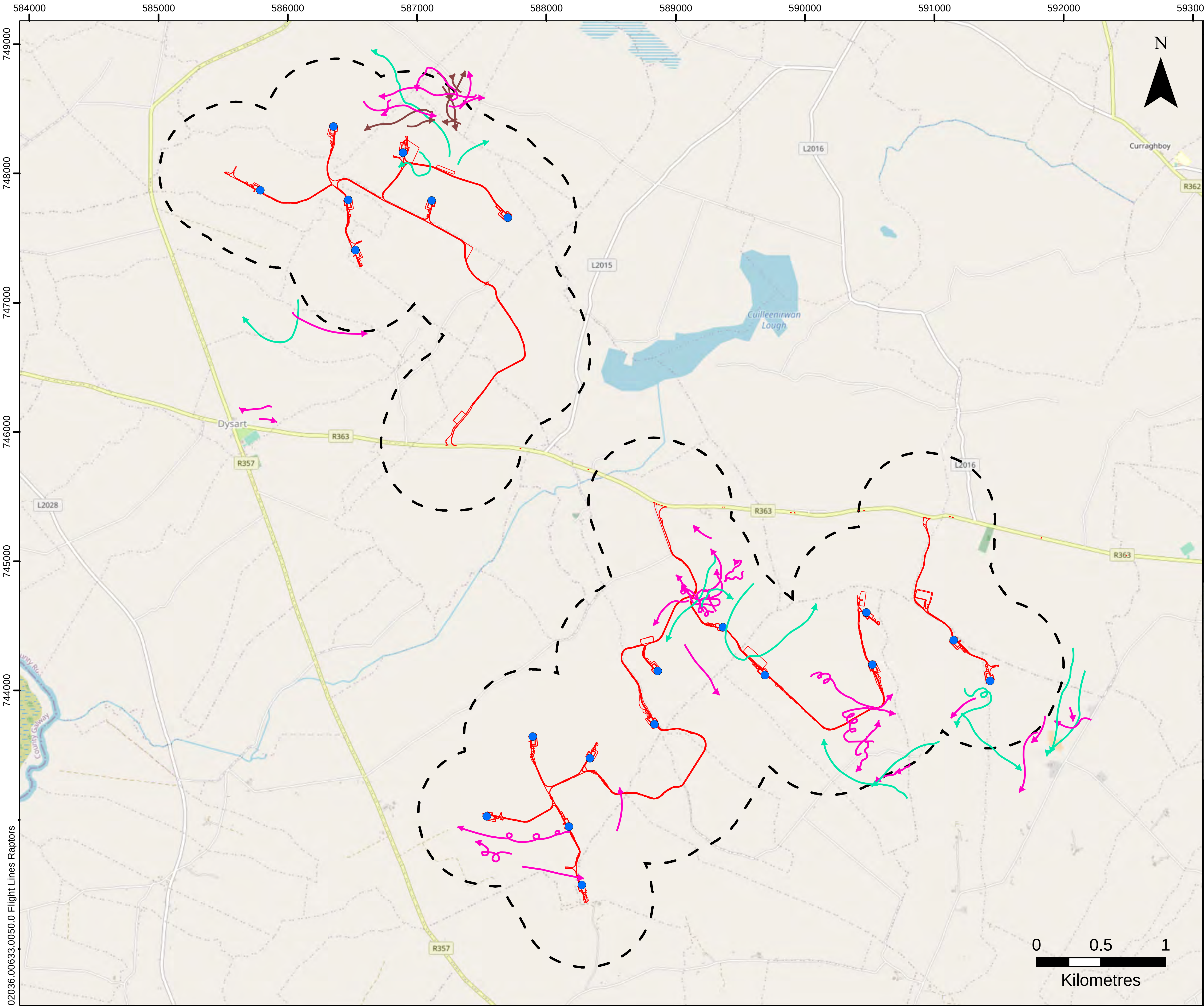
VANTAGE POINT LOCATIONS & VIEWING ARCS

FIGURE 1

Scale	Date
1:35,000 @ A3	JUNE 2022

02036.00633.0048.0 Vantage Point Locations and Viewing Arcs



LEGEND

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

Flight Lines

- Kestrel
- Merlin
- Peregrine

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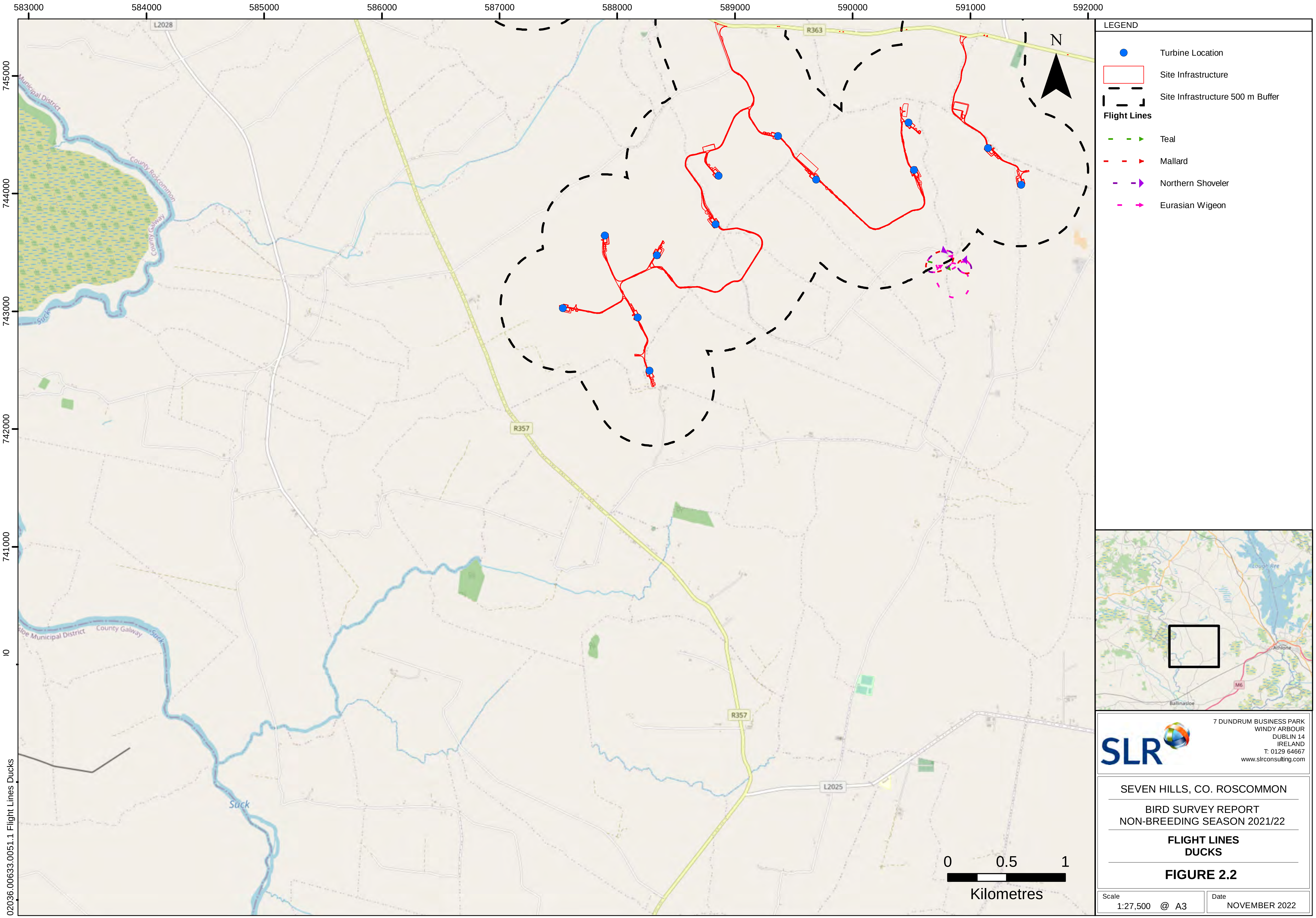
FLIGHT LINES
RAPTORS

FIGURE 2.1

Scale	Date
1:27,500 @ A3	JULY 2022

02036.00633.0050.0 Flight Lines Raptors



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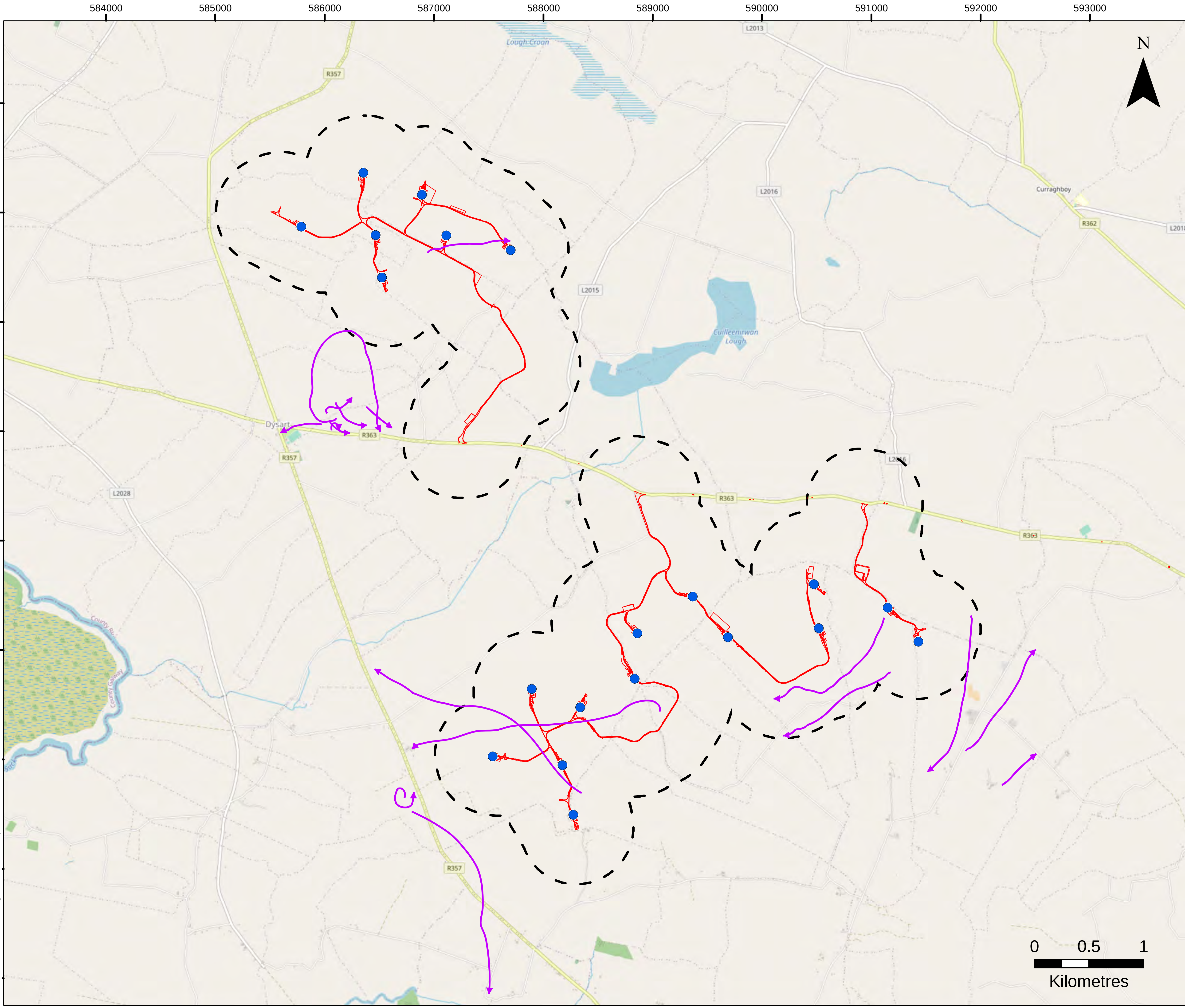
FLIGHT LINES
DUCKS

FIGURE 2.2

Scale	Date
1:27,500 @ A3	NOVEMBER 2022



LEGEND

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

Flight Lines

- Whooper Swan

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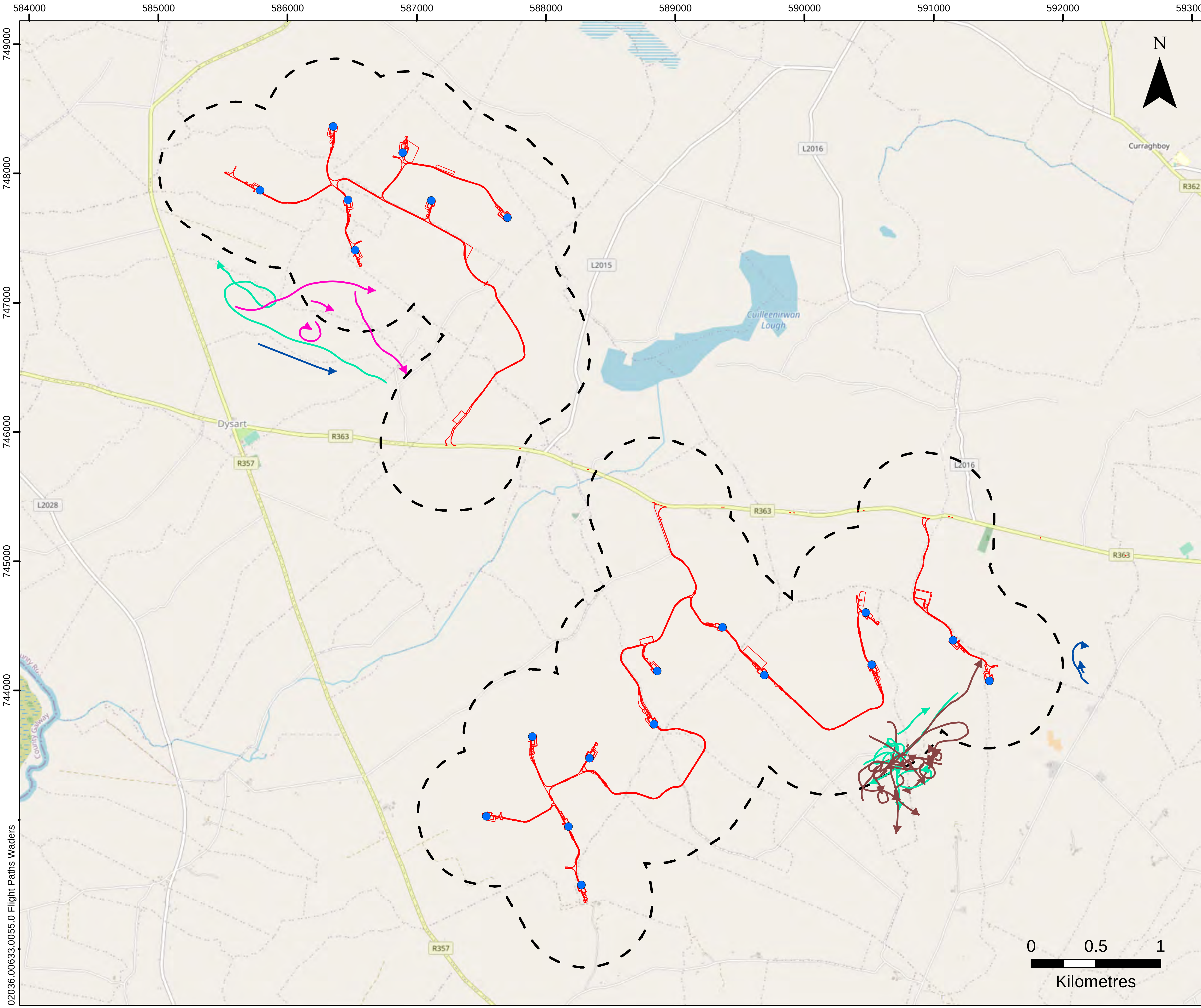
FLIGHT LINES
WHOOPER SWAN

FIGURE 2.3

Scale	Date
1:32,500 @ A3	JULY 2022

02036.00633.0054.0 Flight Lines Whooper Swan



LEGEND

Turbine Location

Site Infrastructure

Site Infrastructure 500 m Buffer

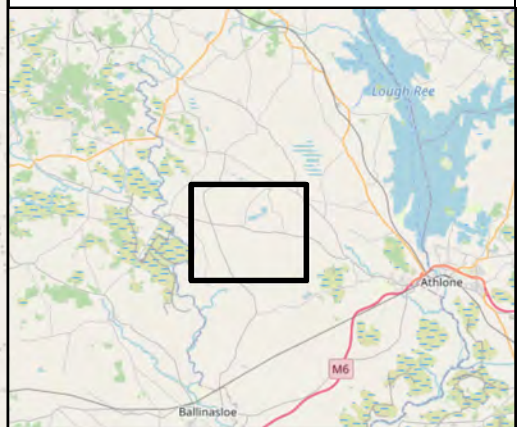
Flight Lines

Curlew

Golden Plover

Lapwing

Snipe



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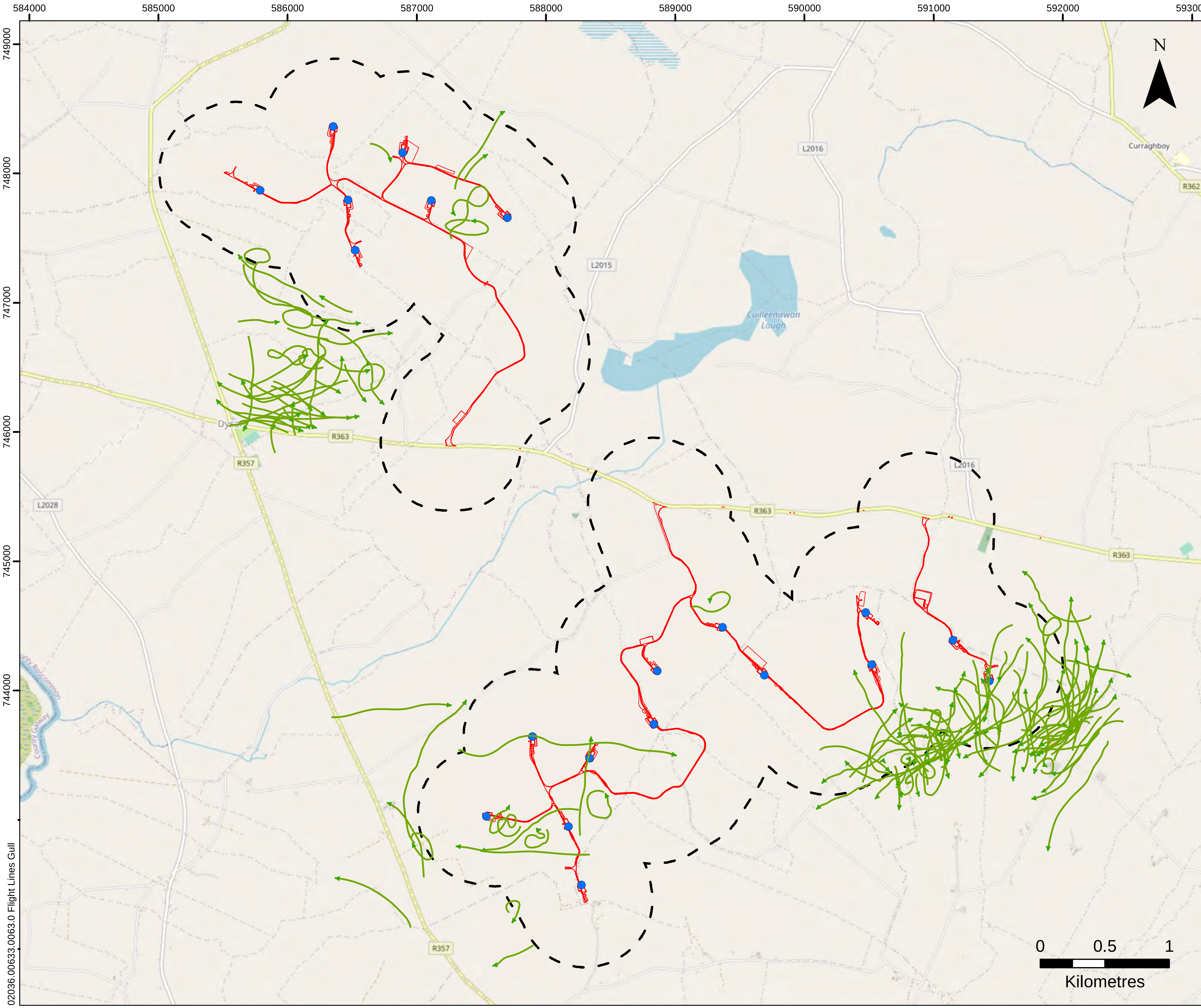
FLIGHT LINES
WADERS

FIGURE 2.4

Scale	Date
1:27,500 @ A3	JULY 2022

02036.00633.0055.0 Flight Paths Waders



LEGEND

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

Flight Lines

- Black-Headed Gull

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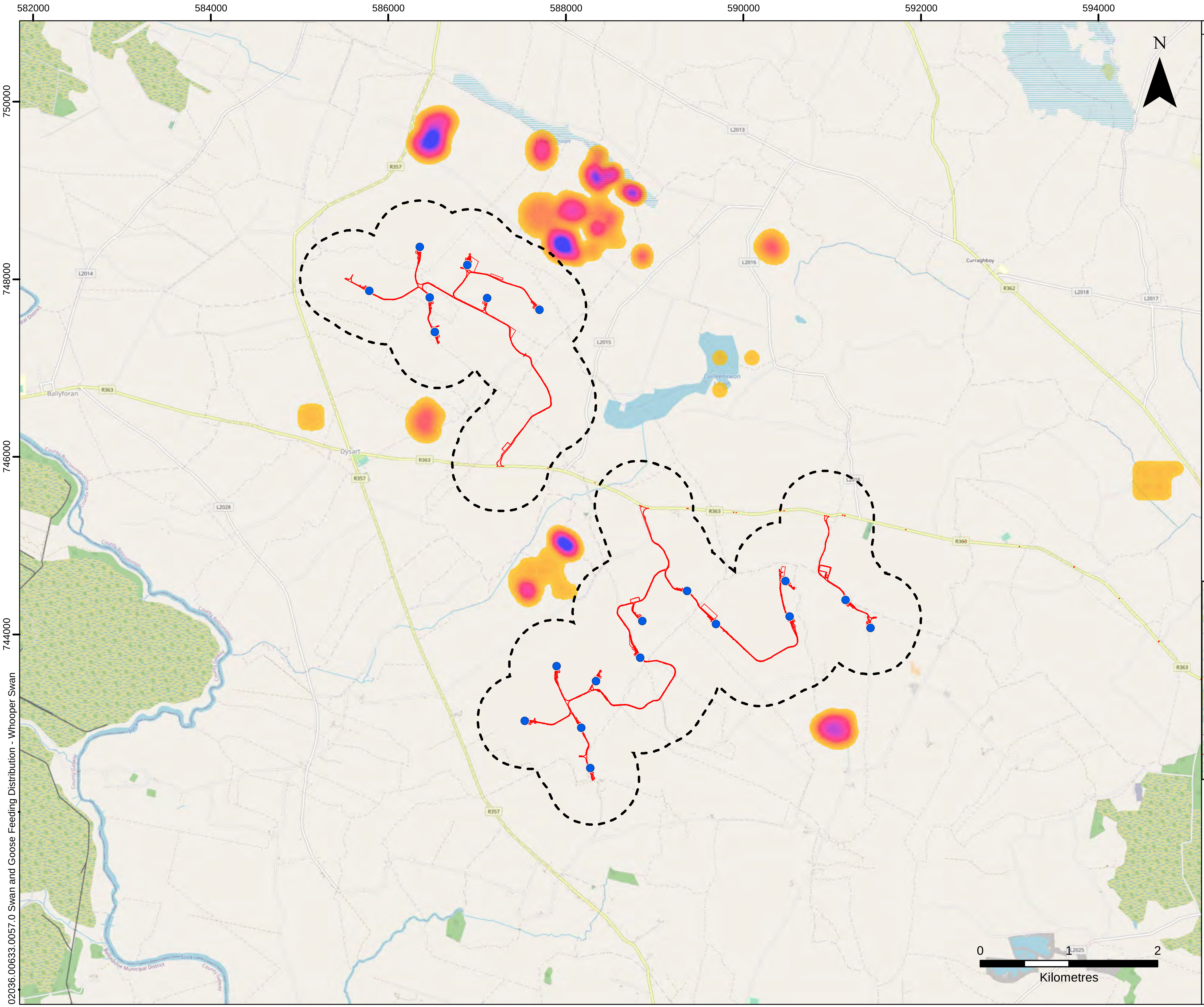
FLIGHT LINES
GULL

FIGURE 2.5

Scale	Date
1:27,500 @ A3	NOVEMBER 2022

02036.00633.0063.0 Flight Lines Gull



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BIRD SURVEY REPORT
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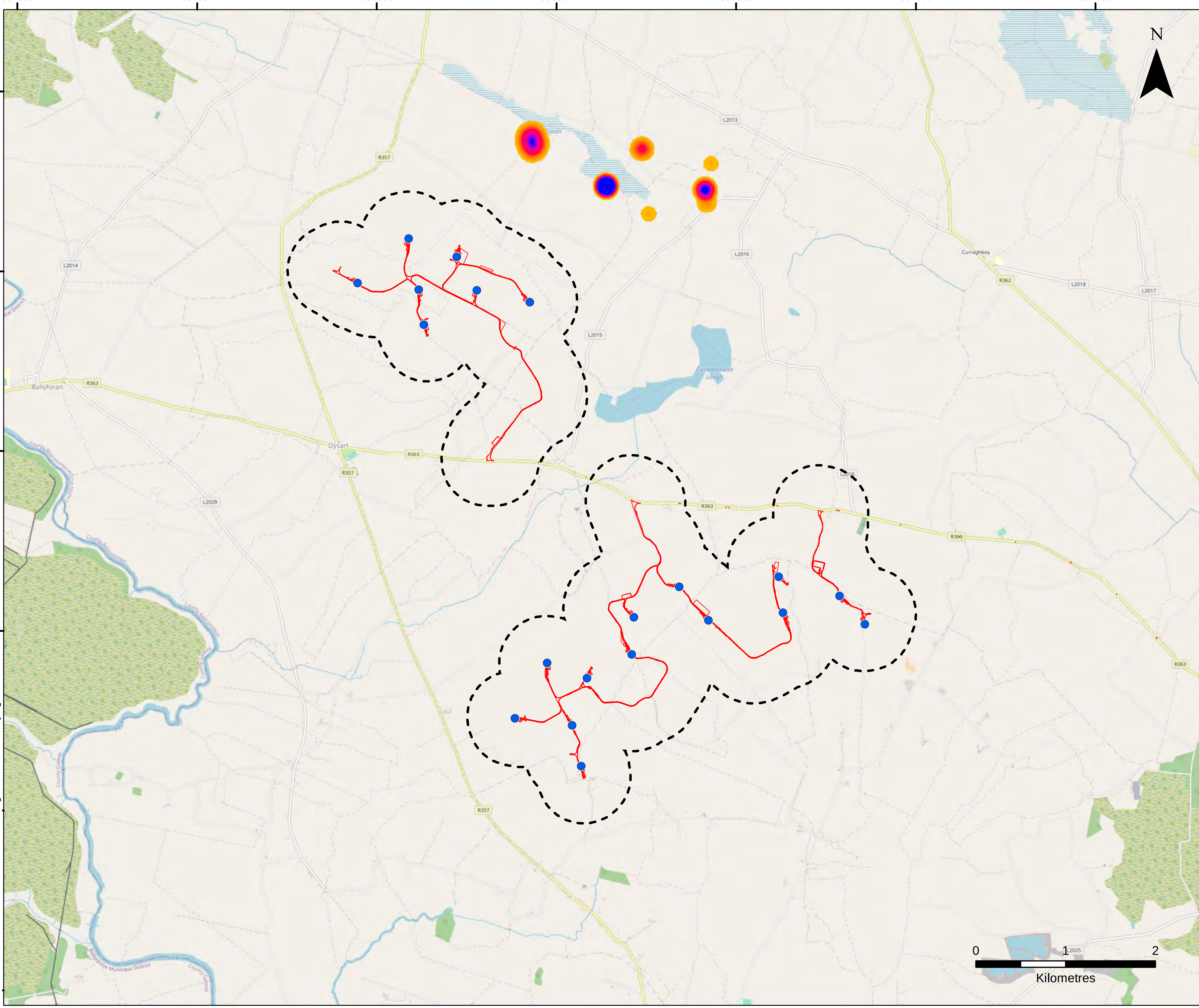
GOOSE & SWAN FEEDING DISTRIBUTION SURVEY RESULTS

FIGURE 3.1

Scale 1:40,000 @ A3

Date JULY 2022

02036.00633.0057.0 Swan and Goose Feeding Distribution - Whooper Swan



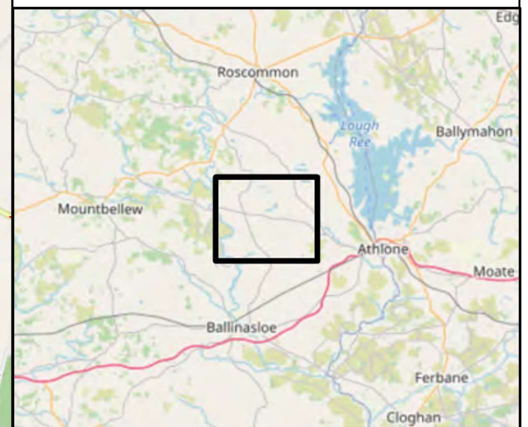
LEGEND

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

Greylag Goose Feeding Distribution (Records/100m ^{2})

Highest Density : (17.3)

Lowest Density (<1)



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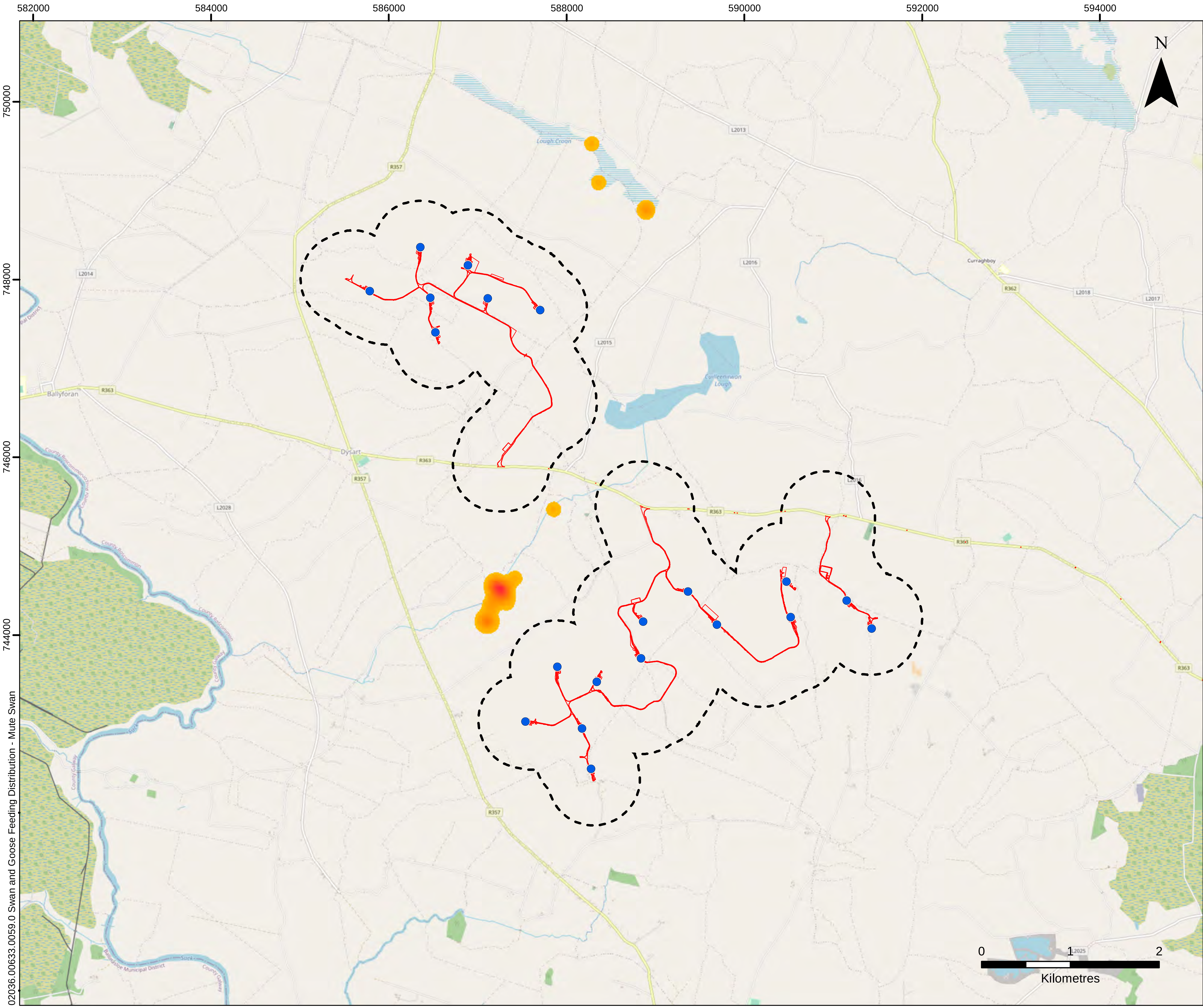
GOOSE & SWAN FEEDING DISTRIBUTION SURVEY RESULTS

FIGURE 3.2

Scale 1:40,000 @ A3

Date JULY 2022

02036.00633.0058.0 Swan and Goose Feeding Distribution - Greylag Goose



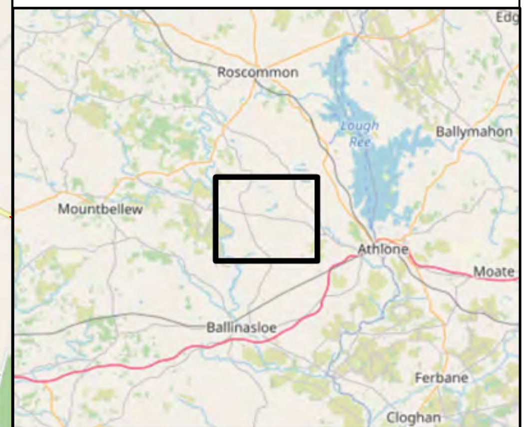
LEGEND

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

Mute Swan Feeding Distribution (Records/100m^2)

Highest Density (2.3)

Lowest Density (<1)



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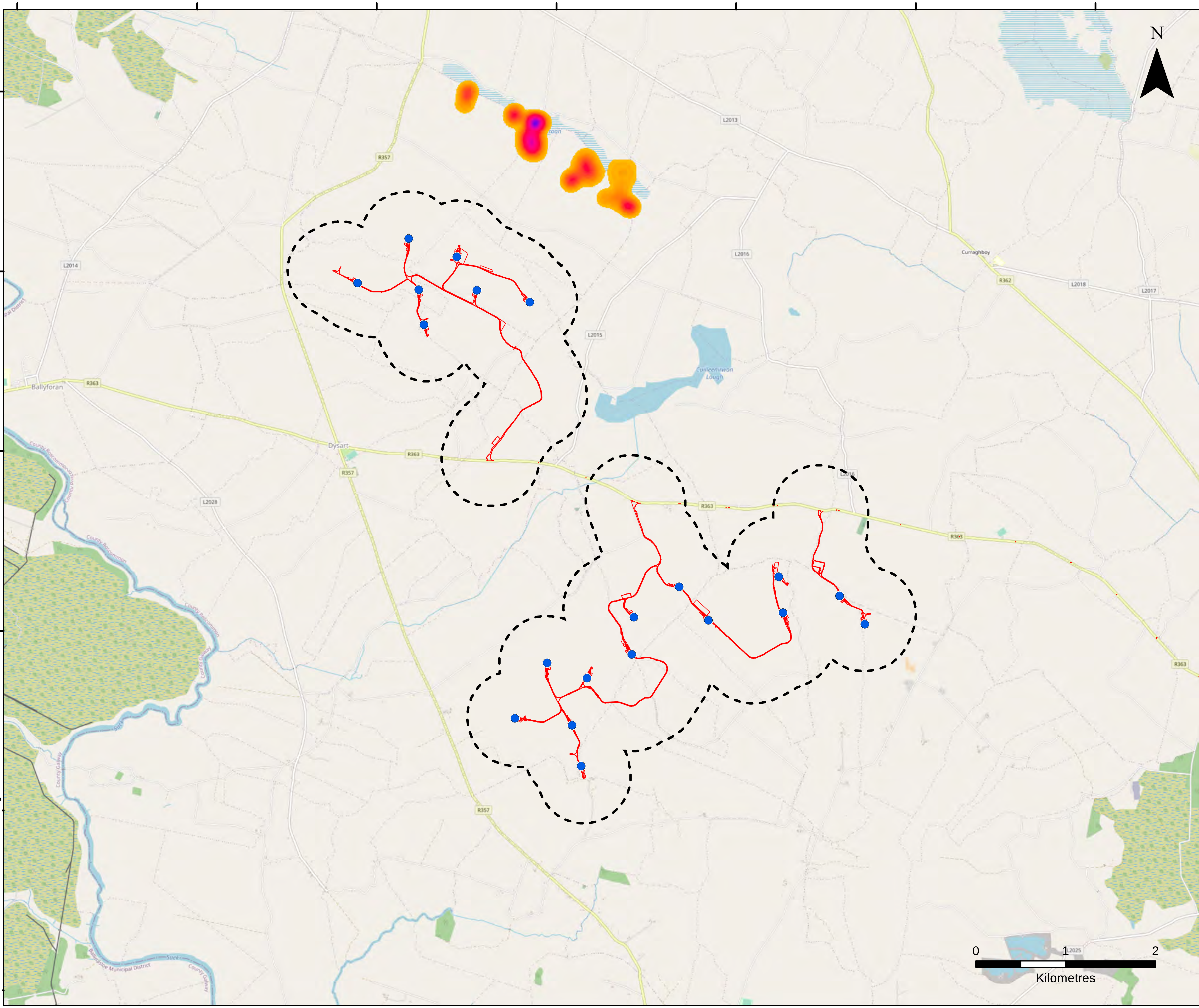
GOOSE & SWAN FEEDING DISTRIBUTION SURVEY RESULTS

FIGURE 3.3

Scale 1:40,000 @ A3

Date JULY 2022

02036.00633.0059.0 Swan and Goose Feeding Distribution - Mute Swan



LEGEND

Turbine Location

Site Infrastructure

Site Infrastructure 500 m Buffer

White-fronted Goose Feeding Distribution (Records/100m ^{2})

Highest Density (5.2)

Lowest Density (<1)

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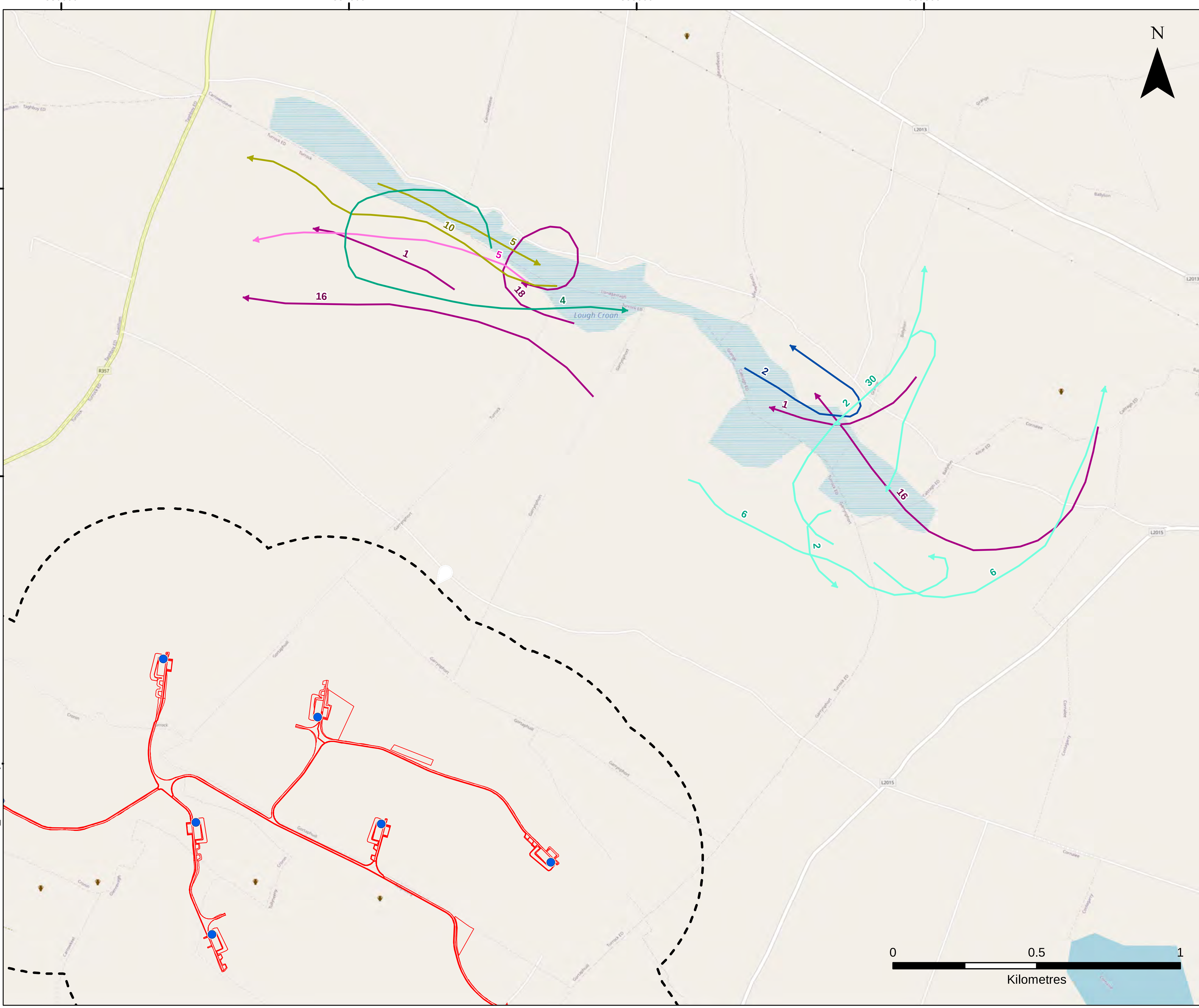
GOOSE & SWAN FEEDING DISTRIBUTION SURVEY RESULTS

FIGURE 3.4

Scale 1:40,000 @ A3

Date JULY 2022

02036.00633.0061.0 Swan and Goose Feeding Distribution - White-fronted Goose



LEGEND

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

Greenland White-fronted Goose Flightline (Label Indicates Count)

- November 2021 - Dawn
- November 2021 - Dusk
- December 2021 - Dawn
- January 2022 - Dawn
- February 2022 - Dawn
- February 2022 - Dusk

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GREENLAND WHITE-FRONTED GOOSE ROOST DAWN/DUSK SURVEY AT LOUGH CROAN VANTAGE POINT LOCATIONS & FLIGHT LINES

FIGURE 4

Scale 1:12,500 @ A3

Date NOVEMBER 2022

02036.00633.0062.0 Goose Roost Dawn_Dusk Survey

APPENDIX 01

Survey dates, times and observers

Table AI-1
Details of VP surveys undertaken from Northern Cluster Vantage Point 1

Date	Surveyor	Start	End	Survey Duration
07/10/2021	AK	09:15	12:15	03:00
08/10/2021	AK	07:30	10:30	03:00
03/11/2021	AK	14:00	17:00	03:00
04/11/2021	AK	10:30	13:30	03:00
02/12/2021	AK	13:00	15:30	02:30
03/12/2021	AK	11:40	15:10	03:30
12/01/2022	AK	11:30	14:30	03:00
13/01/2022	AK	10:30	13:30	03:00
09/02/2022	AK	12:30	15:30	03:00
10/02/2022	AK	11:00	14:00	03:00
08/03/2022	AK	15:45	18:45	03:00
10/03/2022	AK	12:05	15:05	03:00
Total Hours				**36**

Table AI-2
Details of VP surveys undertaken from Northern Cluster Vantage Point 2

Date	Surveyor	Start	End	Survey Duration
06/10/2021	AK	12:10	15:10	03:00
07/10/2021	AK	15:45	18:45	03:00
03/11/2021	AK	10:30	13:30	03:00
04/11/2021	AK	14:00	17:00	03:00
03/12/2021	AK	08:10	11:10	03:00
05/01/2022	AK	13:40	16:40	03:00
11/01/2022	AK	12:15	15:15	03:00
13/01/2022	AK	14:00	17:00	03:00
09/02/2022	AK	09:00	12:00	03:00
10/02/2022	AK	14:30	17:30	03:00
08/03/2022	AK	12:30	15:30	03:00
10/03/2022	AK	15:35	18:35	03:00
Total Hours				**36**

Table AI-3
Details of VP surveys undertaken from Southern Cluster Vantage Point 1

Date	Surveyor	Start	End	Survey Duration
05/10/2021	FL	14:30	16:00	01:30
06/10/2021	FL	10:30	12:00	01:30
21/10/2021	JD	09:10	12:10	03:00
03/11/2021	FL	10:10	13:10	03:00
02/11/2021	FL	11:10	14:10	03:00
19/11/2021	JD	07:55	10:55	03:00
01/12/2021	FL	11:15	14:15	03:00
11/01/2022	FL	11:20	14:20	03:00
28/01/2022	SC	09:00	12:00	03:00
09/02/2022	FL	12:20	15:20	03:00
25/02/2022	JD	12:00	15:00	03:00
09/03/2022	FL	13:15	16:15	03:00
23/03/2022	JD	10:30	13:30	03:00
Total Hours				**36**

Table AI-4
Details of VP surveys undertaken from Southern Cluster, Vantage Point 2

Date	Surveyor	Start	End	Survey Duration
05/10/2021	FL	10:30	13:30	03:00
06/10/2021	FL	12:40	15:40	03:00
17/11/2021	JD	13:30	16:30	03:00
02/12/2021	FL	11:45	14:45	03:00
15/12/2021	JD	08:40	11:40	03:00
05/01/2022	AK	10:00	13:00	03:00
11/01/2022	AK	08:30	11:30	03:00
27/01/2022	SC	14:30	17:30	03:00
12/01/2022	FL	11:05	14:05	03:00
10/02/2022	FL	11:00	14:00	03:00
23/02/2022	JD	15:00	18:00	03:00
10/03/2022	FL	10:30	13:30	03:00
23/03/2022	JD	06:45	09:45	03:00
Total Hours				**39**

Table AI-5
Details of VP surveys undertaken from Southern Cluster, Vantage Point 3

Date	Surveyor	Start	End	Survey Duration
20/10/2021	JD	15:25	18:25	03:00
22/10/2021	JD	08:00	11:00	03:00
05/11/2021	AK	08:30	11:30	03:00
18/11/2021	JD	07:55	10:55	03:00
14/12/2021	JD	10:00	13:00	03:00
04/01/2022	AK	10:00	13:00	03:00
14/01/2022	AK	08:30	11:30	03:00
27/01/2022	SC	14:30	17:30	03:00
11/02/2022	AK	11:15	14:15	03:00
24/02/2022	JD	12:00	15:00	03:00
11/03/2022	AK	10:20	13:20	03:00
24/03/2022	JD	12:20	15:20	03:00
Total Hours				**36**

Table AI-6
Details of VP surveys undertaken from Southern Cluster, Vantage Point 4

Date	Surveyor	Start	End	Survey Duration
20/10/2021	JD	11:55	14:55	03:00
22/10/2021	JD	11:30	14:30	03:00
05/11/2021	AK	12:00	15:00	03:00
18/11/2021	JD	11:25	14:25	03:00
14/12/2021	JD	13:30	16:30	03:00
04/01/2022	AK	13:30	16:30	03:00
14/01/2022	AK	12:00	15:00	03:00
27/01/2022	SC	10:00	13:00	03:00
11/02/2022	AK	07:45	10:45	03:00
24/02/2022	JD	15:30	18:30	03:00
11/03/2022	AK	06:50	09:50	03:00
24/03/2022	JD	08:50	11:50	03:00
Total Hours				**36**

Table AI-7
Details of swan and goose feeding and distribution surveys undertaken during winter 2021/2022

Date	Surveyor	Start	End	Survey Duration
05/10/2021	AK	13:05	16:30	03:25
21/10/2021	JD	12:10	16:10	04:00
02/11/2021	AK	10:30	15:00	04:30
17/11/2021	JD	10:00	13:00	03:00
01/12/2021	AK	10:20	14:20	04:00
15/12/2021	JD	11:40	14:00	02:20
10/01/2022	AK	10:00	15:00	05:00
26/01/2022	SC	13:20	16:20	03:00
08/02/2022	AK	12:15	15:25	03:10
23/02/2022	JD	10:40	13:40	03:00
09/03/2022	AK	12:30	16:30	04:00
22/03/2022	JD	10:50	14:00	3:10
Total Hours				**42:35**

Table AI-8
Details of Greenland white-fronted goose roost surveys undertaken during winter 2021/2022

Date	Surveyor	Start	End	Survey Duration
05/10/2021	AK/FL	17:00	19:30	02:30
06/10/2021	AK/FL	07:15	09:15	02:00
02/11/2021	AK/FL	15:30	17:30	02:00
03/11/2021	AK/FL	07:00	09:00	02:00
01/12/2021	AK/FL	15:00	17:00	02:00
02/12/2021	AK/FL	07:55	09:55	02:00
12/01/2022	AK/FL	08:15	10:15	02:00
12/01/2022	AK/FL	15:10	17:10	02:00
09/02/2022	AK/FL	16:00	18:00	02:00
10/02/2022	AK/FL	07:30	09:30	02:00
09/03/2022	AK/FL	16:50	18:50	02:00
24/03/2022	AK/JD	05:50	07:50	02:00
Total Hours				**24:20**

APPENDIX 02

Weather Data

Table AII-1
Weather data collected during flight activity surveys undertaken at northern cluster VP1

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
07/10/2021	AK	09:15	12:15	1	3	SW	3	8	2	2	0	0	17
07/10/2021	AK	09:15	12:15	2	3	SW	1	8	2	2	0	0	17
07/10/2021	AK	09:15	12:15	3	3	SW	1	8	2	2	0	0	18
08/10/2021	AK	07:30	10:30	1	2	SW	3	8	2	2	0	0	16
08/10/2021	AK	07:30	10:30	2	3	SW	2	8	1	2	0	0	16
08/10/2021	AK	07:30	10:30	3	3	SW	1	8	2	2	0	0	16
03/11/2021	AK	14:00	17:00	1	3	N	0	3	2	2	0	0	10
03/11/2021	AK	14:00	17:00	2	3	N	0	4	2	2	0	0	9
03/11/2021	AK	14:00	17:00	3	4	N	1	3	2	1	0	0	9
04/11/2021	AK	10:30	13:30	1	2	NW	0	4	2	2	0	0	6
04/11/2021	AK	10:30	13:30	2	3	NW	0	7	1	2	0	0	7
04/11/2021	AK	10:30	13:30	3	3	NW	1	6	1	2	0	0	8
02/12/2021	AK	13:00	15:30	1	1	SW	2	8	1	1	0	0	6
02/12/2021	AK	13:00	15:30	2	1	SW	1	8	1	0	0	0	6
02/12/2021	AK	13:00	15:30	3	1	SW	0	8	2	2	0	0	6
03/12/2021	AK	11:40	15:10	1	2	W	0	8	2	2	0	0	7
03/12/2021	AK	11:40	15:10	2	2	W	0	8	2	2	0	0	8
03/12/2021	AK	11:40	15:10	3	2	SW	0	7	2	2	0	0	8

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
03/12/2021	AK	11:40	15:10	4	2	SW	0	7	2	2	0	0	8
12/01/2022	AK	11:30	14:30	1	1	SW	0	1	2	2	0	0	8
12/01/2022	AK	11:30	14:30	2	2	SW	0	1	2	2	0	0	8
12/01/2022	AK	11:30	14:30	3	2	SW	0	1	2	2	0	0	8
13/01/2022	AK	10:30	13:30	1	1	S	1	8	2	2	0	0	5
13/01/2022	AK	10:30	13:30	2	1	S	0	8	2	2	0	0	6
13/01/2022	AK	10:30	13:30	3	1	S	0	8	2	2	0	0	6
09/02/2022	AK	12:30	15:30	1	3	W	2	5	2	2	0	0	7
09/02/2022	AK	12:30	15:30	2	3	W	2	5	2	2	0	0	7
09/02/2022	AK	12:30	15:30	3	3	W	2	7	1	2	0	0	7
10/02/2022	AK	11:00	14:00	1	2	W	0	1	2	2	0	0	6
10/02/2022	AK	11:00	14:00	2	4	W	0	2	2	2	0	0	7
10/02/2022	AK	11:00	14:00	3	4	W	0	4	2	2	0	0	7
08/03/2022	AK	15:45	18:45	1	4	S	3	6	1	1	0	0	8
08/03/2022	AK	15:45	18:45	2	4	S	2	3	1	2	0	0	7
08/03/2022	AK	15:45	18:45	3	2	S	0	3	2	2	0	0	5
10/03/2022	AK	12:05	15:05	1	4	S	0	4	2	2	0	0	8
10/03/2022	AK	12:05	15:05	2	4	S	0	4	2	2	0	0	10
10/03/2022	AK	12:05	15:05	3	4	S	0	6	1	2	0	0	10
Rain/ Precipitation None 0			**Cloud Cover** Expressed in oktas (n/8)			**Visibility** Poor (<1km) 0			**Lying Snow** None 0			**Frost** None 0	

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4			**Cloud Height** Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2			Moderate (1-3km) 1 Good (>3km) 2			On site 1 On higher ground 2			Ground 1 All day 2	

Table AII-2
Weather data collected during flight activity surveys undertaken at northern cluster VP2

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
06/10/2021	AK	12:10	15:10	1	2	E	3	8	2	2	0	0	11
06/10/2021	AK	12:10	15:10	2	2	E	1	8	1	1	0	0	12
06/10/2021	AK	12:10	15:10	3	2	E	2	8	1	1	0	0	14
07/10/2021	AK	15:45	18:45	1	2	SW	0	8	2	2	0	0	18
07/10/2021	AK	15:45	18:45	2	3	SW	1	8	2	2	0	0	17
07/10/2021	AK	15:45	18:45	3	2	SW	0	8	2	2	0	0	17
03/11/2021	AK	10:30	13:30	1	2	NW	0	1	2	2	0	0	10
03/11/2021	AK	10:30	13:30	2	3	NW	0	3	2	2	0	0	10
03/11/2021	AK	10:30	13:30	3	4	N	0	3	2	2	0	0	10
04/11/2021	AK	14:00	17:00	1	3	NW	2	8	1	1	0	0	9
04/11/2021	AK	14:00	17:00	2	2	NW	2	6	1	2	0	0	9

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
04/11/2021	AK	14:00	17:00	3	1	NW	0	5	1	2	0	0	8
03/12/2021	AK	08:10	11:10	1	2	W	1	8	2	2	0	0	7
03/12/2021	AK	08:10	11:10	2	2	W	0	8	2	2	0	0	7
03/12/2021	AK	08:10	11:10	3	2	W	0	8	2	2	0	0	7
05/01/2022	AK	13:40	16:40	1	1	W	0	7	2	2	0	0	4
05/01/2022	AK	13:40	16:40	2	1	W	0	4	2	2	0	0	4
05/01/2022	AK	13:40	16:40	3	1	W	0	3	2	2	0	0	3
11/01/2022	AK	12:15	15:15	1	2	WS	0	1	2	2	0	0	7
11/01/2022	AK	12:15	15:15	2	2	SW	0	3	2	2	0	0	8
11/01/2022	AK	12:15	15:15	3	2	SW	0	5	2	2	0	0	8
13/01/2022	AK	14:00	17:00	1	1	S	0	8	2	2	0	0	7
13/01/2022	AK	14:00	17:00	2	1	S	0	8	2	2	0	0	7
13/01/2022	AK	14:00	17:00	3	1	S	0	8	2	2	0	0	7
09/02/2022	AK	09:00	12:00	1	2	W	0	4	2	2	0	0	4
09/02/2022	AK	09:00	12:00	2	2	W	0	6	2	2	0	0	5
09/02/2022	AK	09:00	12:00	3	2	W	0	4	2	2	0	0	5
10/02/2022	AK	14:30	17:30	1	4	NW	3	7	1	1	0	0	7
10/02/2022	AK	14:30	17:30	2	2	NW	2	4	2	2	0	0	6
10/02/2022	AK	14:30	17:30	3	2	NW	0	2	2	2	0	0	6
08/03/2022	AK	12:30	15:30	1	4	SE	0	6	1	2	0	0	8
08/03/2022	AK	12:30	15:30	2	4	SE	3	5	1	1	0	0	8

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
08/03/2022	AK	12:30	15:30	3	4	SE	0	6	1	2	0	0	8
10/03/2022	AK	15:35	18:35	1	4	S	0	8	1	2	0	0	9
10/03/2022	AK	15:35	18:35	2	3	S	0	8	1	2	0	0	9
10/03/2022	AK	15:35	18:35	3	3	S	0	8	1	2	0	0	8

Rain/ Precipitation	**Cloud Cover**	**Visibility**	**Lying Snow**	**Frost**
None 0 Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4	Expressed in oktas (n/8) **Cloud Height** Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2	Poor (<1km) 0 Moderate (1-3km) 1 Good (>3km) 2	None 0 On site 1 On higher ground 2	None 0 Ground 1 All day 2

Table AII-3
Weather data collected during flight activity surveys undertaken at southern cluster VP1

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/10/2021	FL	14:30	16:00	1	4	NW	0	4	2	2	0	0	13
05/10/2021	FL	14:30	16:00	2	4	NW	2	6	2	2	0	0	13
06/10/2021	FL	10:30	12:00	1	2	S	2	8	1	1	0	0	9
06/10/2021	FL	10:30	12:00	2	3	S	0	8	1	2	0	0	11
03/11/2021	FL	10:10	13:10	1	2	NW	0	1	2	2	0	0	10
03/11/2021	FL	10:10	13:10	2	3	NW	0	2	2	2	0	0	10
03/11/2021	FL	10:10	13:10	3	3	NW	0	4	2	2	0	0	10
02/11/2021	FL	11:10	14:10	1	3	NW	0	3	2	2	0	0	9
02/11/2021	FL	11:10	14:10	2	3	NW	0	3	2	2	0	0	9
02/11/2021	FL	11:10	14:10	3	3	NW	0	3	2	2	0	0	9
21/10/2021	JD	09:10	12:10	1	0	NW	0	1	2	2	0	0	4
21/10/2021	JD	09:10	12:10	2	0	NW	0	2	2	2	0	0	5
21/10/2021	JD	09:10	12:10	3	0	NW	0	2	2	2	0	0	6
19/11/2021	JD	07:55	10:55	1	2	SW	0	7	2	2	0	0	10
19/11/2021	JD	07:55	10:55	2	2	SW	0	7	2	2	0	0	10
19/11/2021	JD	07:55	10:55	3	3	SW	0	6	2	2	0	0	11
01/12/2021	FL	11:15	14:15	1	4	NW	0	2	2	2	0	0	7
01/12/2021	FL	11:15	14:15	2	4	NW	0	1	2	2	0	0	7
01/12/2021	FL	11:15	14:15	3	4	NW	0	2	2	2	0	0	7

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
11/01/2022	FL	11:20	14:20	1	2	S	0	3	2	2	0	0	7
11/01/2022	FL	11:20	14:20	2	2	S	0	3	2	2	0	0	7
11/01/2022	FL	11:20	14:20	3	2	S	0	4	2	2	0	0	8
28/01/2022	SC	09:00	12:00	1	2	NW	1	8	0	2	0	0	9
28/01/2022	SC	09:00	12:00	2	2	NW	1	8	0	2	0	0	9.5
28/01/2022	SC	09:00	12:00	3	1	NW	1	8	0	2	0	0	10
09/02/2022	FL	12:20	15:20	1	2	W	0	5	2	2	0	0	7
09/02/2022	FL	12:20	15:20	2	2	W	0	4	1	2	0	0	7
09/02/2022	FL	12:20	15:20	3	2	W	0	4	2	2	0	0	7
25/02/2022	JD	12:00	15:00	1	2	SW	0	8	1	1	0	0	9
25/02/2022	JD	12:00	15:00	2	2	SW	1	8	1	1	0	0	10
25/02/2022	JD	12:00	15:00	3	2	SW	1	8	1	1	0	0	11
09/03/2022	FL	13:15	16:15	1	1	N	0	8	2	2	0	0	6
09/03/2022	FL	13:15	16:15	2	1	N	0	8	2	2	0	0	6
09/03/2022	FL	13:15	16:15	3	1	N	0	8	2	2	0	0	6
23/03/2022	JD	10:30	13:30	1	2	SE	0	2	2	2	0	0	12
23/03/2022	JD	10:30	13:30	2	2	SE	0	1	2	2	0	0	14
23/03/2022	JD	10:30	13:30	3	2	SE	0	1	2	2	0	0	16

Rain/ Precipitation	Cloud Cover	Visibility	Lying Snow	Frost
None 0	Expressed in oktas (n/8)	Poor (<1km) 0	None 0	None 0
Drizzle 1	**Cloud Height**	Moderate (1-3km) 1	On site 1	Ground 1
Light showers/snow 2	Height of cloud above	Good (>3km) 2	On higher ground 2	All day 2

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
Heavy showers/snow 3 Heavy rain/snow 4			average height of viewshed <150m 0 150-500m 1 >500m 2										

Table AII-4
Weather data collected during flight activity surveys undertaken at southern cluster VP2

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/10/2021	FL	10:30	13:30	1	4	NW	0	2	2	2	0	0	11
05/10/2021	FL	10:30	13:30	2	4	NW	0	2	2	2	0	0	12
05/10/2021	FL	10:30	13:30	3	4	NW	0	2	2	2	0	0	12
06/10/2021	FL	12:40	15:40	1	4	S	1	8	1	2	0	0	12
06/10/2021	FL	12:40	15:40	2	4	S	2	8	1	2	0	0	12
06/10/2021	FL	12:40	15:40	3	4	S	0	8	1	2	0	0	12
17/11/2021	JD	13:30	16:30	1	2	SW	0	8	2	2	0	0	11
17/11/2021	JD	13:30	16:30	2	2	SW	0	8	2	2	0	0	10
17/11/2021	JD	13:30	16:30	3	2	SW	0	8	2	2	0	0	9
02/12/2021	FL	11:45	14:45	1	1	W	0	8	2	2	0	0	6
02/12/2021	FL	11:45	14:45	2	1	W	0	8	1	2	0	0	6
02/12/2021	FL	11:45	14:45	3	1	W	0	8	2	2	0	0	6
15/12/2021	JD	08:40	11:40	1	2	SW	0	8	1	2	0	0	8
15/12/2021	JD	08:40	11:40	2	2	SW	0	8	1	2	0	0	8
15/12/2021	JD	08:40	11:40	3	2	SW	0	8	1	2	0	0	9
05/01/2022	AK	10:00	13:00	1	1	NW	0	7	2	2	0	1	1
05/01/2022	AK	10:00	13:00	2	1	W	0	8	2	2	0	1	1
05/01/2022	AK	10:00	13:00	3	1	W	0	6	2	2	0	1	1
11/01/2022	AK	08:30	11:30	1	2	SW	0	3	2	2	0	0	3

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
11/01/2022	AK	08:30	11:30	2	2	SW	0	2	2	2	0	0	3
11/01/2022	AK	08:30	11:30	3	2	SW	0	2	2	2	0	0	3
12/01/2022	FL	11:05	14:05	1	2	S	0	2	2	2	0	0	8
12/01/2022	FL	11:05	14:05	2	2	S	0	2	2	2	0	0	8
12/01/2022	FL	11:05	14:05	3	2	S	0	2	2	2	0	0	8
27/01/2022	SC	14:30	17:30	1	2	S	0	5	2	2	0	0	12
27/01/2022	SC	14:30	17:30	2	2	S	0	5	2	2	0	0	11
27/01/2022	SC	14:30	17:30	3	2	S	0	6	2	2	0	0	11
10/02/2022	FL	11:00	14:00	1	3	W	0	1	2	2	0	0	7
10/02/2022	FL	11:00	14:00	2	3	W	0	1	2	2	0	0	7
10/02/2022	FL	11:00	14:00	3	3	W	0	5	2	2	0	0	7
23/02/2022	JD	15:00	18:00	1	5	SW	3	8	1	1	0	0	8
23/02/2022	JD	15:00	18:00	2	5	SW	2	8	1	1	0	0	7
23/02/2022	JD	15:00	18:00	3	5	SW	3	8	1	1	0	0	5
10/03/2022	FL	10:30	13:30	1	2	SE	0	5	2	2	0	0	7
10/03/2022	FL	10:30	13:30	2	2	SE	0	4	2	2	0	0	7
10/03/2022	FL	10:30	13:30	3	3	SE	0	6	2	2	0	0	9
23/03/2022	JD	06:45	09:45	1	2	SE	0	3	2	2	0	0	7
23/03/2022	JD	06:45	09:45	2	2	SE	0	3	2	2	0	0	7
23/03/2022	JD	06:45	09:45	3	2	SE	0	6	2	2	0	0	10
Rain/ Precipitation			**Cloud Cover**			**Visibility**			**Lying Snow**			**Frost**	

<table>
<tr><th>Date</th><th>Surveyor</th><th>Start</th><th>End</th><th>Survey Hour</th><th>Wind Speed</th><th>Wind Direction</th><th>Rain</th><th>Cloud Cover</th><th>Cloud Height</th><th>Visibility</th><th>Snow</th><th>Frost</th><th>Temp (°c)</th></tr>
<tr><td colspan="3">None 0
Drizzle 1
Light showers/snow 2
Heavy showers/snow 3
Heavy rain/snow 4</td><td colspan="3">Expressed in oktas (n/8)
Cloud Height
Height of cloud above average height of viewshed
<150m 0
150-500m 1
>500m 2</td><td colspan="3">Poor (<1km) 0
Moderate (1-3km) 1
Good (>3km) 2</td><td colspan="3">None 0
On site 1
On higher ground 2</td><td colspan="2">None 0
Ground 1
All day 2</td></tr>
</table>

Table AII-5
Weather data collected during flight activity surveys undertaken at southern cluster VP3

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/11/2021	AK	08:30	11:30	1	2	SW	0	8	1	2	0	0	7
05/11/2021	AK	08:30	11:30	2	2	SW	0	6	2	2	0	0	8
05/11/2021	AK	08:30	11:30	3	2	W	0	5	2	2	0	0	8
20/10/2021	JD	15:25	18:25	1	3	NW	0	4	2	2	0	0	13
20/10/2021	JD	15:25	18:25	2	3	NW	0	3	2	2	0	0	13
20/10/2021	JD	15:25	18:25	3	2	NW	0	4	2	2	0	0	11
22/10/2021	JD	08:00	11:00	1	1	NW	0	7	2	2	0	0	9
22/10/2021	JD	08:00	11:00	2	1	NW	1	8	2	2	0	0	9
22/10/2021	JD	08:00	11:00	3	2	W	0	8	2	2	0	0	9

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
18/11/2021	JD	07:55	10:55	1	2	SW	0	6	2	2	0	0	12
18/11/2021	JD	07:55	10:55	2	2	SW	0	8	2	2	0	0	12
18/11/2021	JD	07:55	10:55	3	2	SW	0	7	2	2	0	0	12
14/12/2021	JD	10:00	13:00	1	2	SW	0	1	2	2	0	1	6
14/12/2021	JD	10:00	13:00	2	2	SW	0	1	2	2	0	0	6
14/12/2021	JD	10:00	13:00	3	2	SW	0	1	2	2	0	0	7
04/01/2022	AK	10:00	13:00	1	2	NW	0	0	n/a	2	0	1	2
04/01/2022	AK	10:00	13:00	2	2	NW	0	0	n/a	2	0	1	3
04/01/2022	AK	10:00	13:00	3	2	NW	0	0	n/a	2	0	0	4
14/01/2022	AK	08:30	11:30	1	1	SE	0	8	2	2	0	0	2
14/01/2022	AK	08:30	11:30	2	1	SE	0	8	2	2	0	0	2
14/01/2022	AK	08:30	11:30	3	1	SE	0	8	2	2	0	0	2
27/01/2022	SC	14:30	17:30	1	0	N/A	0	5	1	2	0	0	11.5
27/01/2022	SC	14:30	17:30	2	0	N/A	0	3	1	2	0	0	11
27/01/2022	SC	14:30	17:30	3	0	N/A	0	3	1	2	0	0	10.5
11/02/2022	AK	11:15	14:15	1	3	S	0	3	2	2	0	0	6
11/02/2022	AK	11:15	14:15	2	3	S	0	2	2	2	0	0	6
11/02/2022	AK	11:15	14:15	3	4	S	0	5	2	2	0	0	8
24/02/2022	JD	12:00	15:00	1	3	SW	3	5	1	1	0	0	5
24/02/2022	JD	12:00	15:00	2	4	W	3	5	1	1	0	0	6

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
24/02/2022	JD	12:00	15:00	3	4	SW	3	7	1	1	0	0	6
11/03/2022	AK	10:20	13:20	1	2	SE	3	8	0	1	0	0	8
11/03/2022	AK	10:20	13:20	2	2	SE	3	8	1	1	0	0	8
11/03/2022	AK	10:20	13:20	3	2	SE	3	8	1	1	0	0	9
24/03/2022	JD	12:20	15:20	1	1	SW	0	8	1	2	0	0	14
24/03/2022	JD	12:20	15:20	2	1	SW	0	8	1	2	0	0	15
24/03/2022	JD	12:20	15:20	3	1	SW	0	8	1	2	0	0	16

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

Lying Snow
None 0
On site 1
On higher ground 2

Frost
None 0
Ground 1
All day 2

Table AII-6
Weather data collected during flight activity surveys undertaken at southern cluster VP4

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/11/2021	AK	12:00	15:00	1	3	W	0	8	2	2	0	0	11
05/11/2021	AK	12:00	15:00	2	3	W	0	8	2	2	0	0	11
05/11/2021	AK	12:00	15:00	3	3	W	0	8	2	2	0	0	11
20/10/2021	JD	11:55	14:55	1	2	N	0	5	2	2	0	0	11
20/10/2021	JD	11:55	14:55	2	3	W	0	4	2	2	0	0	12
20/10/2021	JD	11:55	14:55	3	3	W	0	4	2	2	0	0	13
22/10/2021	JD	11:30	14:30	1	2	W	1	7	1	2	0	0	10
22/10/2021	JD	11:30	14:30	2	2	W	0	6	2	2	0	0	12
22/10/2021	JD	11:30	14:30	3	2	NW	1	6	2	2	0	0	12
18/11/2021	JD	11:25	14:25	1	3	SW	0	7	2	2	0	0	13
18/11/2021	JD	11:25	14:25	2	2	SW	0	7	2	2	0	0	13
18/11/2021	JD	11:25	14:25	3	2	SW	0	8	2	2	0	0	13
14/12/2021	JD	13:30	16:30	1	3	SW	0	3	2	2	0	0	8
14/12/2021	JD	13:30	16:30	2	2	SW	0	6	2	2	0	0	9
14/12/2021	JD	13:30	16:30	3	2	SW	0	7	2	2	0	0	8
04/01/2022	AK	13:30	16:30	1	2	NW	2	6	2	2	0	0	5
04/01/2022	AK	13:30	16:30	2	2	NW	0	4	2	2	0	0	5
04/01/2022	AK	13:30	16:30	3	3	NW	2	5	2	2	0	0	4
14/01/2022	AK	12:00	15:00	1	2	SE	0	8	2	2	0	0	2

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
14/01/2022	AK	12:00	15:00	2	2	SE	0	8	2	2	0	0	2
14/01/2022	AK	12:00	15:00	3	2	SE	0	8	2	2	0	0	2
27/01/2022	SC	10:00	13:00	1	1	SE	0	2	2	2	0	0	11
27/01/2022	SC	10:00	13:00	2	1	SE	0	5	2	2	0	0	11
27/01/2022	SC	10:00	13:00	3	2	SE	1	7	2	2	0	0	11.5
11/02/2022	AK	07:45	10:45	1	2	S	0	3	2	2	0	0	0
11/02/2022	AK	07:45	10:45	2	2	S	0	4	2	2	0	0	1
11/02/2022	AK	07:45	10:45	3	2	S	0	4	2	2	0	0	2
24/02/2022	JD	15:30	18:30	1	3	SW	3	7	1	1	0	0	6
24/02/2022	JD	15:30	18:30	2	3	SW	2	7	1	1	0	0	6
24/02/2022	JD	15:30	18:30	3	3	SW	3	7	1	1	0	0	5
11/03/2022	AK	06:50	09:50	1	2	SE	3	8	0	1	0	0	7
11/03/2022	AK	06:50	09:50	2	2	SE	3	8	1	1	0	0	7
11/03/2022	AK	06:50	09:50	3	2	SE	3	8	1	1	0	0	7
24/03/2022	JD	08:50	11:50	1	1	S	0	8	1	1	0	0	9
24/03/2022	JD	08:50	11:50	2	1	SW	0	8	1	2	0	0	10
24/03/2022	JD	08:50	11:50	3	1	SW	0	8	1	2	0	0	12

Rain/ Precipitation		Cloud Cover	Visibility		Lying Snow		Frost	
None	0	Expressed in oktas (n/8)	Poor (<1km)	0	None	0	None	0
Drizzle	1	**Cloud Height**	Moderate (1-3km)	1	On site	1	Ground	1
Light showers/snow	2	Height of cloud above	Good (>3km)	2	On higher ground	2	All day	2
Heavy showers/snow	3	average height of viewshed						

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
Heavy rain/snow	4		<150m 150-500m >500m	0 1 2									

Table AII-7
Weather data collected during feeding distribution surveys

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/10/2021	AK	13:05	16:30	1	4	W	2	6	2	2	0	0	13
05/10/2021	AK	13:05	16:30	2	4	W	2	6	2	2	0	0	13
05/10/2021	AK	13:05	16:30	3	4	W	2	6	2	2	0	0	13
05/10/2021	AK	13:05	16:30	4	4	W	2	6	2	2	0	0	13
02/11/2021	AK	10:30	15:00	1	3	NW	0	3	2	2	0	0	10
02/11/2021	AK	10:30	15:00	2	3	NW	0	3	2	2	0	0	11
02/11/2021	AK	10:30	15:00	3	3	NW	0	5	2	2	0	0	11
02/11/2021	AK	10:30	15:00	4	3	NW	0	5	2	2	0	0	11
02/11/2021	AK	10:30	15:00	5	3	NW	1	6	2	2	0	0	10
21/10/2021	JD	12:10	16:10	1	1	NW	0	1	2	2	0	0	10

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
21/10/2021	JD	12:10	16:10	2	1	NW	0	2	2	2	0	0	11
21/10/2021	JD	12:10	16:10	3	2	NW	0	3	2	2	0	0	11
21/10/2021	JD	12:10	16:10	4	3	NW	1	7	2	2	0	0	12
17/11/2021	JD	10:00	13:00	1	2	SW	0	8	2	2	0	0	11
17/11/2021	JD	10:00	13:00	2	2	SW	0	8	2	2	0	0	11
17/11/2021	JD	10:00	13:00	3	2	SW	0	8	2	2	0	0	11
01/12/2021	AK	10:20	14:20	1	4	NW	3	7	2	2	0	0	6
01/12/2021	AK	10:20	14:20	2	4	NW	0	5	2	2	0	0	6
01/12/2021	AK	10:20	14:20	3	5	NW	0	3	2	2	0	0	7
01/12/2021	AK	10:20	14:20	4	5	NW	1	4	2	2	0	0	7
15/12/2021	JD	11:40	14:00	1	2	SW	0	8	1	2	0	0	9
15/12/2021	JD	11:40	14:00	2	2	SW	0	8	1	2	0	0	9
10/01/2022	AK	10:00	15:00	1	2	S	3	8	1	1	0	0	12
10/01/2022	AK	10:00	15:00	2	2	S	3	8	1	1	0	0	12
10/01/2022	AK	10:00	15:00	3	2	S	3	8	1	1	0	0	12
10/01/2022	AK	10:00	15:00	4	2	S	3	8	1	1	0	0	12
10/01/2022	AK	10:00	15:00	5	2	S	3	8	1	1	0	0	12
08/02/2022	AK	12:15	15:25	1	2	SW	0	8	1	1	0	0	9
08/02/2022	AK	12:15	15:25	2	2	SW	1	8	1	1	0	0	9
08/02/2022	AK	12:15	15:25	3	2	SW	2	8	0	0	0	0	9

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
08/02/2022	AK	12:15	15:25	4	2	SW	1	8	0	1	0	0	9
09/03/2022	AK	12:30	16:30	1	2	NW	2	8	1	1	0	0	5
09/03/2022	AK	12:30	16:30	2	1	NE	0	8	1	2	0	0	5
09/03/2022	AK	12:30	16:30	3	1	NE	0	7	2	2	0	0	5
09/03/2022	AK	12:30	16:30	4	1	NE	2	7	2	2	0	0	5
26/01/2022	SC	13:20	16:20	1	2	S	0	6	1	2	0	0	9
26/01/2022	SC	13:20	16:20	2	1	S	0	8	1	2	0	0	9
26/01/2022	SC	13:20	16:20	3	1	S	0	8	1	2	0	0	8.5
23/02/2022	JD	10:40	13:40	1	5	SW	0	8	1	1	0	0	9
23/02/2022	JD	10:40	13:40	2	5	SW	0	8	1	1	0	0	10
23/02/2022	JD	10:40	13:40	3	4	SW	0	6	2	2	0	0	9
22/03/2022	JD	10:50	14:00	1	2	SE	0	7	2	2	0	0	13
22/03/2022	JD	10:50	14:00	2	2	SE	0	6	2	2	0	0	16
22/03/2022	JD	10:50	14:00	3	2	SE	1	8	2	2	0	0	17

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

Lying Snow
None 0
On site 1
On higher ground 2

Frost
None 0
Ground 1
All day 2

Table AII-8
Weather data collected during Greenland white-fronted goose roost surveys

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
05/10/2021	AK	17:00	19:30	1	4	W	0	4	2	2	0	0	13
05/10/2021	AK	17:00	19:30	2	2	W	0	5	2	2	0	0	11
05/10/2021	AK	17:00	19:30	3	0	n/a	0	3	2	2	0	0	9
06/10/2021	AK	07:15	09:15	1	0	n/a	1	7	2	1	0	0	7
06/10/2021	AK	07:15	09:15	2	1	W	1	8	2	2	0	0	9
02/11/2021	AK	15:30	17:30	1	3	NW	3	6	1	2	0	0	10
02/11/2021	AK	15:30	17:30	2	3	NW	3	5	1	2	0	0	10
03/11/2021	AK	07:00	09:00	1	1	NW	3	0	0	1	0	1	6
03/11/2021	AK	07:00	09:00	2	1	NW	2	1	1	1	0	1	6
01/12/2021	AK	15:00	17:00	1	5	NW	2	6	2	2	0	0	7
01/12/2021	AK	15:00	17:00	2	5	NW	2	6	2	2	0	0	7
02/12/2021	AK	07:55	09:55	1	1	NW	0	8	2	2	0	0	5
02/12/2021	AK	07:55	09:55	2	1	NW	0	6	2	2	0	0	5
12/01/2022	AK	08:15	10:15	1	1	SW	0	2	2	2	0	0	5
12/01/2022	AK	08:15	10:15	2	1	SW	0	2	2	2	0	0	5
12/01/2022	AK	15:10	17:10	1	2	SW	0	1	2	2	0	0	9
12/01/2022	AK	15:10	17:10	2	2	SW	0	1	2	2	0	0	7
09/02/2022	AK	16:00	18:00	1	2	W	2	5	2	2	0	0	6
09/02/2022	AK	16:00	18:00	2	2	SW	0	3	2	2	0	0	5

Date	Surveyor	Start	End	Survey Hour	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Snow	Frost	Temp (°c)
10/02/2022	AK	07:30	09:30	1	2	W	0	2	2	2	0	1	3
10/02/2022	AK	07:30	09:30	2	2	W	0	2	2	2	0	1	3
09/03/2022	AK	16:50	18:50	1	1	NW	3	7	2	2	0	0	5
09/03/2022	AK	16:50	18:50	2	1	NW	0	5	1	1	0	0	5
24/03/2022	AK	05:50	07:50	1	1	SW	0	8	0	0	0	0	5
24/03/2022	AK	05:50	07:50	2	1	SW	0	8	0	0	0	0	5

Rain/ Precipitation	Cloud Cover	Visibility	Lying Snow	Frost
None 0 Drizzle 1 Light showers/snow 2 Heavy showers/snow 3 Heavy rain/snow 4	Expressed in oktas (n/8) **Cloud Height** Height of cloud above average height of viewshed <150m 0 150-500m 1 >500m 2	Poor (<1km) 0 Moderate (1-3km) 1 Good (>3km) 2	None 0 On site 1 On higher ground 2	None 0 Ground 1 All day 2

APPENDIX 03

Flight activity survey data

Primary Target Species

Table AIII-1a
Primary target species recorded during flight activity surveys undertaken at northern cluster VP1

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
03/11/2021	AK	1	ML	1	Ad	U	14:41	30
03/11/2021	AK	2	ML	1	Ad	U	15:31	15
03/11/2021	AK	3	PE	1	U	U	15:52	30
04/11/2021	AK	1	ML	1	Ad	U	13:20	7
12/01/2022	AK	1	PE	1	U	U	12:28	90
13/01/2022	AK	1	BH	3	U	U	12:32	40
09/02/2022	AK	1	PE	1	U	U	13:33	30
09/02/2022	AK	2	BH	36	U	U	13:57	45
09/02/2022	AK	3	BH	54	U	U	14:46	75
10/02/2022	AK	1	ML	1	U	U	12:31	5
08/03/2022	AK	1	K.	1	Ad	M	15:47	10
08/03/2022	AK	2	K.	1	Ad	M	16:27	65
08/03/2022	AK	3	WS	14	U	U	16:31	35
08/03/2022	AK	4	ML	1	Ad	F	17:47	5
08/03/2022	AK	5	ML	1	Ad	F	17:51	20
08/03/2022	AK	6	ML	1	Ad	F	18:04	18

Table AIII-2a
Primary target species recorded during flight activity surveys undertaken at northern cluster VP2

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
07/10/2021	AK	1	SN	1	U	U	16:21	33
07/10/2021	AK	2	K.	1	Ad	M	16:33	4
07/10/2021	AK	3	K.	1	Ad	M	16:44	10
03/11/2021	AK	1	L.	10	Ad	U	11:22	56
04/11/2021	AK	1	BH	1	Ad	U	14:19	66
04/11/2021	AK	2	BH	2	Ad	U	14:51	25
04/11/2021	AK	3	BH	23	Ad	U	15:01	64
04/11/2021	AK	4	BH	15	Ad	U	15:53	10
03/12/2021	AK	1	BH	12	Ad	U	09:03	27
03/12/2021	AK	2	PE	1	U	U	10:47	35
03/12/2021	AK	3	BH	3	Ad	U	11:07	50
05/01/2022	AK	1	BH	6	U	U	13:45	50
05/01/2022	AK	2	BH	6	Ad	U	13:48	35
05/01/2022	AK	3	GP	18	U	U	14:12	5
05/01/2022	AK	4	BH	1	Ad	U	14:12	25
05/01/2022	AK	5	BH	1	Ad	U	14:17	20

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
05/01/2022	AK	6	BH	3	U	U	14:19	20
05/01/2022	AK	7	BH	1	Ad	U	14:30	20
05/01/2022	AK	8	GP	6	U	U	16:07	20
11/01/2022	AK	1	BH	8	U	U	12:29	10
11/01/2022	AK	2	BH	34	U	U	12:37	10
11/01/2022	AK	3	BH	12	U	U	12:42	10
11/01/2022	AK	4	BH	4	U	U	12:51	5
11/01/2022	AK	5	BH	25	U	U	12:57	20
11/01/2022	AK	6	BH	1	U	U	14:14	65
11/01/2022	AK	7	BH	1	U	U	14:16	45
11/01/2022	AK	8	K.	1	U	U	15:01	33
13/01/2022	AK	1	BH	5	U	U	14:22	10
13/01/2022	AK	2	BH	1	U	U	14:34	35
13/01/2022	AK	A	WS	5	Ad	U	15:01	
13/01/2022	AK	3	BH	21	Ad	U	16:08	60
09/02/2022	AK	1	BH	2	Ad	U	09:05	30
09/02/2022	AK	2	BH	1	U	U	09:07	75
09/02/2022	AK	3	WS	2	Ad	U	09:27	20
09/02/2022	AK	4	WS	18	U	U	09:50	60
09/02/2022	AK	5	BH	38	U	U	10:18	0
09/02/2022	AK	6	WS	7	U	U	11:19	115
09/02/2022	AK	7	BH	50	U	U	11:32	120
09/02/2022	AK	8	MA	8	Ad	5M 3F	11:44	30
10/02/2022	AK	1	BH	1	U	U	14:47	45
10/02/2022	AK	2	BH	7	U	U	15:12	60
10/02/2022	AK	3	BH	36	U	U	15:39	30
10/02/2022	AK	4	BH	52	U	U	15:46	405
10/02/2022	AK	4	BH	52	U	U	15:46	405
10/02/2022	AK	5	GP	74	U	U	15:51	60
10/02/2022	AK	6	BH	9	U	U	15:54	45
10/02/2022	AK	7	BH	96	U	U	15:59	135
10/02/2022	AK	8	BH	1	Ad	U	16:12	75
10/02/2022	AK	9	WN	43	U	U	16:54	105
10/02/2022	AK	10	GP	40	U	U	16:52	105
08/03/2022	AK	1	WS	3	Ad	U	13:48	5
10/03/2022	AK	1	K.	1	Ad	F	12:21	60
10/03/2022	AK	2	K.	1	Ad	F	12:32	90
10/03/2022	AK	3	K.	1	Ad	F	12:39	77
10/03/2022	AK	4	BH	5	Ad	U	13:50	75

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
10/03/2022	AK	5	BH	60	U	U	14:48	105
10/03/2022	AK	6	K.	1	Ad	F	14:55	5

Table AIII-3a
Primary target species recorded during flight activity surveys undertaken at southern cluster VP1

Date	Surveyor	Flight ID	Species	Num. Birds	Sex	Age	Obs. Time	Flight time (s)
03/11/2021	FL	1	K.					165
03/11/2021	FL	2	K.					75
01/12/2021	FL	1	PE	1	Ad	U	11:30	45
01/12/2021	FL	2	K.	1	Ad	F	11:49	75
02/12/2021	FL	1	WS	5	Ad	U	14:27	75
11/01/2022	FL	1	K.	1	Ad	F	12:10	20
11/01/2022	FL	2	K.	1	Ad	F	12:27	60
11/01/2022	FL	3	SH	1	Ad	M	12:28	25
28/01/2022	SC	1	PE	1	Ad	U	09:52	75
28/01/2022	SC	2	BH	15	Ad	U	10:23	135
25/02/2022	JD	1	K.	1	Ad	M	12:52	120
09/03/2022	FL	2	K.	1	Ad	F	15:30	30
09/03/2022	FL	3	K.	1	Ad	F	15:43	30
23/03/2022	JD	1	K.	1	Ad	F	11:20	45
23/03/2022	JD	2	PE	1	Ad	F	12:02	30

Table AIII-4a
Primary target species recorded during flight activity surveys undertaken at southern cluster VP2

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
06/10/2021	FL	1	K.	1	U	U	14:35	70
15/12/2021	JD	1	BH	2	Ad	U	08:40	30
05/01/2022	AK	1	BH	250	U	U	11:04	35
05/01/2022	AK	2	BH	32	U	U	11:59	35
05/01/2022	AK	3	BH	46	U	U	12:21	180
05/01/2022	AK	4	BH	22	U	U	12:51	80
11/01/2022	AK	1	WS	6	U	U	09:31	135
11/01/2022	AK	2	WS	5	U	U	09:59	20
11/01/2022	AK	3	WS	5	Ad	U	10:23	170
11/01/2022	AK	4	BH	2	U	U	11:09	30
27/01/2022	SC	1	BH	36	U	U	14:46	60
27/01/2022	SC	2	BH	30	U	U	15:20	90
27/01/2022	SC	3	BH	50	U	U	16:55	130

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
10/02/2022	FL	1	BH	7	U	U	11:18	45
10/02/2022	FL	2	BH	39	U	U	11:49	135
10/02/2022	FL	3	BH	10	U	U	12:27	135
10/02/2022	FL	4	K.	1	U	U	12:33	30
10/03/2022	FL	1	K.	1	Ad	U	11:18	45
10/03/2022	FL	2	K.	1	Ad	F	12:12	70
10/03/2022	FL	3	BH	2	Ad	M	12:41	60
23/03/2022	JD	1	BH	5	Ad	U	06:50	76

Table AIII-5a
Primary target species recorded during flight activity surveys undertaken at southern cluster VP3

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
05/11/2021	AK	1	L.	3	Ad	U	08:34	40
05/11/2021	AK	2	L.	3	Ad	U	08:41	48
05/11/2021	AK	3	K.	1	Ad	F	09:16	25
05/11/2021	AK	4	WS	4	Ad	U	11:31	56
20/10/2021	JD	1	K.	1	Ad	F	15:38	88
20/10/2021	JD	2	K.	1	Ad	F	15:46	405
20/10/2021	JD	2	K.	1	Ad	F	15:46	405
20/10/2021	JD	3	K.	1	Ad	F	15:53	90
20/10/2021	JD	4	WS	8	Ad	U	18:22	30
22/10/2021	JD	1	CU	5	Ad	U	09:53	30
22/10/2021	JD	2	K.	1	Ad	F	10:10	15
22/10/2021	JD	3	BH	8	Ad	U	10:30	60
22/10/2021	JD	4	CU	5	Ad	U	10:42	65
18/11/2021	JD	1	CU	1	Ad	U	08:05	90
14/12/2021	JD	1	K.	1	Ad	F	10:16	30
14/12/2021	JD	2	BH	2	Ad	U	10:27	37
14/12/2021	JD	3	BH	28	Ad	U	10:28	5
14/12/2021	JD	4	BH	3	Ad	U	10:54	60
14/12/2021	JD	5	BH	1	Ad	U	11:00	65
14/12/2021	JD	6	BH	25	Ad	U	11:03	10
14/12/2021	JD	7	CU	28	Ad	U	11:05	20
14/12/2021	JD	8	BH	2	Ad	U	11:45	120
14/12/2021	JD	9	BH	2	Ad	U	12:25	150
04/01/2022	AK	1	L.	1	Ad	U	10:21	8
04/01/2022	AK	2	L.	14	Ad	U	10:22	10

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
04/01/2022	AK	3	L.	17	Ad	U	10:22	10
04/01/2022	AK	4	L.	17	Ad	U	10:25	5
04/01/2022	AK	5	L.	3	Ad	U	10:33	10
04/01/2022	AK	6	BH	4	Ad	U	10:57	54
04/01/2022	AK	7	PE	1	Ad	U	10:59	55
04/01/2022	AK	8	L.	63	U	U	10:59	190
04/01/2022	AK	9	BH	1	Ad	U	11:07	50
04/01/2022	AK	10	L.	46	Ad	U	11:10	45
04/01/2022	AK	11	BH	18	Ad	U	11:19	65
04/01/2022	AK	12	BH	1	Ad	U	11:22	30
04/01/2022	AK	13	BH	2	Ad	U	11:32	16
04/01/2022	AK	14	L.	41	Ad	U	11:37	10
04/01/2022	AK	15	BH	1	Ad	U	12:29	50
04/01/2022	AK	16	CU	1	Ad	U	12:52	5
14/01/2022	AK	1	BH	1	Ad	U	09:25	45
14/01/2022	AK	2	BH	1	Ad	U	09:27	15
14/01/2022	AK	3	BH	2	Ad	U	09:37	45
14/01/2022	AK	4	BH	4	Ad	U	09:43	20
14/01/2022	AK	5	BH	2	Ad	U	09:45	5
14/01/2022	AK	6	PE	1	U	U	10:16	60
14/01/2022	AK	7	BH	24	U	U	10:22	5
14/01/2022	AK	8	CU	36	U	U	10:30	45
14/01/2022	AK	9	L.	27	U	U	10:30	45
14/01/2022	AK	10	BH	150	U	U	10:30	45
14/01/2022	AK	11	BH	12	U	U	10:34	105
27/01/2022	SC	1	BH	36	Ad	U	14:38	60
27/01/2022	SC	2	BH	30	Ad	U	15:04	90
27/01/2022	SC	3	BH	50	Ad	U	15:44	90
27/01/2022	SC	4	CU	11	Ad	U	15:37	240
27/01/2022	SC	5	T.	2	Ad	F	16:11	75
27/01/2022	SC	6	CU	11	Ad	U	16:12	90
27/01/2022	SC	7	CU	15	Ad	U	17:25	135
11/02/2022	AK	12	BH	3	U	U	11:00	10
11/02/2022	AK	13	WN	4	U	U	12:13	80
11/02/2022	AK	1	BH	16	U	U	11:20	10
11/02/2022	AK	2	BH	11	U	U	11:35	30
11/02/2022	AK	3	BH	18	U	U	11:57	45
11/02/2022	AK	4	WN	43	U	U	12:06	75
11/02/2022	AK	4	MA	6	U	U	12:06	75
11/02/2022	AK	4	SV	2	U	U	12:06	75

Date	Surveyor	Flight ID	Species	Num. Birds	Age	Sex	Obs. Time	Flight time (s)
11/02/2022	AK	5	BH	13	U	U	12:23	30
11/02/2022	AK	6	BH	9	U	U	12:36	45
11/02/2022	AK	7	BH	17	U	U	12:57	45
11/02/2022	AK	8	BH	11	U	U	13:16	75
11/02/2022	AK	9	BH	36	U	U	13:21	15
11/02/2022	AK	10	BH	23	U	U	13:37	105
24/02/2022	JD	1	CU	11	Ad	U	12:37	25
24/02/2022	JD	2	BH	5	Ad	U	12:40	5
24/02/2022	JD	3	CU	4	Ad	U	13:15	10
24/02/2022	JD	4	K.	1	Ad	M	14:00	120
24/02/2022	JD	5	BH	10	Ad	U	14:45	75
11/03/2022	AK	11	WN	18	U	U	13:43	10
11/03/2022	AK	12	CU	60+	U	U	13:57	60
11/03/2022	AK	1	WN	67	U	U	10:49	135
11/03/2022	AK	2	CU	1	Ad	U	10:51	60
11/03/2022	AK	3	CU	5	Ad	U	11:03	70
11/03/2022	AK	3	BH	32	U	U	11:03	70
11/03/2022	AK	4	CU	13	Ad	U	11:37	210
11/03/2022	AK	4	WN	116	U	U	11:37	240
11/03/2022	AK	4	MA	14	U	U	11:37	120
11/03/2022	AK	4	SV	7	U	U	11:37	120
11/03/2022	AK	4	BH	40	U	U	11:37	90
11/03/2022	AK	5	CU	18	Ad	U	11:40	135
11/03/2022	AK	6	BH	48	U	U	12:19	75
11/03/2022	AK	7	PE	1	Ad	U	13:08	105
24/03/2022	JD	2	BH	10	Ad	U	12:25	75
24/03/2022	JD	3	BH	7	Ad	U	13:19	60

Table AIII-6a
Primary target species recorded during flight activity surveys undertaken at southern cluster VP4

Date	Surveyor	Flight ID	Species	Num. Birds	M/F	Age	Obs. Time	Flight time (s)
20/10/2021	JD	1	PE	2	Ad, Ju	F, U	12:10	35
22/10/2021	JD	1	SN	1	Ad	U	13:30	30
04/01/2022	AK	1	BH	4	U	U	13:37	35
04/01/2022	AK	2	BH	12	U	U	13:41	55
04/01/2022	AK	3	BH	5	U	U	13:43	65
04/01/2022	AK	4	BH	1	U	U	14:10	60
04/01/2022	AK	5	BH	2	U	U	14:12	40
04/01/2022	AK	6	BH	7	U	U	14:31	25

Date	Surveyor	Flight ID	Species	Num. Birds	M/F	Age	Obs. Time	Flight time (s)
04/01/2022	AK	7	PE	1	U	U	14:34	35
04/01/2022	AK	8	K.	1	Ad	M	14:51	10
04/01/2022	AK	9	BH	17	Ad	U	15:00	130
04/01/2022	AK	10	BH	33	Ad	U	15:33	65
04/01/2022	AK	11	BH	13	Ad	U	15:41	60
14/01/2022	AK	1	BH	2	Ad	U	12:20	60
14/01/2022	AK	2	BH	5	Ad	U	13:01	120
14/01/2022	AK	3	BH	17	Ad	U	13:03	195
14/01/2022	AK	4	K.	1	Ad	M	13:15	30
14/01/2022	AK	5	K.	1	Ad	M	13:28	60
14/01/2022	AK	6	BH	1	Ad	U	13:33	60
14/01/2022	AK	7	BH	5	Ad	U	13:58	75
14/01/2022	AK	8	BH	22	Ad	U	14:00	90
14/01/2022	AK	9	BH	8	Ad	U	14:36	45
14/01/2022	AK	10	BH	22	Ad	U	14:49	45
27/01/2022	SC	1	WS	1	Ad	U	10:00	60
27/01/2022	SC	2	BH	1	Ad	U	10:06	45
27/01/2022	SC	3	BH	2	Ad	U	10:11	75
27/01/2022	SC	4	BH	25	Ad	U	10:24	60
11/02/2022	AK	1	WS	13	U	U	07:46	90
11/02/2022	AK	2	BH	34	U	U	07:46	45
11/02/2022	AK	3	BH	47	U	U	07:48	60
11/02/2022	AK	4	BH	11	U	U	08:01	60
11/02/2022	AK	5	BH	19	U	U	08:03	75
11/02/2022	AK	6	BH	8	U	U	08:08	45
11/02/2022	AK	7	BH	1	U	U	08:09	45
11/02/2022	AK	8	BH	4	Ad	U	08:22	30
11/02/2022	AK	9	BH	15	Ad	U	08:23	15
11/02/2022	AK	10	BH	8	U	U	08:46	95
11/02/2022	AK	11	BH	5	Ad	U	08:50	45
11/02/2022	AK	12	BH	26	U	U	09:03	15
11/02/2022	AK	13	BH	17	U	U	09:12	135
11/02/2022	AK	14	BH	11	U	U	09:35	60
11/02/2022	AK	15	PE	1	Ad	U	10:00	75
11/02/2022	AK	16	BH	70	U	U	10:20	180
11/02/2022	AK	17	K.	1	Ad	F	10:25	15
24/02/2022	JD	1	SN	1	Ad	U	15:45	20
11/03/2022	AK	1	BH	21	Ad	U	07:16	60
11/03/2022	AK	2	WS	13	U	U	07:28	25

Date	Surveyor	Flight ID	Species	Num. Birds	M/F	Age	Obs. Time	Flight time (s)
11/03/2022	AK	3	WS	2	U	U	07:34	10
11/03/2022	AK	4	WS	7	U	U	07:37	12
11/03/2022	AK	5	BH	170	U	U	07:43	130
11/03/2022	AK	6	BH	92	U	U	07:49	60
11/03/2022	AK	7	BH	22	U	U	08:45	45
11/03/2022	AK	8	BH	23	U	U	08:47	30
11/03/2022	AK	9	BH	7	Ad	U	08:57	25
11/03/2022	AK	10	BH	12	U	U	08:58	45
11/03/2022	AK	11	BH	45	U	U	09:07	52
11/03/2022	AK	12	BH	9	Ad	U	09:11	30
11/03/2022	AK	13	BH	1	Ad	U	09:29	25
11/03/2022	AK	14	BH	1	Ad	U	09:47	20
24/03/2022	JD	1	BH	2	Ad	U	09:17	16
24/03/2022	JD	2	BH	1	Ad	U	10:17	45

Secondary Target Species

Table AIII-1b
Secondary target species recorded during flight activity surveys undertaken at northern cluster VP1

Date	Survey Start	Survey End	Species	Count	5 min period
07/10/2021	09:15	12:15	LB	1	09:45
07/10/2021	09:15	12:15	CM	1	10:05
07/10/2021	09:15	12:15	RN	1	10:10
08/10/2021	07:30	10:30	CA	1	10:25
03/11/2021	14:00	17:00	RN	2	16:20
04/11/2021	10:30	13:30	RN	1	11:10
04/11/2021	10:30	13:30	BZ	2	11:40
04/11/2021	10:30	13:30	BZ	2	12:10
02/12/2021	13:00	15:30	RN	2	13:00
02/12/2021	13:00	15:30	RN	2	13:10
02/12/2021	13:00	15:30	RN	1	13:20
02/12/2021	13:00	15:30	RN	1	13:25
02/12/2021	13:00	15:30	RN	4	13:30
02/12/2021	13:00	15:30	RN	4	13:40
02/12/2021	13:00	15:30	RN	3	14:15
02/12/2021	13:00	15:30	RN	2	15:10
02/12/2021	13:00	15:30	RN	1	15:25
03/12/2021	11:40	15:10	RN	1	12:00
03/12/2021	11:40	15:10	RN	2	12:15
03/12/2021	11:40	15:10	RN	1	12:25
03/12/2021	11:40	15:10	RN	4	12:30
03/12/2021	11:40	15:10	RN	3	12:35
03/12/2021	11:40	15:10	RN	1	12:40
03/12/2021	11:40	15:10	RN	1	12:50
03/12/2021	11:40	15:10	RN	1	13:00
03/12/2021	11:40	15:10	RN	4	13:10
03/12/2021	11:40	15:10	RN	1	13:50
03/12/2021	11:40	15:10	BZ	1	13:50
03/12/2021	11:40	15:10	RN	5	13:55
03/12/2021	11:40	15:10	RN	3	14:10
03/12/2021	11:40	15:10	RN	1	14:15
03/12/2021	11:40	15:10	RN	2	14:35

Date	Survey Start	Survey End	Species	Count	5 min period
03/12/2021	11:40	15:10	BZ	1	14:45
03/12/2021	11:40	15:10	RN	3	14:45
13/01/2022	10:30	13:30	RN	2	11:30
13/01/2022	10:30	13:30	CA	2	11:55
13/01/2022	10:30	13:30	H.	1	12:50
13/01/2022	10:30	13:30	RN	4	13:15
09/02/2022	12:30	15:30	CM	1	13:00
09/02/2022	12:30	15:30	RN	1	13:55
09/02/2022	12:30	15:30	BZ	1	14:05
10/02/2022	11:00	14:00	RN	1	11:45
10/02/2022	11:00	14:00	BZ	1	11:55
10/02/2022	11:00	14:00	RN	3	12:05
10/02/2022	11:00	14:00	BZ	1	13:45
08/03/2022	15:45	18:45	BZ	1	16:40
10/03/2022	12:05	15:05	BZ	1	12:25
10/03/2022	12:05	15:05	LB	3	12:35
10/03/2022	12:05	15:05	RN	2	12:35
10/03/2022	12:05	15:05	RN	1	13:05
10/03/2022	12:05	15:05	RN	2	13:50
10/03/2022	12:05	15:05	BZ	1	13:55
10/03/2022	12:05	15:05	LB	3	14:00
10/03/2022	12:05	15:05	RN	6	14:05
10/03/2022	12:05	15:05	LB	1	14:05
10/03/2022	12:05	15:05	LB	3	14:20
10/03/2022	12:05	15:05	LB	1	14:35
10/03/2022	12:05	15:05	LB	1	14:40
10/03/2022	12:05	15:05	RN	1	14:40
10/03/2022	12:05	15:05	LB	15	14:45

Table AIII-2
Secondary target species recorded during flight activity surveys undertaken at northern cluster VP2

Date	Survey Start	Survey End	Species	Count	5 min period
06/10/2021	12:10	15:10	CM	1	12:20
06/10/2021	12:10	15:10	CM	1	12:25
06/10/2021	12:10	15:10	CM	1	12:40
06/10/2021	12:10	15:10	CM	1	13:15
06/10/2021	12:10	15:10	CM	3	14:05
06/10/2021	12:10	15:10	LB	1	14:35
07/10/2021	15:45	18:45	CM	1	15:55
07/10/2021	15:45	18:45	LB	21	16:20
07/10/2021	15:45	18:45	CM	1	16:30
07/10/2021	15:45	18:45	LB	2	17:15
07/10/2021	15:45	18:45	CM	2	17:50
07/10/2021	15:45	18:45	CM	3	18:15
03/11/2021	10:30	13:30	LB	1	10:30
03/11/2021	10:30	13:30	H.	1	10:35
03/11/2021	10:30	13:30	BH	1	12:05
04/11/2021	14:00	17:00	CM	5	14:00
04/11/2021	14:00	17:00	H.	1	14:05
03/12/2021	08:10	11:10	RN	1	09:30
03/12/2021	08:10	11:10	RN	2	10:40
05/01/2022	13:40	16:40	RN	2	14:00
05/01/2022	13:40	16:40	RN	3	14:05
05/01/2022	13:40	16:40	BZ	1	14:10
05/01/2022	13:40	16:40	RN	2	14:10
05/01/2022	13:40	16:40	RN	2	14:15
05/01/2022	13:40	16:40	RN	1	14:15
05/01/2022	13:40	16:40	BZ	1	14:15
05/01/2022	13:40	16:40	BZ	1	14:20
05/01/2022	13:40	16:40	BZ	1	14:25
05/01/2022	13:40	16:40	RN	1	14:25
05/01/2022	13:40	16:40	LB	1	15:35
05/01/2022	13:40	16:40	BZ	1	15:55
05/01/2022	13:40	16:40	RN	4	16:15
13/01/2022	14:00	17:00	RN	1	14:40
09/02/2022	09:00	12:00	RN	2	08:55

Date	Survey Start	Survey End	Species	Count	5 min period
09/02/2022	09:00	12:00	RN	2	10:35
09/02/2022	09:00	12:00	RN	2	10:55
09/02/2022	09:00	12:00	RN	2	11:15
09/02/2022	09:00	12:00	BZ	2	11:40
09/02/2022	09:00	12:00	BZ	1	11:45
10/02/2022	14:30	17:30	BZ	1	14:55
08/03/2022	12:30	15:30	BZ	1	13:35
08/03/2022	12:30	15:30	BZ	1	13:40
08/03/2022	12:30	15:30	BZ	1	13:45
08/03/2022	12:30	15:30	BZ	3	14:20
08/03/2022	12:30	15:30	LB	34	14:35
08/03/2022	12:30	15:30	LB	1	14:50
08/03/2022	12:30	15:30	CM	1	15:10
08/03/2022	12:30	15:30	GJ	2	14:25
10/03/2022	15:35	18:35	BZ	1	15:55
10/03/2022	15:35	18:35	LB	1	16:05
10/03/2022	15:35	18:35	LB	1	16:15
10/03/2022	15:35	18:35	RN	1	16:30
10/03/2022	15:35	18:35	LB	1	16:40
10/03/2022	15:35	18:35	RN	1	16:45
10/03/2022	15:35	18:35	LB	2	17:30

Table AIII-3b
Secondary target species recorded during flight activity surveys undertaken at southern cluster VP1

Date	Survey Start	Survey End	Species	Count	5 min period
05/10/2021	14:30	16:00	RN	1	14:42
03/11/2021	10:10	13:10	SH	1	12:12
02/11/2021	10:10	13:10	BZ	2	12:45
03/11/2021	10:10	13:10	BZ	3	13:39
21/10/2021	09:10	12:10	BZ	1	09:20
19/11/2021	07:55	10:55	BZ	1	08:20
01/12/2021	11:15	14:15	RN	1	11:41
11/01/2022	11:20	14:20	H.	1	11:59
11/01/2022	11:20	14:20	BZ	1	12:22
11/01/2022	11:20	14:20	RN	4	12:22
11/01/2022	11:20	14:20	BZ	2	12:33
11/01/2022	11:20	14:20	BZ	2	12:51
11/01/2022	11:20	14:20	RN	1	13:06
11/01/2022	11:20	14:20	RN	1	13:30
09/02/2022	12:20	15:20	RN	1	12:40
09/02/2022	12:20	15:20	RN	1	13:20
25/02/2022	12:00	15:00	BZ	1	12:00
25/02/2022	12:00	15:00	BZ	1	13:10
09/03/2022	13:15	16:15	RN	4	13:58
09/03/2022	13:15	16:15	RN	1	14:17
09/03/2022	13:15	16:15	RN	1	14:23
23/03/2022	10:30	13:30	LB	2	11:25
23/03/2022	10:30	13:30	BZ	1	11:40

Table AIII-4b
Secondary target species recorded during flight activity surveys undertaken at southern cluster VP2

Date	Survey Start	Survey End	Species	Count	5 min period
05/10/2021	10:30	13:30	RN	3	10:44
05/10/2021	10:30	13:30	BZ	3	10:59
05/10/2021	10:30	13:30	RN	3	10:59
05/10/2021	10:30	13:30	RN	10	11:32
05/10/2021	10:30	13:30	BZ	10	11:32
05/10/2021	10:30	13:30	RN	6	11:37
05/10/2021	10:30	13:30	RN	6	11:46
05/10/2021	10:30	13:30	BZ	10	11:46
05/10/2021	10:30	13:30	H.	10	11:52
05/10/2021	10:30	13:30	RN	6	12:06
05/10/2021	10:30	13:30	RN	3	12:12
05/10/2021	10:30	13:30	BZ	3	12:40
05/10/2021	10:30	13:30	RN	3	13:01
05/10/2021	10:30	13:30	H.	1	13:01
06/10/2021	12:40	15:40	RN	2	14:20
06/10/2021	12:40	15:40	RN	1	15:30
17/11/2021	13:30	16:30	RN	1	13:30
17/11/2021	13:30	16:30	RN	4	14:05
17/11/2021	13:30	16:30	BZ	1	15:25
17/11/2021	13:30	16:30	RN	2	15:25
02/12/2021	11:45	14:45	BZ	1	11:50
02/12/2021	11:45	14:45	RN	1	11:50
02/12/2021	11:45	14:45	RN	1	12:03
02/12/2021	11:45	14:45	RN	1	13:01
02/12/2021	11:45	14:45	RN	1	13:32
02/12/2021	11:45	14:45	RN	1	14:33
15/12/2021	08:40	11:40	BZ	1	08:45
15/12/2021	08:40	11:40	H.	1	11:20
15/12/2021	08:40	11:40	SH	1	11:20
05/01/2022	10:00	13:00	RN	2	10:00
05/01/2022	10:00	13:00	RN	2	10:05
05/01/2022	10:00	13:00	RN	1	10:45
05/01/2022	10:00	13:00	RN	2	10:50
05/01/2022	10:00	13:00	RN	1	10:50

Date	Survey Start	Survey End	Species	Count	5 min period
05/01/2022	10:00	13:00	BZ	2	11:05
05/01/2022	10:00	13:00	RN	1	11:05
05/01/2022	10:00	13:00	BZ	1	11:10
05/01/2022	10:00	13:00	RN	1	11:20
05/01/2022	10:00	13:00	BZ	1	11:25
05/01/2022	10:00	13:00	RN	1	11:25
05/01/2022	10:00	13:00	RN	1	11:30
05/01/2022	10:00	13:00	BZ	1	11:40
05/01/2022	10:00	13:00	BZ	1	11:50
05/01/2022	10:00	13:00	RN	5	11:55
05/01/2022	10:00	13:00	CA	1	11:55
05/01/2022	10:00	13:00	RN	2	11:55
05/01/2022	10:00	13:00	RN	3	12:00
05/01/2022	10:00	13:00	BZ	1	12:10
11/01/2022	08:30	11:30	RN	1	09:00
11/01/2022	08:30	11:30	BZ	1	09:05
11/01/2022	08:30	11:30	RN	1	09:40
11/01/2022	08:30	11:30	RN	1	10:05
11/01/2022	08:30	11:30	RN	2	10:25
11/01/2022	08:30	11:30	RN	1	10:25
12/01/2022	11:05	14:05	BZ	2	13:23
12/01/2022	11:05	14:05	RN	1	13:23
12/01/2022	11:05	14:05	RN	1	14:08
27/01/2022	10:30	13:30	BZ	1	11:25
10/02/2022	11:00	14:00	RN	2	11:49
10/02/2022	11:00	14:00	RN	2	11:55
10/02/2022	11:00	14:00	RN	2	12:20
10/02/2022	11:00	14:00	RN	1	12:34
10/02/2022	11:00	14:00	BZ	3	13:01
10/02/2022	11:00	14:00	CM	2	11:47
23/02/2022	15:00	18:00	RN	4	15:05
23/02/2022	15:00	18:00	RN	2	16:00
23/02/2022	15:00	18:00	RN	4	16:15
23/02/2022	15:00	18:00	RN	4	16:55
23/02/2022	15:00	18:00	RN	1	17:20

Date	Survey Start	Survey End	Species	Count	5 min period
23/02/2022	15:00	18:00	H.	1	17:30
23/02/2022	15:00	18:00	RN	5	17:55
10/03/2022	10:30	13:30	BZ	1	10:30
10/03/2022	10:30	13:30	BZ	2	11:28
10/03/2022	10:30	13:30	RN	2	11:28
23/03/2022	06:45	09:45	1	1	07:35
23/03/2022	06:45	09:45	1	1	09:00
23/03/2022	06:45	09:45	5	5	09:10
23/03/2022	06:45	09:45	2	2	09:20
23/03/2022	06:45	09:45	5	5	09:40

Table AIII-5b
Secondary target species recorded during flight activity surveys undertaken at southern cluster VP3

Date	Survey Start	Survey End	Species	Count	5 min period
05/11/2021	08:30	11:30	RN	1	10:30
05/11/2021	08:30	11:30	RN	1	11:05
20/10/2021	15:25	18:25	RN	1	15:50
20/10/2021	15:25	18:25	LB	1	15:50
20/10/2021	15:25	18:25	LB	1	16:55
20/10/2021	15:25	18:25	RN	1	17:35
20/10/2021	15:25	18:25	CA	1	18:00
20/10/2021	15:25	18:25	RN	2	18:00
22/10/2021	08:00	11:00	RN	1	08:30
22/10/2021	08:00	11:00	RN	2	08:40
22/10/2021	08:00	11:00	RN	3	08:45
22/10/2021	08:00	11:00	RN	2	09:15
22/10/2021	08:00	11:00	RN	2	09:30
22/10/2021	08:00	11:00	RN	2	10:20
18/11/2021	07:55	10:55	RN	1	08:10
18/11/2021	07:55	10:55	RN	1	08:15
18/11/2021	07:55	10:55	RN	1	08:35
18/11/2021	07:55	10:55	RN	3	08:45
18/11/2021	07:55	10:55	RN	2	09:00
18/11/2021	07:55	10:55	RN	1	09:30
18/11/2021	07:55	10:55	RN	5	09:40
18/11/2021	07:55	10:55	SH	1	10:00

Date	Survey Start	Survey End	Species	Count	5 min period
18/11/2021	07:55	10:55	RN	1	10:00
18/11/2021	07:55	10:55	RN	6	10:50
14/12/2021	10:00	13:00	BZ	1	10:30
14/12/2021	10:00	13:00	SH	2	10:30
14/12/2021	10:00	13:00	RN	3	10:30
14/12/2021	10:00	13:00	BZ	1	10:45
14/12/2021	10:00	13:00	SH	1	11:15
14/12/2021	10:00	13:00	RN	3	11:20
14/12/2021	10:00	13:00	H.	1	11:50
04/01/2022	10:00	13:00	RN	2	10:15
04/01/2022	10:00	13:00	RN	1	10:25
04/01/2022	10:00	13:00	RN	1	10:55
04/01/2022	10:00	13:00	BZ	1	10:55
04/01/2022	10:00	13:00	RN	1	12:05
14/01/2022	08:30	11:30	RN	3	09:40
14/01/2022	08:30	11:30	RN	1	10:00
14/01/2022	08:30	11:30	SH	1	11:15
27/01/2022	14:30	17:30	L.	25	
27/01/2022	14:30	17:30	CO	7	
11/02/2022	11:15	14:15	RN	2	11:35
11/02/2022	11:15	14:15	RN	2	11:50
11/02/2022	11:15	14:15	BZ	1	12:20
11/02/2022	11:15	14:15	BZ	1	12:25
11/02/2022	11:15	14:15	SH	1	12:40
11/02/2022	11:15	14:15	SH	1	12:55
11/02/2022	11:15	14:15	BZ	1	13:25
11/02/2022	11:15	14:15	RN	2	13:40
11/02/2022	11:15	14:15	BZ	3	14:00
11/02/2022	11:15	14:15	BZ	3	14:05
24/02/2022	12:00	15:00	RN	2	12:05
24/02/2022	12:00	15:00	MS	2	12:20
24/03/2022	12:20	15:20	RN	4	13:00
24/03/2022	12:20	15:20	LB	1	14:05
24/03/2022	12:20	15:20	LB	2	14:15
24/03/2022	12:20	15:20	LB	1	14:20

Table AIII-6b
Secondary target species recorded during flight activity surveys undertaken at southern cluster VP4

Date	Survey Start	Survey End	Species	Count	5 min period
20/10/2021	11:55	14:55	RN	1	12:00
20/10/2021	11:55	14:55	BZ	1	12:40
20/10/2021	11:55	14:55	RN	3	13:15
22/10/2021	11:30	14:30	RN	1	12:10
22/10/2021	11:30	14:30	RN	1	12:45
22/10/2021	11:30	14:30	BZ	1	14:00
18/11/2021	11:25	14:25	RN	3	11:35
18/11/2021	11:25	14:25	RN	1	13:15
14/12/2021	13:30	16:30	RN	2	13:40
04/01/2022	13:30	16:30	RN	2	14:25
04/01/2022	13:30	16:30	RN	4	14:40
04/01/2022	13:30	16:30	RN	1	14:45
04/01/2022	13:30	16:30	RN	1	14:55
11/02/2022	07:45	10:45	RN	2	09:45
11/02/2022	07:45	10:45	RN	1	10:35
11/03/2022	06:50	09:50	LB	1	07:20
11/03/2022	06:50	09:50	CM	2	07:20
11/03/2022	06:50	09:50	CM	1	07:25
11/03/2022	06:50	09:50	RN	1	07:25
11/03/2022	06:50	09:50	LB	2	07:35
11/03/2022	06:50	09:50	CM	3	07:40
11/03/2022	06:50	09:50	CM	1	07:50
11/03/2022	06:50	09:50	RN	2	07:55
11/03/2022	06:50	09:50	RN	2	08:00
11/03/2022	06:50	09:50	LB	1	08:00
11/03/2022	06:50	09:50	LB	1	08:15
11/03/2022	06:50	09:50	RN	1	08:20
11/03/2022	06:50	09:50	CM	1	08:30
24/03/2022	08:50	11:50	RN	2	09:50
24/03/2022	08:50	11:50	RN	1	09:55
24/03/2022	08:50	11:50	RN	4	10:10
24/03/2022	08:50	11:50	SH	1	11:10

APPENDIX 04

Legal and Conservation Status of Target Species Recorded

Table AIV 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 AIV
Legal and Conservation Status of Target Species

Primary or Secondary Target	Species (BTO code)	Legal and Conservation status in Ireland
Primary	European golden plover (GP)	Annex 1, BoCCI4 Red
	Northern lapwing (L.)	BoCCI4 Red
	Common snipe (SN)	BoCCI4 Red
	Common kestrel (K.)	BoCCI4 Red
	Merlin (ML)	Annex 1, BoCCI4 Amber
	Whooper swan (WS)	Annex 1, BoCCI4 Amber
	Peregrine falcon (PE)	Annex 1, BoCCI4 Green
	Black-headed gull (BH)	BoCCI4 Amber
	Eurasian curlew (CU)	BoCCI4 Red
	Mallard (MA)	BoCCI4 Amber
	Eurasian wigeon (WN)	BoCCI4 Amber
	Northern shoveler (SV)	BoCCI4 Red
	Eurasian teal (T.)	BoCCI4 Amber
Secondary	Common buzzard (BZ)	BoCCI4 Green
	Northern raven (RN)	BoCCI4 Green
	Common gull (CM)	BoCCI4 Amber
	Grey heron (H.)	BoCCI4 Green
	Lesser black-backed gull (LB)	BoCCI4 Amber
	Greylag goose (non-domestic) (GJ)	BoCCI4 Amber

Primary or Secondary Target	Species (BTO code)	Legal and Conservation status in Ireland
	Eurasian coot (CO)	BoCCI4 Amber
	Eurasian sparrowhawk (SH)	BoCCI4 Green
	Mute swan (MS)	BoCCI4 Amber
	Great cormorant (CA)	BoCCI4 Amber
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 status category (Gilbert *et al.*, 2021).

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Seven Hills Wind Farm (ABP-313750-22)

APPENDIX 3

NOCTURNAL GOLDEN PLOVER SURVEY REPORT, WINTER 2022-2023

NOCTURNAL GOLDEN PLOVER SURVEY REPORT, WINTER 2022-23

Seven Hills Wind Farm

Prepared for: Seven Hills Wind Farm Ltd

SLR Ref: 501.064824.00001
Version No: Issue01
March 2023

BASIS OF REPORT

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APPENDICES

1.0 Introduction

SLR Consulting Ireland Ltd (SLR) was commissioned by Seven Hills Wind Farm Ltd in November 2022 to carry out nocturnal European golden plover *Pluvialis apricaria* surveys for the proposed Seven Hills Wind Farm, Co. Roscommon ('the Project) during the non-breeding period 2022/23. There are two proposed turbine clusters within the wind farm design, hereafter referred to as the 'northern and southern cluster' and collectively referred to as 'the Project Site'.

1.1 Background

Planning permission was originally granted by An Bord Pleanála (ABP) for both clusters (Phase 1 ABP Planning Ref: PL 20.244346 / 20.239759 and Phase 2 ABP Planning Ref: PL 20.244347 / 20.241069) but was subsequently refused following the appeal process. The main reasons for refusal of planning cited by ABP were issues relating to the lack of certainty in relation to the impact of the Project on European Sites in the vicinity of the Project Site and the qualifying interests for which those European Sites are designated.

Subsequently, SLR carried out three years of breeding and non-breeding season surveys between October 2018 to September 2021. These surveys were used to inform a planning application (including an Environmental Impact Assessment Report or 'EIAR'[1] and Natura Impact Statement or 'NIS'[2]), which was submitted to ABP in June 2022. Further non-breeding season surveys were also carried out during the winter period 2021/22[3].

Nocturnal surveys for European golden plover were carried out in the non-breeding season in 2020 (SLR, 2021)[4] and the results were used to inform the EIAR and NIS; however, they were constrained by health and safety concerns and other significant limitations associated with undertaking such surveys at night, notably the availability of suitable technology at the time. The results that were obtained did not indicate significant usage of the Project Site by European golden plover.

Following the planning application, ABP received several ornithology-related submissions from the Development Applications Unit (DAU) and other third parties in August 2022, two of which related to nocturnal European golden plover surveys. The DAU response suggested that the limitations to the 2020 nocturnal surveys for golden plover could affect the validity of the assessment because research has shown that diurnal surveys do not necessarily predict nocturnal patterns for European golden plover and northern lapwing *Vanellus vanellus*. Another third-party response suggested that without nocturnal surveys for golden plover there cannot be certainty regarding the assessment of no significant effect on nearby SPA European golden plover populations. In response to these comments and following substantial technological advances since the time of the original surveys in 2020, further nocturnal surveys were carried out during the non-breeding season 2022/23.

1.2 Project Site Description

The dominant habitat within the boundaries of the northern cluster is improved agricultural grassland. The southern cluster is in a slightly more diverse area with dominant habitats including improved agricultural grassland, dry calcareous grassland, and scrub.

The Project Site does not hold any designations for nature conservation, although there are several conservation designations within the surrounding area. These include five European sites designated for non-breeding European golden plover: Lough Croan Turlough SPA 004139 (1.5 km north), River Suck Callows SPA 004097 (1.7

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[1] MKO. 2022. Volume 1 – Environmental Impact Assessment Report. Proposed Seven Hills Wind Farm, Co. Roscommon.
[2] MKO. 2022. Natura Impact Statement. Proposed Seven Hills Wind Farm, Co. Roscommon.
[3] SLR Consulting. 2022. Seven Hills Wind Farm Bird Survey Report Winter 2021-22.
[4] SLR Consulting. 2021. Seven Hills Wind Farm Bird Survey Report Winter 2019-20.

km west), Four Roads Turlough SPA 004140 (1.9 km north), Lough Ree SPA 004064 (8 km east) and Middle Shannon Callows SPA 004096 (11.4 km southeast).

1.3 Scope of Work

The scope of survey work was based on existing knowledge of the area and considered current NatureScot (NS) (formerly Scottish Natural Heritage; SNH) 2017 guidance[5]. This 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[5] 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).*"

1.4 Target Species

The primary targets of surveys were European golden plover, although northern lapwing, which utilises similar habitats to European golden plover, was also targeted and all other waterbird species detected were also recorded.

1.5 Purpose of the Report

This report outlines the surveys undertaken, methods used and survey data obtained.

The assessment of impacts resulting from the Project is beyond the scope of this report. However, this report will be used to inform responses to submissions received from the DAU and other third parties pertaining to European golden plover surveys and associated impact assessment.

[5] Scottish Natural Heritage (2017) Recommended bird survey methods to inform impact assessment of onshore wind farms. Version 2. SNH Guidance. SNH, Battleby.

2.0 Methodology

2.1 Field Surveys

2.1.1 Field Survey Team: Evidence of Technical Competence and Experience

Jonathon Dunn (JD) – Project Manager

JD is a Senior Ecologist 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 (CIEEM). JD is a highly skilled and experienced bird surveyor with eight years' post graduate experience as a professional consultant ecologist. He has conducted bird surveys for many onshore wind farms in Ireland. JD 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 and writing this report.

Aisling Kinsella (AK) – Lead Bird Surveyor

AK is a Senior Field Ecologist who joined SLR in September 2020. AK holds a BSc in Biological, Earth and Environmental Sciences (Zoology) from University College Cork and an MSc in Wildlife Management and Conservation from University College Dublin. AK's main interest is in ornithology and has undertaken a wide range of bird surveys for onshore wind farm projects. AK acted as lead bird surveyor.

Faolán Linnane (FL) – Assistant Bird Surveyor

FL is a Senior Field Ecologist with SLR and has worked in consultancy since June 2021. FL holds a BSc in Environmental Science (Zoology) from University College Cork and an MSc in Marine Biology from University College Cork. FL has undertaken many bird surveys for onshore wind farm projects. FL acted as an assistant surveyor to AK.

Jake Matthews (JM) – Assistant Bird Surveyor

JM is a Project Ecologist with SLR and has worked in consultancy since 2018. He is a qualifying member of CIEEM. JM holds a BSc in Wildlife Conservation and Zoo Biology from University of Salford and an MSc in Ecology and Environmental Management from Liverpool Hope University. JM has undertaken many bird surveys for onshore wind farm projects. JM acted as an assistant surveyor to AK.

Hugo Brooks (HB) – Assistant Bird Surveyor

HB is a Graduate Ecologist with SLR since January 2023. He is a qualifying member of CIEEM. HB holds a BSc in Zoology from University College Dublin. HB is an experienced ornithologist. HB acted as an assistant surveyor to AK.

2.1.2 Nocturnal Golden Plover Survey Methods

Survey transects were identified within each wind farm cluster that were representative of potentially suitable winter habitats (see Gillings *et al*., 2007[6] for further details of winter habitat use) for European golden plover and northern lapwing (see **Figure 01**). Transects were focused on pastures and were located with views of both wetter areas (e.g. Gortaphuill Turlough in the northern cluster and Feacle Turlough in the southern cluster) and localised arable crop areas.

[6] 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 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 (see Appendix 01 for an example videograb from one of the thermal images recorded).

Each transect was walked at least once per month, from December 2022 to March 2023 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.

Five surveys were completed: one in December 2022, one in January 2023, two in February 2023 and one in March 2023.

Full details of survey dates, times and observers are provided in Appendix 02 and details of the weather conditions during surveys are provided in Appendix 03.

2.2 Survey Limitations

Access to all of the land within the EIAR boundary was not possible due to health and safety concerns, primarily relating to the presence of cattle, drystone walls and rocky terrain, which made accessing some areas unsafe in the dark.

Additionally, not all the habitats within the Project Site were suitable for European golden plover and northern lapwing. Within the northern cluster, c.30% of the area consisted of calcareous grassland with some areas of scrub and recolonising bare ground, which is unsuitable for European golden plover and northern lapwing. These areas were located in the centre and west of the northern cluster. Within the southern cluster, c.75% of the area consisted of calcareous grassland, with patches of scrub and limestone boulders (see Plate 1), unsuitable for the target species. The areas with most unsuitable habitats and cattle were located in the west of the southern cluster.

The transects sampled at least c.50% of potentially suitable foraging habitats within each turbine cluster (recognising that habitats c.350 m from the transect were also visible). Therefore, nocturnally foraging European golden plover and northern lapwing should have been detected if regularly present at either turbine cluster in any numbers.

Plate 1
Limestone boulders occurring within calcareous grassland habitats (taken from EIAR chapter[1]), which is unsuitable for European golden plover and northern lapwing

Surveys did not start until December 2022 due to delays in the delivery of the thermal monocular. An extra survey was undertaken in February 2023 to make up for the missed surveys in November 2022. Thus, five rounds of surveys were completed, which is considered representative of the winter 2022/23 season.

Overall, the limitations outlined above are not considered to have significantly affected the validity of the survey results obtained.

3.0 Results

3.1 Nocturnal Golden Plover Surveys

3.1.1 Northern Cluster

One mixed flock of 13 plovers was recorded on 9th February 2023 near Gortaphuill Turlough c. 220 m NE of turbine T4 (see **Figure 02**). Due to the distance of the birds from the surveyor and a lack of calls, it was not possible to distinguish between species with certainty for all birds but based on size and movements, both European golden plover and northern lapwing were identified to be present within the flock.

A small number of ducks (likely Eurasian wigeon *Mareca penelope* and Eurasian teal *Anas crecca*) were also recorded among the mixed plover flock on 9th February 2023.

No other plovers or waterbird species were recorded during any of the other four surveys.

3.1.2 Southern Cluster

No European golden plover or northern lapwing were recorded during surveys in the southern cluster. Northern lapwing and whooper swan *Cygnus cygnus* were heard calling from the direction of Feacle Turlough during the March surveys but none were recorded foraging within the Project Site.

No other waterbird species were recorded during any of the other four surveys.

4.0 Summary and Conclusions

Five nocturnal surveys for European golden plover, Northern lapwing and other waterbird species were carried out within a representative sample of potentially suitable habitats between December 2022 and March 2023 using a thermal imaging camera.

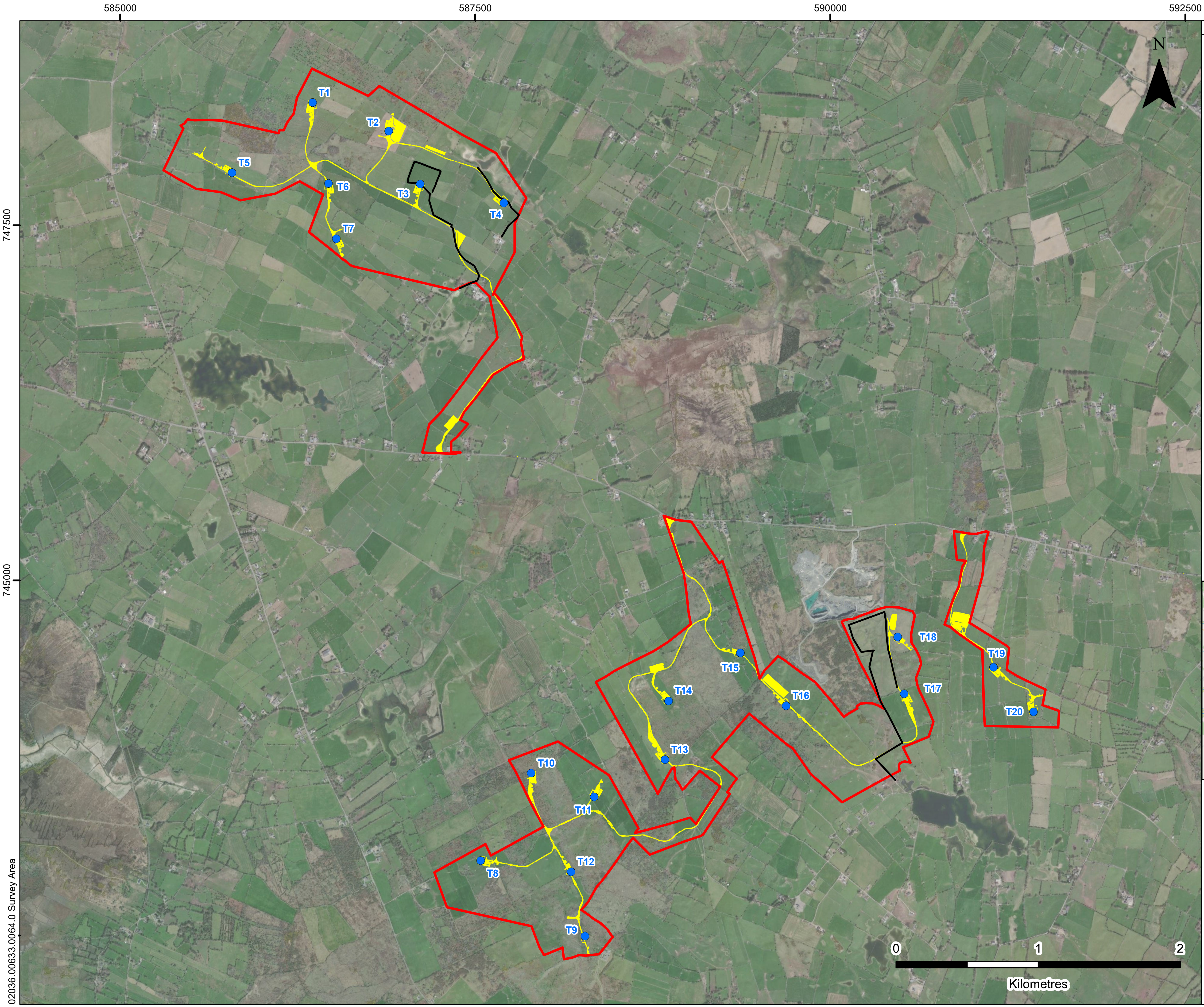
Only a single mixed flock of 13 birds was recorded, in February, c. 220 m NE of turbine T4 in the northern cluster. This flock consisted of both European golden plover and Northern lapwing.

No other observations of these or any other waterbird species were made at either turbine cluster during any of the other survey dates.

The results from the non-breeding 2022/23 surveys suggest that while there is some usage of the Project Site by European golden plover and Northern lapwing, the numbers involved are small and birds are present only occasionally and in the northern cluster.

The results of this survey tally with the results of the 2020 nocturnal European golden plover surveys and the low level of usage reported in the EIAR.

5.0 Figures



LEGEND

- EIAR Boundary
- Site Infrastructure
- Turbine Location
- Golden Plover Transect Route

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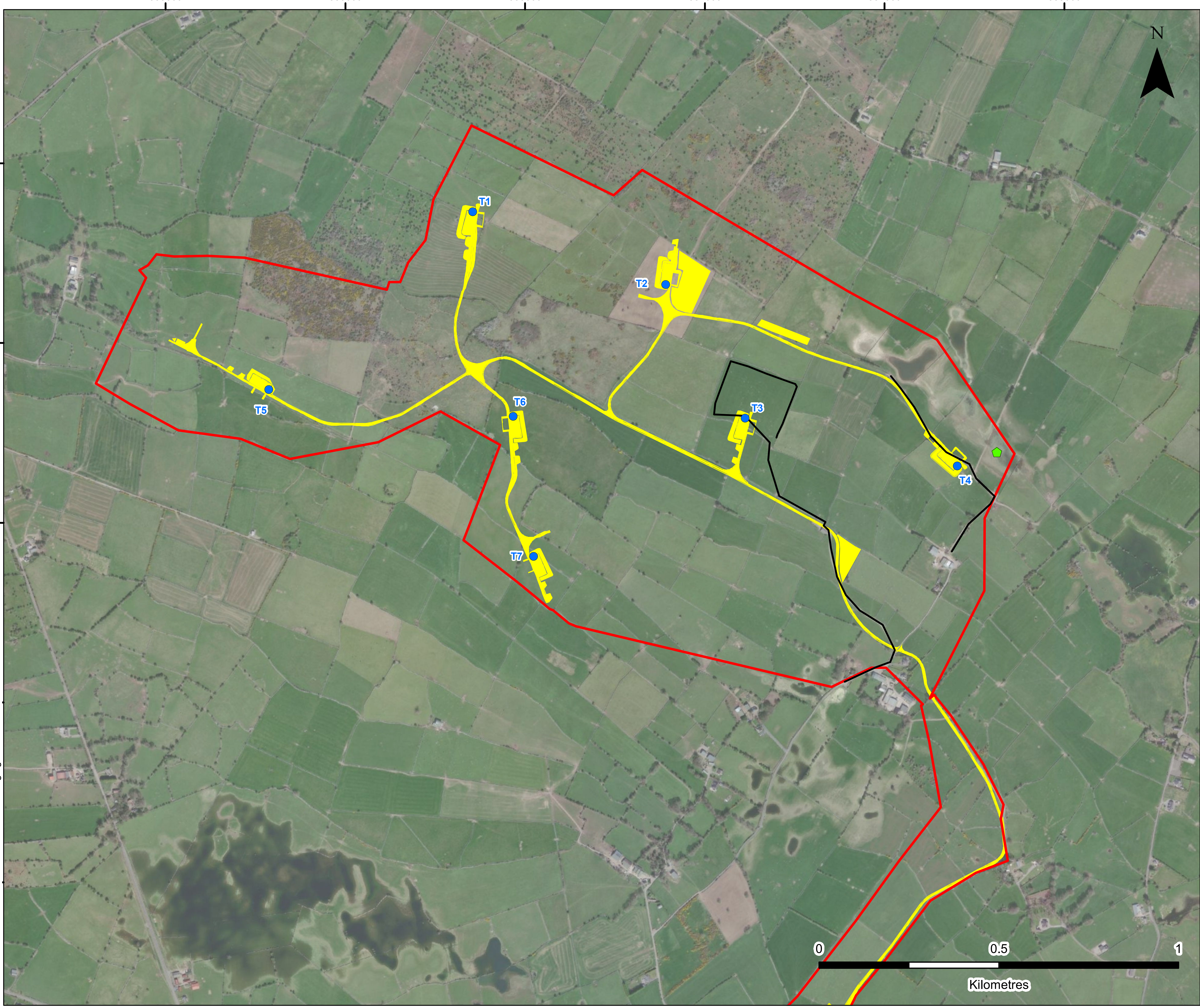
SEVEN HILLS WIND FARM

NOCTURNAL GOLDEN PLOVER SURVEY REPORT

SURVEY AREA

FIGURE 1

Scale	Date
1:25,000 @ A3	MARCH 2023



LEGEND

- EIAR Boundary
- Site Infrastructure
- Turbine Location
- Golden Plover Transect Route
- Mixed Golden Plover and Lapwing Flock

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NOCTURNAL GOLDEN PLOVER SURVEY REPORT

NOCTURNAL GOLDEN PLOVER SURVEY RESULTS

FIGURE 2

Scale 1:10,000 @ A3

Date MARCH 2023

02036.00633.0065.0 Nocturnal Golden Plover Foraging Area

APPENDIX 01

Thermal image example (videograb)

APPENDIX 02

Survey dates, times and observers

Table A2-1
Details of surveys undertaken from both turbine clusters

Turbine cluster	Date	Surveyor	Start	End	Survey Duration
South	06/12/2022	AK, FL	17:00	19:00	02:00
North	07/12/2022	AK, FL	17:05	18:05	01:00
North	24/01/2023	AK, JM	17:30	18:30	01:00
South	25/01/2023	AK, JM	17:45	18:45	01:00
North	09/02/2023	AK, JM	18:00	19:00	01:00
South	09/02/2023	AK, JM	19:30	20:15	00:45
South	14/02/2023	AK, FL	19:00	19:40	00:40
North	14/02/2023	AK, FL	20:10	21:10	01:00
North	02/03/2023	AK, HB	19:15	20:15	01:00
South	02/03/2023	AK, HB	20:30	21:10	00:40

APPENDIX 03

Weather data

Table A3-1
Weather data collected during nocturnal golden plover surveys at both clusters

Date	Start	End	Survey Hour	Wind Speed[7]	Wind Direction	Precipitation[8]	Cloud Cover[9]	Cloud Height[10]	Visibility[11]	Snow[12]	Frost[13]	Temperature (°C)
06/12/2022	17:00	19:00	1	2	N	0	4	2	0	0	0	4
06/12/2022	17:00	19:00	2	2	N	0	4	2	0	0	0	4
07/12/2022	17:05	18:05	1	1	N	0	6	2	0	0	0	1
24/01/2023	17:30	18:30	1	1	SW	1	8	0	0	0	0	7
25/01/2023	17:45	18:45	1	2	N	0	1	2	0	0	0	6
09/02/2023	18:00	19:00	1	2	W	0	5	2	0	0	0	6
09/02/2023	19:30	20:15	2	2	W	0	5	2	0	0	0	5
14/02/2023	19:00	21:10	1	1	SW	0	5	2	0	0	0	7
14/02/2023	19:00	21:20	2	1	SW	0	6	2	0	0	0	8
02/03/2023	19:15	21:10	1	1	NE	0	6	2	0	0	0	6

[7] Beaufort scale
[8] Key: 0 = none, 1 = drizzle, 2 = light shower/snow, 3 = heavy showers/snow, 4 = heavy rain/snow
[9] Expressed in oktas (n/8)
[10] Key: cloud height expressed above average height of viewshed 0 = <150 m, 1 = 150-500 m, 2 = >500 m
[11] Key: 0 = poor (< 1 km), 1 = moderate (1-3 km), 2 = good (>3 km)
[12] Key: 0 = none, 1 = on site, 2 = on higher ground
[13] Key: 0 = none, 1 = ground, 2 = all day

Date	Start	End	Survey Hour	Wind Speed[7]	Wind Direction	Precipitation[8]	Cloud Cover[9]	Cloud Height[10]	Visibility[11]	Snow[12]	Frost[13]	Temperature (°C)
02/03/2023	19:15	21:10	2	1	NE	0	6	2	0	0	0	6

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Seven Hills Wind Farm (ABP-313750-22)

APPENDIX 4

APPLICANT AND RCC CORRESPONDENCE REGARDING MAP CORRECTION

Comhairle Contae
Ros Comáin
Roscommon
County Council

Roscommon County
Development Plan
2022-2028

By E-MAIL

Ms Sara Tinsley,
Planning and Environmental Consents Manager,
Energia Renewables,
Mill House,
Ashtown Gate,
Navan Road,
Dublin,
D15 H70K

Date: 28th July 2022

Re: **Correction of map error – Map 7 (Areas Suitable for Wind Development) contained in the *Renewable Energy Strategy* which forms part of the *Roscommon County Development Plan 2022-2028***

Correction of minutes of Special Meeting of 8th March 2022 - Chief Executive's Recommendation No. 15

Dear Ms Tinsley,

Further to recent communications from Energia Renewables, including the documentation which you provided to Roscommon County Council via the Topsec Cloud Solutions FileXchange Service on 8th July 2022, the matters raised therein in respect of (a) the inclusion of an incorrect map in Figure 7 (Areas Suitable for Wind Development) of the electronic version of the adopted *Renewable Energy Strategy* as published on the dedicated *Roscommon County Development Plan* website (www.rosdevplan.ie) and (b) an omission in the minutes of the Special Council meeting of 8th March 2022 relating to Recommendation No. 15 of the *Chief Executive's Report on Submissions Received on the Proposed Material Alterations to the Draft Roscommon County Development Plan,* have been examined. Further to that examination, it is accepted that the map error identified had occurred and the decision of the elected members relating to Recommendation No. 15 was not recorded in the minutes of the meeting. The following actions (as outlined below) have been taken to address and rectify these matters.

Map Error

(a) The correct map has been inserted into the electronic version (page 40) of the *Renewable Energy Strategy*. In the interests of transparency and in order to provide clarity for any party that may have previously viewed the *Renewable Energy Strategy* content, the incorrect map and explanatory text advising of the map error will continue to be included in the on-line version of the document (on page 44). As the error was identified prior to the finalisation of the print order of the suite of County Development Plan documents, the printed publication will contain the correct map only;

(b) A letter has issued to all prescribed bodies advising of the on-line map error and its correction;

(c) The map error has been specifically highlighted in a letter accompanying Roscommon County Council's submission of a report to An Bord Pleanála in relation to the current application to the Board under Section 37E of the Planning and Development Act 2000 (as amended) for the proposed Seven Hills Wind Farm Development. It has been confirmed to the Board, in both the letter and in the Chief Executive's Report on the proposal, that the entirety of the lands on which the turbine clusters are proposed is identified in the *Renewable Energy Strategy* as 'Most Favoured' for wind energy development.

Minutes of the Special Meeting of 8th March 2022

(a) At the Council plenary meeting of the 25th July 2022, the Meetings Administrator brought the matter of the omission from the minutes of the aforementioned Special Meeting to the attention of the elected Members. The Meetings Administrator read into the record the proposed addition to the minutes (which had been omitted) pertaining to Members agreement on 8th March 2022 to accept Recommendation No. 15 of the *Chief Executive's Report on Submissions Received on the Proposed Material Alterations to the Draft Roscommon County Development Plan.* The Members agreed on the 25th July 2022 to amend the minutes of the Special Meeting, to accurately reflect the Members decision in respect of Recommendation No. 15.

    The minutes of the meeting of 25th July 2022 will not be formally approved until the next scheduled meeting of the Council on 26th September 2022. However, the minutes of the Special Meeting of the 8th March 2022 have been updated and are available to view at the following link – https://meetings.roscommoncoco.ie/documents/g2881/Printed%20minutes%2008th-Mar-2022%2010.15%20Special%20Meeting.pdf?T=1

On behalf of Roscommon County Council, I regret any inconvenience caused by the above matters and wish to assure you, as detailed above, that all necessary action has been taken to rectify them once identified.

Míse le meas,

Shane Tiernan

Shane Tiernan
Director of Services - Roads and Transportation, Active Travel,
Emergency Services, Building Control, Planning and Boyle MD Area Manager

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Figure 7: Areas Suitable for Wind Development