Natura Impact Statement

Bracklyn Wind Farm,
Co. Westmeath

Report produced by Woodrow Sustainable Solutions Ltd.

On behalf of Bracklyn Wind Farm Limited.

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September 2021

DOCUMENT CONTROL

Document	Natura Impact Statement – Bracklyn Wind Farm, Co. Westmeath
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Status / Version / Date	Final issue / V.01 / 29-Sep-2021

STATEMENT OF AUTHORITY

Woodrow Sustainable Solutions Ltd (Woodrow) is an established and accomplished environmental consultancy committed to delivering robust ecological assessment services for clients in the private and public sectors. Woodrow provides an in-house team of ecologists and environmental professionals whose primary specialisms include botany, habitats, birds, bats, mammals, invertebrates and aquatic ecology. Woodrow's investment in high-technology field equipment and software, and the development of our own field-data collection app (Eco-Log), ensures reliability and confidence in our work. Woodrow staff are fully conversant with wildlife legislation in both Ireland and the UK, and work to exacting standards, according to established guidelines issued by the Chartered Institute of Ecology and Environmental Management (CIEEM). All the ecological surveys were undertaken by appropriately experienced surveyors.

The information in this Natura Impact Statement (NIS) comprises tabular and graphic information based on the relevant desk-based information and is supported by ecological surveys undertaken at the proposed development site by Woodrow Sustainable Solutions Ltd. This NIS is informed by Chapter 7 (Water) of the Environmental Impact Assessment Report (EIAR) and prepared by Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) and David Broderick (BSc, H.Dip Env Eng, MSc) of Hydro-Environmental Services (HES).

This NIS was compiled by Mike Trewby and approved by Will Woodrow. Mike is a Senior Ecologist with Woodrow and is full member of CIEEM. He has 20 years fieldwork and research experience in the field of ecology, predominately working on the ornithological aspects of projects. He has worked as an ecological consultant since 2011 and regularly carries out ecological impact assessment and monitoring for a range of development projects.

Will is a Director at Woodrow Sustainable Solutions Ltd. He is an experienced ecologist with over 30 years of experience in ecological surveys and impact assessment. Will is a full member of the CIEEM and a Chartered Ecologist.

Will Woodrow – Qualifications:
HND - Conservation Management. Farnborough College of Technology, 1989.
M.Sc. - European Environmental Policy & Regulation. Lancaster University, 1994.
M.Sc. (Arch) - Advanced Environmental & Energy Studies. University of East London, 2006.

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CONTENTS

1 INTRODUCTION

1.1 Background

Woodrow Sustainable Solutions Ltd. (Woodrow) was engaged on behalf of the applicant – Bracklyn Wind Farm Ltd. – to prepare a Natura Impact Statement (NIS) for the proposed development of a wind farm at Bracklyn, Co. Westmeath, with associated infrastructure which crosses into Co Meath. The proposed development is for the construction, operation and decommissioning of a nine-turbine wind farm located within the townland of Bracklin, Co. Westmeath, with a grid connection route that crosses into Co. Meath through the townland of Coolronan.

The intention of this NIS is to determine, in view of best scientific knowledge, applying the precautionary principle, and in light of the conservation objectives of the relevant Natura 2000 sites, whether the proposed development, either alone or in combination with other plans or projects, may adversely affect the integrity of any Natura 2000 sites. Natura 2000 sites, also known as European Sites, are Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

The legal basis on which SACs are selected and designated is the EU Habitats Directive, transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011), as amended. SACs are designated for the protection of certain habitats and species under the Habitats Directive. Ireland is required under the terms of the EU Birds Directive (2009/147/EC) to designate SPAs for the protection of endangered species of wild birds. This includes certain listed rare and vulnerable species, regularly occurring migratory species, such as ducks, geese and waders, and wetlands, especially those of international importance, which attract large numbers of migratory birds each year.

This report provides information which can be used to assist the Competent Authority in applying Article 6(3) and 6(4) of the Habitats Directive[1] as necessary, under their roles, functions and responsibilities in relation to the Appropriate Assessment of plans or projects.

The legislative context of the requirement to undertake Appropriate Assessment (AA) and the AA process is outlined in the following sections.

1.2 Legislative context

1.2.1 Requirement for Appropriate Assessment Screening

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (*The Habitats Directive*) was transposed into Irish law by the European Communities (Natural Habitats) Regulations 1997, which was subsequential consolidated through the European Communities (Birds and Natural Habitats) Regulations 2011 (*The Habitats Regulations*) (as Amended 2013, 2015 & 2021).

1 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, as amended by Council Directive 97/62/EC. Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm [Accessed July 2019].

An Appropriate Assessment Screening provides the information necessary to fulfil the requirements of Article 6 of the EU Habitats Directive 1992 and Regulation 42 of the Habitats Regulations 2011 (as Amended) in determining the potential impacts on Natura 2000 Sites from the proposal. Regulation 42(1) of the of the Habitat Regulations requires that:

> *"A Screening for Appropriate Assessment of a plan or project for which an application for consent is received, or which a public authority wishes to undertake or adopt, and which is not directly connected with or necessary to the management of the Site as a Natura 2000 Site, shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the Site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the Natura 2000 Site".*

Case law[2] has required that measures which are *intended to avoid or reduce* the harmful effects of the proposed development on any relevant Natura 2000 site, i.e. specific mitigation, cannot be considered at the screening stage of the Appropriate Assessment process and where this arises, the plan or project must be assessed fully.

If, following the screening process, a likely significant effect is predicted or cannot be ruled out; under Regulation 42(6) of the Habitat Regulations, an Appropriate Assessment is required in order to determine the potential for impact on the integrity of a Natura 2000 site. In the event of a negative assessment in terms of an adverse effect on Site integrity, a proposal can only be consented in the absence of feasible alternatives and for 'Imperative Reasons of Overriding Public Interest' (IROPI). In such cases, compensatory measures to ensure the integrity of the Natura 2000 Site is maintained, are required. The Guidance document on Article 6(4) of the 'Habitats Directive' states that:

> *"any uncertainty over the precise nature and/or magnitude of the adverse effects should be thoroughly tested. Where appropriate, a precautionary approach should be adopted and the assessment of adverse effect based on a worse-case scenario."*[3]

1.2.2 Requirement for a Natura Impact Statement

The Appropriate Assessment test assesses whether, in view of the best scientific knowledge and applying the precautionary principle, and in light of the conservation objectives of the relevant Natura 2000 sites, the proposed project, either alone or in combination with other plans or projects, may adversely affect the integrity of any Natura 2000 sites.

If, following the screening process, a potential significant effect is predicted or cannot be ruled out, under Regulation 42(6) of the European Communities (Birds and Natural habitats) Regulations 2011 (as Amended) and part 177U (part XAB) of the Planning and Development Act 2000, an Appropriate Assessment is required in order to determine the potential for impact on integrity of Natura 2000 sites. The Screening for Appropriate Assessment, as detailed in **Section 4** of this report, determined that potential significant effects on Natura 2000 Sites could not be ruled out and therefore a Natura Impact Statement (NIS) is required.

2 People Over Wind and Peter Sweetman v Coillte Teoranta (C-323/17); and, Heather Hill Management Company clg v An Bord Pleanála [2019] IEHC 450.

3 European Commission (2007) Available at: http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf [Accessed July 2021].

1.3 The Appropriate Assessment (AA) Process

The sections, paragraphs and tables of this report relate in sequence to the process of assessing the potential impact of the proposed development in the context of the sequential requirements detailed under Article 6 of the EU Habitats Directive. As outlined in guidance provided by Department of Environment, Heritage and Local Government (DoEHLG, 2010)[4], the four-stage process of Appropriate Assessment has been followed, whereby the outcome at each successive stage determines whether a further stage in the process is required, including:

- Stage 1: Screening for Appropriate Assessment
- Stage 2: Appropriate Assessment – provision of Natura Impact Statement (NIS)
- Stage 3: Alternative Solutions
- Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

Stage 1: Screening for Appropriate Assessment (AA)

This process identifies, without consideration of mitigation measure, whether the proposed development is:

i) directly connected to or necessary for the management of a Natura 2000 site(s); and
ii) identifies whether the development is likely to have significant effects upon a Natura 2000 site(s) in view of a site's conservation objectives either alone or in combination with other projects or plans.

The outcome from this stage is a determination for each Natura 2000 site(s) of not significant, significant, potentially significant, or uncertain effects. The latter three determinations for a given Natura 2000 site triggers Stage 2 of the AA process.

Stage 2: Appropriate Assessment

This stage considers any adverse effects of the proposed development on the integrity of Natura 2000 sites, either alone or in combination with other projects or plans, with respect to a site's:

i) conservation objectives; and
ii) its structure and function.

Mitigation measures necessary to avoid, reduce or off negative effects are proposed and assessed at this stage.

The output from this stage is a Natura Impact Statement (NIS). This document must include sufficient information for the competent authority to carry out the appropriate assessment. If the assessment is negative, i.e. adverse effects on the integrity of a site cannot be excluded, then the process must consider alternatives (Stage 3) or proceed to Stage 4.

Stage 3: Alternative Solutions

This stage examines alternative ways of achieving the objectives of the project that avoid adverse effects on the integrity of a Natura 2000 site. This assessment may be carried out

4 Department of Environment, Heritage and Local Government (DoEHLG, 2009 as amended in 2010). *Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities*

concurrently with Stage 2 in order to find the most appropriate solution. If no alternatives exist or all alternatives would result in adverse effects to the integrity of Natura 2000 site(s), then the process either moves to Stage 4 or the project is abandoned.

Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

This stage includes the identification and assessment of compensatory measures where, in the context of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed although it has been determined that no less damaging alternative solution exists.

1.4 Main sources of information

The following guidance documents and sources of information were consulted:

- Department of Environment, Heritage and Local Government (DoEHLG, 2009 as amended in 2010). Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities;
- European Community Habitats Directive (92/43/EEC) – The Habitats Directive;
- European Communities (Natural Habitats) Regulations 1997;
- European Commission Environment DG (2001). Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- European Commission Environment DG (2018) Managing Natura 2000 Sites: The Provisions of Article 6 of the Habitats Directive 92/43/EEC;
- Environmental Protection Agency (EPA) Maps[5];
- National Parks and Wildlife Services online MapViewer[6];
- National Parks and Wildlife Service's data (downloaded GIS datafiles)[7];
- To review other planning applications in Co. Westmeath and Co. Meath - National Planning Application Database[8];
- Hydrogeological and Hydrological Impact Assessment (HEC, 2021), included in the Environmental Impact Assessment Report - EIAR as Chapter 7: Water (reviewed September 2021);
- EcIA - Ecological Impact Assessment (Woodrow, 2021), included in the Environmental Impact Assessment Report - EIAR as Chapter 5: Biodiversity (reviewed September 2021);
- Outline Construction Environmental Management Plan (Jennings, 2021) included in Environmental Impact Assessment Report (EIAR) as Annex 3.8 (reviewed September 2021).
- More specific sources of information on species/habitat distribution used to inform the desk-based study are provided in **Section 3.1**.

The proposed development was informed by a comprehensive suite of ecological surveys conducted by Woodrow Sustainable Solutions Ltd., between October 2018 and May 2021. These surveys applied best practice guidelines, as required for ecological assessment for

5 EPA Maps. Available at: https://gis.epa.ie/EPAMaps/ [Accessed July 2021].

6 NPWS Map Viewer. Available at: http://webgis.npws.ie/npwsviewer/ [Accessed July 2021)

7 NPWS Maps and Data. Available at: https://www.npws.ie/maps-and-data [Accessed July 2021].

8 National Planning Application Database. National Planning Application Database (arcgis.com) [Accessed July 2021].

proposed onshore wind farm developments. Of relevance to this NIS are the following surveys, which determined the distribution and occurrence of any Qualifying Interests for Natura 2000 sites within the potential Zone of Influence of the proposed development and identified any source-receptor pathways:

- Habitat mapping of the proposed development site, as per Fossitt (2000) by experienced surveyors able to identify Annex I habitat types requiring further surveying;
- Non-native/alien invasive species surveys;
- Aquatic surveys, including salmon and lamprey suitability surveys, RHATs, kick-sampling and collection of baseline water quality parameters, including: temperature, pH, dissolved oxygen, conductivity and turbidity;
- Invertebrate habitat suitability assessment for species on Annex II of the Habitats Directive, including marsh fritillary and *Vertigo* species
- Monthly winter waterbird surveys covering any suitable habitat up to 5 km from the proposed development site;
- Two years of vantage point (VP) watch surveys used to predict the avian collision risk for the proposed development, through collision risk modelling;
- Kingfisher habitat suitability surveys within the proposed development site;
- Protected mammal surveys covering waterbodies within and up to 150 m from the proposed development site.

1.5 Report structure

Section 1: Outlines the legislative context and methodology for the AA process

Section 2: Provides a description of the proposed development

Section 3: Details the ecological desk study and field surveys undertaken

Section 4: Stage 1: Screening for AA report

Section 5: Provides results of desk study and ecological surveys

Section 6: Stage 2: Natura Impact Statement

Section 7: Consideration of ‘in-combination’ effects

Section 8: Mitigation measures

Section 9: Assessment residual effects

Section 10: Conclusions of the NIS

2 SITE DESCRIPTION & FEATURES OF THE PROPOSED DEVELOPMENT

2.1 Location

The proposed development is located in east County Westmeath and west County Meath, approximately 16 kilometres (km) east of Mullingar, approximately 4km south of Delvin and approximately 5km north of Raharney. **Figure 1** shows the location of the Application Site and layout of the proposed infrastructure. The central Irish grid reference for the Application Site is N 61201 58181 [Lat. 53.570161 Long. -7.0768476]. The core infrastructure for the proposed wind farm is located within Bracklyn farm in the townland of Bracklin, Co. Westmeath. The proposed grid connection route exits the wind farm to the east and crosses into Co. Meath through the townland of Coolronan for 2.5 km and connects to the existing Mullingar-Corduff 110 kV overhead electricity line at Irish grid reference: N 66154 56520 [Lat. 53.554638 Long. -7.0024323]. Candidate quarries which may supply construction materials are also located within Co. Meath.

The turbine component haul route passes through the counties of Waterford, Kilkenny, Carlow, Kildare and Dublin, as shown in **Figure 2**.

2.2 Description of proposed development

The proposed development comprises a wind farm, including all associated development works to accommodate its construction, installation, operation, maintenance and the export of electrical power to the national grid. The operational life of the wind farm is given as 30 years. In summary, the proposed development comprises the following main components:

- 9 no. wind turbines and all associated ancillary infrastructure;
- Upgrades to the turbine component haul route;
- Construction of a 110 kV electricity substation and installation of underground electricity line between the proposed substation and the existing Corduff-Mullingar 110 kV overhead electricity line; and
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and tree felling for turbulence reduction buffers, bat feature buffers and standoffs from the substation, as well as track widening at selected locations.

The assessments throughout this report were based on the site layout shown in **Figure 1**, including the following turbine specifications:

- Turbine make-model: Vestas V162
- Turbine tip heights: 185 m
- Rotor diameter: 162 m (blade length of 81 m)
- Hub height: 104 m
- Rotor swept area 23 to 185 m

These turbine specifications are representative of a ‘worst-case’ scenario, i.e. largest, lowest to ground level rotor swept areas; and therefore, are consistent with a precautionary approach.

The turbine component haul route passes through the counties of Waterford, Kilkenny, Carlow, Kildare and Dublin, as shown in **Figure 2**, with a detailed description presented in **Appendix 1**.

2.3 Description of proposed development site & environs

The proposed development is situated on a lowland site and the topography of the general area is relatively flat, ranging from 70 to 100 m AOD. The landscape surrounding the proposed development site is dominated by intensely managed agricultural land and a range of habitats associated with cut-away raised bog, including industrial cut-away, re-vegetating cut-away, scrub and bog woodland. The land west from proposed location for T2 rises to a local high point that divides the catchments for the River Deel and Stonyford River, which flow on the western and eastern side of the proposed development site respectively, and join the River Boyne to the south/southeast of Ballivor.

The footprint of the proposed development, including turbines, hardstands, assess tracks, substation and temporary infrastructure/storage areas (i.e. excluding the grid connection route) are located within the lands of Bracklyn Farm in Co. Westmeath. Within the site which will contain the proposed wind farm, the landscape is highly modified with open fields of intensively managed grassland and tillage, next to blocks of commercial conifer and broadleaved plantations, planted in what were previously agricultural fields. Much of the length of tracks proposed for connecting site infrastructure will be constructed by upgrading existing forestry tracks and farm lanes and where new tracks are proposed these are within tillage and improved grassland. Likewise, temporary construction compounds and deposition areas are located within fields of tillage.

Large ditches (most > 100 years old) drain the site and the catchment area within the wind farm site converges on a main channel (EPA ref: Bolanstown – 07B45, Co. Westmeath, with the OPW ref: C1/32/7/3). This channel flows east through the site from near the proposed site entrance and exits the site to the east of the proposed turbine location for T10. After leaving the site this drain/channelised stream flows ESE for *c*. 7.8 km where it joins the Stonyford River *c*. 2 km north of Ballivor. This section of the Stonyford River is designated as part of the River Boyne and River Blackwater SAC and SPA. There was no direct surface flow of surface water connecting the proposed development site to the River Deel, which is also designated as part of the River Boyne and River Blackwater SAC and SPA. Ditches in the south-western part of the site, around the proposed location for T5 were found to flow east and hydrologically connected to the main drainage channel through the site. In this area ditches on the periphery of the site were found to flow west, with a hydrological connection to the River Deel, however no development activity is scheduled to occur within 50m of these drains.

Bracklyn Farm was historically part of the Bracklyn Estate and parts of the estate would have been managed for shooting. Features from this period of time have been retained or persisted, including the woodlands on the periphery of the lands-made-available (LMA), mature beech treelines/copses and the high incidence of non-native shrubs, like cherry laurel, that were planted within woodlands to provide ground cover for game. Likewise, many of the older trees occurring in the site are not native, including beech treelines/copses and probably the rows of Scot's pines occurring along the edge of the bog.

The footprint of the proposed development was designed to avoid old growth and semi-natural woodland. This includes Bracklin Wood, which occurs in a thin band from south of

T4/T5 and runs east along the northern edge of the bog; extending from the bog pool (Bracklin Lough) to the former gate lodge for Bracklyn Estate. Parts of Bracklin Wood have been classed as a Type I long-established woodland, and the area is listed within the top ten native woodland sites of conservation interest (non-designated) in Co. Westmeath[9]. Likewise, the remnants of raised bog known as Lisclogher Bog, which abuts Bracklin Wood and extends northeast to include the area south of T11 was avoided through project design. Potentially sensitive habitats avoided, include raised bog, fen, bog woodland and oak-birch-holly woodland.

The grid connection route exits the wind farm to the east of proposed turbine T10 and heads ESE for *c*. 4.5 km, crossing into Co. Meath where it will connect to the existing 110 kV Mullingar-Finglas electricity transmission line in the townland of Coolronan. The proposed grid connection route largely follows a local public road (*c*. 1.9 km). An element in the middle (*c*. 1.79 km) deviates away from the road to follow the channelised 2nd order stream that drains the site (EPA ref: Bolanstown – 07B45), which joins a 3rd order stream as it crosses into Co. Meath (EPA ref: Cartenstown – 07C60). A short section (*c*. 0.3 km) at the end also deviates away from the road to follow this 3rd order stream (EPA ref: Cartenstown – 07C60 and OPW ref: C1/32/7/3). For the road sections, the grid connection will be buried below the existing road or under species-poor roadside verges and excavation works will pass through areas where the adjacent land holds semi-natural woodland, treelines, fields of improved grassland, cut away bog, hedgerows and gardens with ornamental plants. There are roadside drainage ditches along sections of the road. These ditches flow parallel to the road and are hydrologically connected to the main channel noted above, which joins the SAC/SPA north of Ballivor at the confluence of the Stonyford River and the Cartenstown stream in the case of the SPA, and *c*. 280 m upstream the confluence for the SAC.

9 County Westmeath Biodiversity Action Plan (2015-2020). Available at: http://www.westmeathcoco.ie/en/media/Westmeath%20Biodiversity%20Action%20Plan%2020142020.pdf

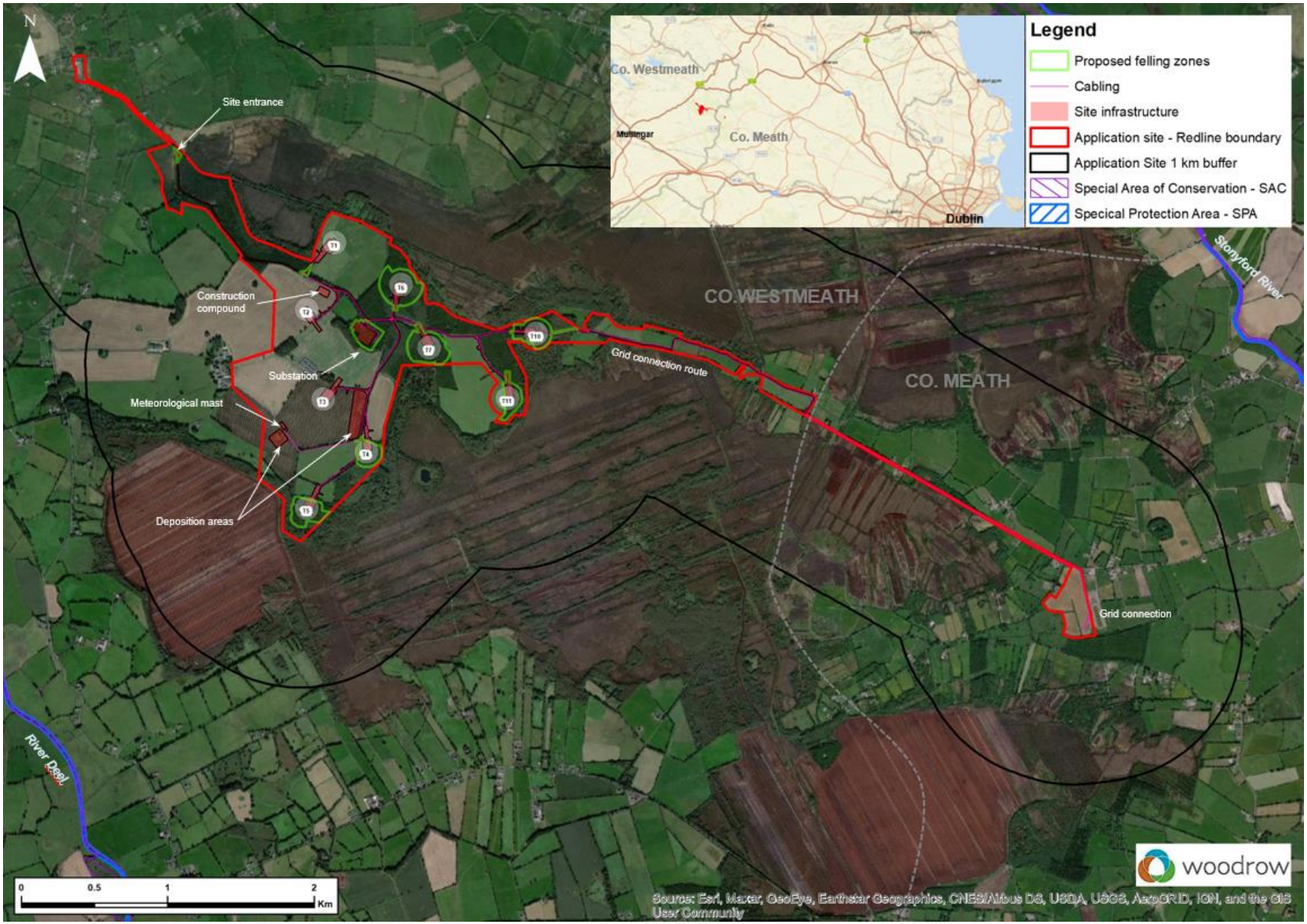

Figure 1: Application Site for Bracklyn Wind Farm and proposed infrastructure

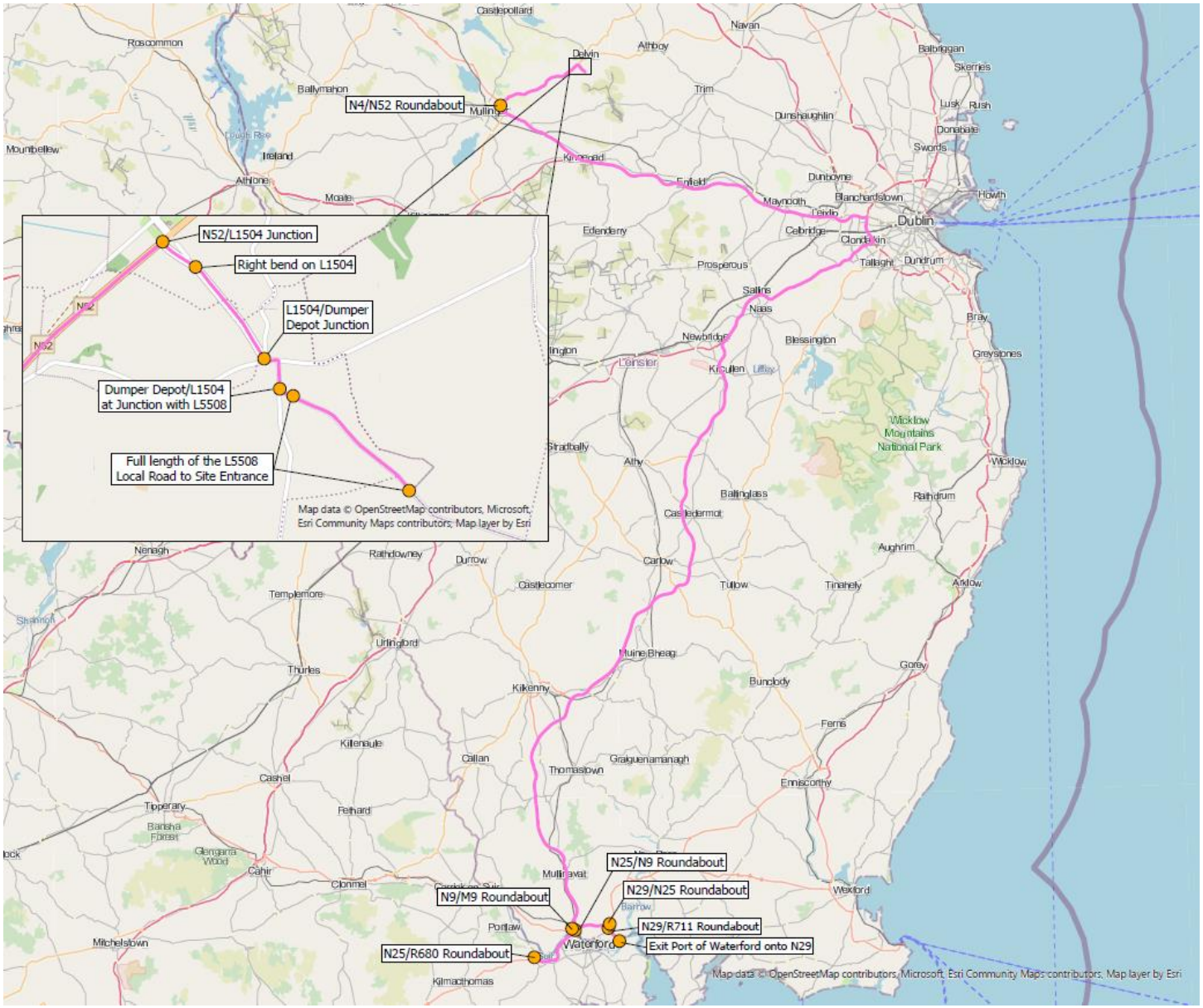

Figure 2: Proposed haul route for turbine components (Source: Jennings O'Donovan & Partners Ltd, 2021)

3 FIELD SURVEYS & ASSESSMENT METHODOLOGY

3.1 Desk study

Prior to the commencement of ecological surveys for the proposed development a desktop scoping exercise was conducted to determine the occurrence of Natura 2000 sites in and around the proposed development site. This identified any species and habitats listed as Qualifying Interests (QI) for designated sites and facilitated a targeted approach to conducting ecological surveying to inform the Appropriate Assessment (AA) process.

Desk-based studies and field surveys for AA focused on determining connectivity (source-receptor pathways) between the proposed development and Natura 2000 sites by investigating the occurrence and distribution of:

- Habitat types listed in Annex I of the Habitats Directive;
- Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; and
- Species of bird listed in Annex I of the Birds Directive.

As part of site scoping, a preliminary screening for Appropriate Assessment was undertaken for the lands-made-available for the project and this has since been refined to consider the specifics of the proposed development.

As outlined in DoEHLG (2010)[10] guidelines (based on review by Scott Wilson *et al*., 2006)[11], potential for source-receptor connectivity between the proposed development site and Natura 2000 sites within 15 km of the proposed development site were initially considered. The 15 km is an arbitrary distance within which the initial desktop search was undertaken; in some cases, the zone of influence of a proposal may be much shorter depending on the ecological feature being considered, or it could occasionally extend significantly beyond this distance, for example where there is hydrological connectivity to a designated site via a river network. For Annex I bird species (QI species for SPAs) specific guidance was used to assess connectivity with SPAs, as per Scottish Natural Heritage guidance - SNH (2016)[12], with consideration given to Mc Guinness *et al*. (2015)[13].

Primary sources of information for the desktop study included:

- Site layout plans and drawings provided Bracklyn Wind Farm Ltd.
- Orth-imagery and 6-inch mapping was viewed using Bing Maps, Google Earth Pro, Google Maps, Ordnance Survey Ireland – GeoHive.
- National Parks & Wildlife Service - NPWS Designations Viewer[14] was used to identify the location of sites designated for nature conservation, specifically Natura 2000 sites

10 Department of Environment, Heritage and Local Government (2010) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Local Authorities

11 Scott Wilson, Levett-Therivel Sustainability Consultants, Treweek Environmental Consultants & Land Use Consultants. (2006). *Appropriate Assessment of Plans*.

12 Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas* (*SPAs*) *Guidance* (Version 3). SNH

13 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow.

14 NPWS Designation Viewer - Available at: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=8f7060450de3485fa1c1085536d477ba Accessed July 2021

(SPA & SAC). Shapefiles and metadata for designated sites have been downloaded and are updated annually for use by Woodrow ecologists on local GIS.

- Environmental Protection Agency - EPA Maps[15] provide an online mapviewer which was used to investigate hydrological connectivity to sites designated for nature conservation, aquifer vulnerability and groundwater vulnerability.
- Office of Public Works - OPWs national flood information portal[16], specifically the floodinfo.ie mapviewer, was used to investigate flood risk in the area and the influence of arterial drainage on the proposed development site.
- Strategic Flood Risk Assessment Map Viewer for Co. Westmeath[17] and Co. Meath[18]
- A data request was submitted to and received from the National Parks & Wildlife Service (NPWS) for ecological datasets within 10 km of the potential development lands.
- Where available, habitats and species metadata and shapefiles files were downloaded from the NPWS website[19] for Annex I habitat types and species list in Annex II and/or IV of the Habitats Directive and species of birds list on Annex I of the Birds Directive. This included: Article 17 and Article 12 reporting data, National Survey of Woodlands 2003-2008, Ancient and Long-Established Woodland.
- Species records were collated from the National Biodiversity Data Centre (NBDC) database using the report function on Biodiversity Maps[20] to generate a biological records data report with the search area extended to 10 km from the potential development lands. This map viewer was also used to examine other data sets including:
  - BWI: Bird sensitivity to wind energy (as per Mc Guinness *et al*., 2015)
  - Kingfisher surveys (as per Cummins *et al*. 2010)
  - Ancient and long-established woodland (as per Perrin & Daly, 2010)[21]
  - National survey of native woodland (as per Perrins *et al*., 2008)[22]
- The distribution of Annex I species and species assemblages for which SPAs are designated (namely wintering waterbirds and seabirds) were examined using the following sources:
  - Current and historical distribution of wintering and breeding Annex I bird species was investigated using Sharrock (1976)[23], Hutchinson (1989)[24], Gibbons (1993)[25], Balmer *et al*. (2013)[26].

15 EPA Maps – Available at: EPA Maps Accessed July 2021

16 OPW: National flood information portal – Available at: https://www.floodinfo.ie/ Accessed July 2021

17 The Westmeath County Development Plan 2021-2027, Strategic Flood Risk Assessment Map Viewer – Available at: https://westmeathcoco.maps.arcgis.com/apps/webappviewer/index.html?id=c1437c1c9f8e48dcaf289f76198213f4

18 The draft Meath County Development Plan 2021-2027, Strategic Flood Risk Assessment Map Viewer – Available at: https://meath.maps.arcgis.com/apps/webappviewer/index.html?id=4e9fe580ce1a48fabd8c6623e39ce7e0

19 NPWS website – Habitat & Species data – Available at https://www.npws.ie/maps-and-data/habitat-and-species-data Accessed July 2021

20 NBDC Biodiversity Maps – Available at: Maps - Biodiversity Maps (biodiversityireland.ie) Accessed July 2021

21 Perrin, P.M. & Daly, O.H. (2010). A provisional inventory of ancient and long-established woodland in Ireland. *Irish Wildlife Manuals*, No. 46. NPWS, DoEHLG, Dublin, Ireland.

22 Perrin P., Martin J., Barron S. O'Neil F., McNutt K. & Delaney A. (2008). *National Survey of Native Woodlands 2003-2008*. Volume I: Main report. Botanical, Environmental & Conservation Consultants Ltd. report submitted to the NPWS

23 Sharrock. J.TR. (1976). The Atlas of breeding Birds in Britain and Ireland.

24 Hutchinson, C. D. (1989). *Birds of Ireland*. T. & A. D. Poyser.

25 Gibbons, D. W. (1993). The New Atlas of Breeding Birds in Britain and Ireland (1988–91).

26 Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller R.J. (2013). Bird Atlas 2007–11: The Breeding and Wintering Birds of Britain and Ireland. BTO, Thetford.

- Cummins *et al*. (2010)[27], provides an assessment of the distribution and abundance of kingfisher within the River Boyne and River Blackwater catchments.
- Fox *et al*. (1994[28], 2006[29], 2018[30], 2019[31], 2020[32]) provided information on wintering Greenland white-fronted geese in Ireland.
- The distribution of wetland birds and occurrence within SPAs was investigated using Crowe (2005)[33], Boland & Crowe (2012)[34], Lewis *et al*. (2019)[35].
- The distribution of breeding seabirds and occurrence within SPAs was investigated using Mitchel *et al*. (2004)[36], Cummins *et al*. (2019)[37]
- Hen harrier breeding distribution was investigated using Norriss *et al*. (2002)[38], Barton *et al*. (2006)[39], Ruddock et al. (2012)[40], Ruddock *et al*. (2016)[41]

- National Parks & Wildlife Service site synopsises for Natura 2000 Sites including:
  - NPWS (2014a) - Site synopsis for the River Boyne and River Blackwater SAC
  - NPWS (2010) - Site synopsis for the River Boyne and River Blackwater SPA
  - NPWS (2014b) - Site synopsis for the Lough Derravarragh SPA
  - NPWS (2014c) - Site synopsis for the Lough Owel SPA
  - NPWS (2014d) - Site synopsis for the Lough Iron SPA
  - NPWS (2014e) - Site synopsis for the Lough Ennell SPA
  - NPWS (2012) - Site synopsis for the Garriskil Bog SPA

27 Cummins, S., Fisher, J., Gaj McKeever, R., McNaghten, L. & Crowe, O. (2010). Assessment of the distribution and abundance of Kingfisher *Alcedo atthis* and other riparian birds on six SAC river systems in Ireland. BWI report to the NPWS, Kilcoole, Co. Wicklow.

28 Fox, A.D., Norriss, D.W., Stroud, D.A. & Wilson, H.J. (1994). *Greenland White-fronted Geese in Ireland and Britain 1982/83-1993/94 - the first twelve years of international conservation monitoring*. Greenland White-fronted Goose Study Research Report No. 8. GWGS, Aberystwyth & NPWS, Dublin.

29 Fox, A.D., Stroud, D.A., Walsh, A., Wilson, H.J., Norriss, D.W. & Francis, I.S. (2006). Recent changes in abundance of the Greenland White-fronted Goose. *British Birds* 99: 242-261.

30 Fox, T., Francis, I., Norriss, D. & Walsh, A. (2018). *Report of the 2017/18 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

31 Fox, T., Francis, I., Norriss, D. & Walsh, A. (2019). *Report of the 2018/19 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

32 Fox, T., Francis, I., Norriss, D. & Walsh, A. (2020). *Report of the 2019/20 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

33 Crowe, O. (2005). *Ireland's Wetlands and their Waterbirds: Status and Distribution*. BWI, Rockingham, Co. Wicklow.

34 Boland, H. & Crowe, O. (2012). *Irish wetland bird survey: waterbird status and distribution 2001/02 – 2008/09*. BirdWatch Ireland, Kilcoole, Co. Wicklow.

35 Lewis, L. J., Burke, B., Fitzgerald, N., Tierney, T. D. & Kelly, S. (2019b). Irish Wetland Bird Survey: Waterbird Status and Distribution 2009/10-2015/16. *Irish Wildlife Manuals*, No. 106. NPWS, DoCHG, Ireland.

36 Mitchell, P.I., Newton, S.F., Norman Ratcliffe, N. & Dunn, T.E. (Eds.) (2004). *Seabird Populations of Britain and Ireland: results of the Seabird 2000 census (1998-2002)*. Published by T and A.D. Poyser, London.

37 Cummins, S., Lauder, C., Lauder, A. & Tierney, T. D. (2019) The Status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018. *Irish Wildlife Manuals* No. 114. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland.

38 Norriss, D. W., Marsh, J., McMahon, D. & Oliver, G. A. (2002). A national survey of breeding Hen Harriers *Circus cyaneus* in Ireland 1998- 2000. *Irish Birds* 7: 1-10.

39 Barton, C., Pollock, C., Norriss, D.W., Nagle, T., Oliver, G.A. & Newton, S. (2006). The second national survey of breeding hen harriers *Circus cyaneus* in Ireland 2005. *Irish Birds* 8: 1-20.

40 Ruddock, M., Dunlop, B.J., O'Toole, L., Mee, A. & Nagle, T. (2012). Republic of Ireland National Hen Harrier Survey 2010. *Irish Wildlife Manual* No. 59. NPWS, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

41 Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). The 2015 National Survey of Breeding Hen Harrier in Ireland. *Irish Wildlife Manuals*, No. 93. NPWS, Department of the Arts, Heritage and the Gaeltacht, Ireland.

- Article 17 reporting on the status of Annex I habitats in Ireland and Article 11 reporting on the status of Annex II, IV and V species in Ireland (NPWS, 2013a[42], 2013b[43] & 2013c[44]).
- Information on otter distribution within the River Boyne catchment was provided by Bailey & Rochford (2006)[45] and Reid *et al*. (2006)[46], with information on home range taken from Ó Néill *et al*. (2009)[47].

3.2 Field surveys informing the Appropriate Assessment

This NIS is informed by a comprehensive suite of ecological surveys conducted by Woodrow Sustainable Solutions Ltd., between October 2018 and May 2021. These surveys applied best practice guidelines, as required for ecological assessment for proposed wind farm developments. Of relevance to this NIS are the following surveys, which determined the distribution and occurrence of any Qualifying Interests for Natura 2000 sites within the 15 km potential Zone of Influence of the proposed development and identified any source-receptor pathways:

- Habitat mapping of the proposed development site, as per Fossitt (2000) by experienced surveyors able to identify Annex I habitat types requiring further surveying. During multidisciplinary site walkover surveys any non-native/alien invasive species plant species were identified;
- Aquatic surveys, including salmon and lamprey suitability surveys, RHATs, kick-sampling baseline and basic water quality parameters, including: temperature, pH, dissolved oxygen, conductivity and turbidity;
- Invertebrate habitat suitability assessment, including marsh fritillary and *Vertigo* species;
- Monthly winter waterbird surveys covering any suitable habitat up to 5 km from the proposed development site conducted over three winters;
- Two years of vantage point (VP) watch surveys cover 500 m turbine buffer and used to predict the avian collision risk for the proposed development, through collision risk modelling;
- Kingfisher habitat suitability surveys of water courses within the proposed development site and extending 800 m downstream;
- Protected mammal surveys covering waterbodies within and up to 150 m from the proposed development site.

42 NPWS (2013a). *The Status of Protected EU Habitats and Species in Ireland*. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn

43 NPWS (2013b) *The Status of EU Protected Habitats and Species in Ireland*. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

44 NPWS (2013c) *The Status of EU Protected Habitats and Species in Ireland*. Species Assessments - Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

45 Bailey, M. & Rochford J. (2006). Otter Survey of Ireland 2004/2005. *Irish Wildlife Manuals*, No. 23. NPWS, DoEHLG, Dublin, Ireland.

46 Reid, N., Hayden, B., Lundy, M.G., Pietravalle, S., McDonald, R.A. & Montgomery, W.I. (2013). National Otter Survey of Ireland 2010/12. *Irish Wildlife Manuals*, No. 76. NPWS, DoAHG, Dublin, Ireland.

47 Ó Néill, L., Veldhuizen, T., de Jongh, A. & Rochford, J. (2009). Ranging behaviour and socio-biology of Eurasian otters (*Lutra lutra*) on lowland mesotrophic river systems. *Eur J Wildl Res* 55, 363–370

3.2.1 Habitat mapping and botanical surveys

Preliminary habitat surveys of the lands-made-available for the project were undertaken in March 2020. Habitat surveys were updated in May 2020, September 2020, December 2020 and May 2021. All habitat surveys were conducted during the optimum time of year. A high-level habitat survey conducted for the grid connection route in December 2020 was subsequently updated in May 2021.

Habitat surveys and mapping was undertaken following Smith *et al*. (2011)[48], with all habitats classified into recognised communities defined by Fossitt (2000)[49] and cross-referenced to Annex I habitats of the EU habitats directive. Given the higher level of classification required to Annex I habitats, careful consideration was given to species composition, location, and physical characteristics of the surveyed habitats, as described in European Commission (2013)[50]. In cross checking habitat classifications for semi-natural woodland reference was made to Rodwell (1991)[51], Hall *et al*. (2004)[52], Perrin *et al*. (2008)[53] and Perrin *et al*. (2010)[54]. Cross & Lynn (2013)[55] was used to assess areas supporting habitat types with the potential to qualify as the Annex I priority habitat Bog Woodland.

During habitat surveys and other multidisciplinary surveys, the locations and extent of non-native plant species were recorded. Special attention was given to locating any species classed as invasive alien species in Ireland, especially species listed on Schedule III Part I of S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011. Commonly occurring 'Schedule 3' species of invasive plants include Rhododendron, Japanese knotweed and giant hogweed, which can have significant effects of the integrity of Natura 2000 sites.

Appendix 4 provides habitat maps and a table listing areas of habitat affected by the footprint of the proposed development

3.2.2 Aquatic and fisheries habitat assessment surveys

Aquatic surveys were conducted at seven locations on, and adjacent to, the proposed development site on 14 &15-Oct-2020 and included the follow elements:

- An ecological assessment of the streams within and draining the proposed development site (notability with respect to white-clawed crayfish, salmon and lamprey suitability) was conducted at key locations. Sections of waterbodies potentially directly impacted by the works were walked and assessed for salmonid/lamprey suitability using the LCU - Life Cycle Unit Approach, where aquatic habitats are classified according to type: nursery, holding, spawning; and quality:

48 Smith G.F., O'Donoghue P., O'Hara K. & Delaney E. (2011). *Best practice guidance for habitat survey and mapping*. The Heritage Council

49 Fossitt J.A. (2000), "*A guide to habitats in Ireland*. The Heritage Council

50 European Commission (2013) The Interpretation Manual of European Union Habitats - EUR28

51 Rodwell, J S (ed.) (1991) *British Plant Communities. Volume 1. Woodlands and scrub*. Cambridge University Press, Cambridge

52 Hall, J.E.; Kirby, K.J. & Whitbread, A.M. (2004). *National Vegetation Classification: Field guide to woodland*. Joint Nature Conservation Committee (JNCC)

53 Perrin P., Martin J., Barron S. O'Neil F., McNutt K. & Delaney A. (2008) *National Survey of Native Woodlands 2003-2008*. Volume I: Main report. Botanical, Environmental & Conservation Consultants Ltd. report submitted to the NPWS

54 Cross, J.; Perrin; P. & Little, D. (2010). *The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management*. Native Woodland Information Note No. 6. NPWS, BEC Consultants Ltd & Woodlands of Ireland

55 Cross, J. & Lynn, D. (2013). Results of a monitoring survey of bog woodland. *Irish Wildlife Manuals*, No. 69. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

excellent (1) to marginal (4), as detailed in Kennedy,1984[56] and O'Connor & Kennedy, 2002[57]. Lamprey habitat assessments followed guidance from Maitland (2003)[58] with reference to substrate requirements for adults to spawn, and silt beds for juveniles to develop within.

- River Hydromorphology Assessment Techniques (RHAT) were also undertaken. RHAT allows for the classification of watercourse hydromorphology based on a departure from naturalness, and assigns a morphological classification directly related to that of the WFD: high, good, moderate, poor and bad, based on semi-qualitative and quantitative criteria.

While conducting stream assessments, banks and drains were also searched for signs of otter activity and were assessed for kingfisher suitability.

- At four sample points biological scoring of the streams associated with the proposed development site was carried out to provide for Q-rating of each watercourse. This was undertaken using macro-invertebrate sampling (kick-sampling), a standard assessment methodology, and used to form a baseline for appropriate monitoring in the future. As detailed in Toner *et al*. (2005)[59], macro-invertebrate samples were converted to Q-ratings and assigned to WFD - Water Framework Directive status classes: High to Bad. Basic water quality parameters were measured using portable meters to provide a baseline profile of chemical quality in the principal watercourses. These included temperature, pH, dissolved oxygen, conductivity and turbidity.

3.2.3 Invertebrate species on Annex II of the Habitats Directive

Habitat suitability assessments in the field, combined with information on species distribution complied during the desk-based study ensured that all proposed wind farm infrastructure, including met mast, substation, grid connection routes and areas for temporary infrastructure (deposition areas, site compound) have been sufficiently assessed for invertebrate species listed on Annex II of the Habitats Directive. Assessment methodologies followed are in line with those described in NRA (2009)[60].

A review of distribution maps published as part of Article 17 reporting and showing species range, identified the potential for any Annex II species listed in the Habitats Directive to occur within the Zone of Influence for the proposed development. This highlighted the potential for marsh fritillary *Euphydryas aurinia*, certain rarer species of *Vertigo* snails (whorl snails) and white-clawed crayfish *Austropotamobius pallipes* to occur in the wider area surrounding the development site.

3.2.4 Otter surveys

Waterbodies within and adjacent to the proposed development site were comprehensively surveyed for otters during multidisciplinary walkover surveys. The main focus was to identify

56 Kennedy G.J.A. (1984) Evaluation of techniques for classifying habitats for juvenile salmon (*Salmo salar* L.) *Proceedings of the Atlantic Salmon trust workshop on stock enhancement*.

57 O'Connor L. & Kennedy, R.J (2002). A comparison of catchment-based salmon habitat survey techniques on three rivers in N. Ireland. Fisheries Management & Ecology, 9, 149-161

58 Maitland, P.S. (2003). Ecology of the River, Brook and Sea Lamprey. *Conserving Natura 2000 Rivers*, Ecology Series No. 5

59 Toner P., Bowman J., Clabby K., Lucey L., McGarrigle M., Concannon C., Clenaghan C., Cunningham P., Delaney J., O'Boyle S., MacCárthaigh M., Craig M. & R. Quinn et al. (2005) *Water Quality in Ireland 2001–2003*. EPA – Environmental Protection Agency, Johnstown Castle, Co. Wexford

60 NRA - National Roads Authority (2009). Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. Available from https://www.tii.ie/technical-services/environment/planning/Ecological-Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf

the presence of otter or their resting places such as layups or holts. The approach included the identification of suitable habitat, detection of field signs such as tracks, markings, feeding signs, droppings and scent-points as well as by direct observation. The surveys were undertaken by experienced surveyors in line with guidelines referenced by CIEEM and giving cognisance to Irish survey guidelines, such as those produced by Transport Infrastructure Ireland (NRA, 2009). Given that the works will occur immediately alongside or within the proposed development infrastructure, it was deemed sufficient to extend the mammal survey to 150 m up- and downstream of the proposed construction footprint for otter. A final check for proposed mammals of the proposed works corridor, including the grid connection, was completed over two visits in May 2021.

Maps showing the distribution of otter signs recorded during surveys are provided in **Appendix 5**.

3.2.5 Bird surveys

Details for survey effort and maps showing ornithological study areas are provided in **Appendix 3**.

Kingfisher habitat suitability surveys

The methodology employed to assess kingfisher habitat suitability followed criteria outlined in Cummins *et al*. (2010)[61] and used in other baseline kingfisher surveys conducted in Ireland (Crowe *et al*., 2008[62] & Thomas *et al*. 2007[63]). The length of the main watercourse flowing through the proposed wind farm site and adjacent to the grid connection route was assessed for kingfisher suitability (Bolanstown and Cartenstown streams). In May 2021, this assessment was extended 800 m downstream of the proposed location for connection to the grid. The following characteristics of the sections were noted to provide an assessment of potential habitat for breeding and foraging kingfishers:

- Nesting habitat - bank profile, height and material (typically kingfishers require tall vertical banks with soft material for excavating nest burrows, although existing holes e.g. amongst tree roots, in solid structures and in dead sections of trees are occasionally utilised). The extent of suitable nesting banks was defined for each section as:
  - 1. less than 10 m of suitable bank;
  - 2. 10-100 m of suitable bank; or
  - 3. more than 100 m of suitable bank
- Foraging habitat - water quality and flow, occurrence of fishing perches (e.g. overhanging trees);
- Potential disturbance factors.

61 Cummins, S., Fisher, J., Gaj McKeever, R., McNaghten, L. & Crowe, O. (2010). Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland. A report commissioned by the National Parks and Wildlife Service and prepared by BirdWatch Ireland June 2010.

62 Crowe, O., G. Webb, E. Collins & Smiddy, P. (2008). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on two SAC river systems in Ireland*. A report commissioned by the National Parks and Wildlife Service and prepared by BirdWatch Ireland

63 Thomas, C., Troake, P., Karsch, A.& O. Crowe, O. (2007). Waterways Birds Survey 2006 & 2007. Unpublished report. BirdWatch Ireland, Newtownmountkennedy

Wider area waterbird surveys

In order to determine density of use by wintering bird populations, and especially to identify any foraging or roost sites for swans and geese, point count surveys (in line with those employed for IWebS – Irish Wetland Bird Surveys) were undertaken to survey all publicly accessible/viewable loughs and other wetlands within *c*. 5-6 km of the proposed turbine locations. Surveys were undertaken over three winter seasons including 2018-19, 2019-20 and 2020-21.

Vantage Point (VP) watch surveys

VP watches aim to record flight-line activity through the 500 m buffer around the proposed turbines to provide data on selected target species for assessing avian collision risk.

Four VPs were selected and these were retained throughout the survey period. The VPs selected to cover the proposed development are compliant with the SNH (2017) guidelines., which stipulate that viewsheds from VPs should not extend more than 2 km and that the angle of view should also not be extended beyond an arc of 180 degrees. The four VPs provided comprehensive coverage of the rotor swept area for the entire 500 m turbine buffer – defined as a buffer extending out 500 m from the proposed turbine locations. Based on viewsheds extending 2 km, the viewsheds of the VPs all overlap. Therefore, it is acknowledged that as a function of coverage (survey effort) the flight seconds reported cumulatively for all the VP watches will provide an overestimate for flight times within the 500 m turbine buffer. This is corrected for in collision modelling.

For each VP a minimum of 36 hours of watches has been collected for each season, defined as the breeding season and non-breeding season, i.e. 72 hours per year. For this proposal data has been collected from four VPs over a period of two years spanning from October 2018 to August 2020 and amounting to 578.25 hours of watches for the 500 m turbine buffer. An additional 36 hours per VP was collected during the 2020-21 non-breeding season (i.e. an additional 144 hours), which was reviewed, but not used in the collision risk assessment.

Target species for which flight-line data was captured during VP watches were defined as all raptor species and all water bird species. As such, all species with populations potentially at risk from wind farm developments were surveyed, including species of conservation concern and those susceptible to collision due to flight behaviour. Based on population sensitivity and/or proximity of the proposed development site to Special Protection Areas (SPAs), the primary target species identified for the proposed development site were wintering Greenland white-fronted goose and whooper swan associated with Special Protection Areas in the wider area.

Details of survey effort, including weather conditions, maps showing VP locations and viewsheds are produced in **Appendix 3**, with flight line maps and tabulated records provided in **Appendix 6**.

For target species generating sufficient levels of flight time within the zone of collision risk, data sets were run through a Collision Risk Model (CRM), as detailed in SNH (2000)[64] and

64 Scottish Natural Heritage (2000). Windfarms and Birds - *Calculating a theoretical collision risk assuming no avoiding action*. SNH Guidance Note.

Band *et al*. (2007)[65], employing avoidance rates as given in SNH (2016 & 2018)[66, 67] to provide estimates of the number of collisions per annum and for the life of the project (30 years). A detailed method statement, along with CRM outputs is provided in the **Appendix 7**.

Other bird surveys for Annex I species

Other surveys targeting Annex I species potentially utilising the proposed development site included:

- *Breeding season site walkovers*: Breeding bird surveys provide information on the distribution of breeding birds throughout the proposed development site and ornithological study area, highlighting the locations of potentially sensitive species.
- *Winter site walkovers*: Winter walkover surveys provide information on the distribution of birds wintering throughout the site, highlighting the locations of potentially sensitive species.
- *Breeding season raptor surveys*: Undertaken following SNH guidelines that recommend surveying the wider area (hinterland) for up to 2 km from the site. A combination of mini-VPs, as well as driven and walked transects were used to search potential nesting habitat within the hinterland over the breeding seasons of 2019 and 2020. Survey methods for breeding raptors follow those outlined in Hardey *et al*. 3nd Ed. (2013)[68], with Annex I target species including hen harrier, merlin and peregrine.
- *Hen harrier roost searches*: Areas holding potentially suitable hen harrier roosting habitats were identified within 2 km of the proposed turbine locations (as per Clarke & Watson, 1990[69] and in the Irish national hen harrier winter roost survey guidelines, O'Donoghue, 2012[70] – subsequently updated 2019). These areas were targeted with speculative hen harrier roost searches employing the roost watch methodology detailed in O'Donoghue (2019)[71]. Surveyors observed potentially suitable habitat for 1.5 to 2 hours prior to dusk (complete darkness). Details of survey effort are provided in the **Appendix 3**.

65 Band, W., Madders, M., & Whitfield, DP., (2007). Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farm Sites. In: de Lucas, M., Janss, G. & Ferrer, M. (Eds) 2007. Birds and Wind Farms – Risk Assessment and Mitigation. *Quercus Editions*, Madrid, 259-279

66 Scottish Natural Heritage (2016). Avoidance rates for the onshore SNH wind farm collision risk model.

67 Scottish Natural Heritage (2018). Avoidance rates for the onshore SNH wind farm collision risk model.

68 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). *Raptors: A field guide to survey and monitoring* (Third Edition). The Stationary Office, Edinburgh.

69 Clarke, R. & Watson, D. (1990). The Hen Harrier *Circus cyaneus* Winter Roost Survey in Britain and Ireland, *Bird Study*, 37:2, 84-100

70 O'Donoghue, B. (2012). Hen harrier roost types & guidelines to roost watching. NPWS, Ely Place, Dublin

71 O'Donoghue, B. (2019). Survey Guide: Hen harrier roost types and guidelines to roost watching. IHHWS - Irish Hen Harrier Winter Survey

4 SCREENING FOR APPROPRIATE ASSESSMENT

European Directive 92/43/EEC (The Habitats Directive) requires that any plans or projects that could, alone or in combination with other plans or projects, affect a Natura 2000 site, be subject to screening for potential significant effect on any Natura 2000 site.

4.1 Overview of the screening process

According to the NPWS (2009, as amended in 2010), the Appropriate Assessment Screening exercise can result in the following possible conclusions or outcomes:

- Appropriate Assessment is not required: The proposed development is directly connected with or necessary to the nature conservation objectives of the site.
- Appropriate Assessment is not required: Screening establishes that there is no potential for significant effects on a Natura 2000 site (subject to any further changes to the proposed development)
- Significant effects are likely, or it is uncertain as to whether or not they are likely. Permission must be refused unless the proposed development is subject to Appropriate Assessment.

Alternatively, the Screening process may recommence on the basis of modified plans.

4.2 Natura 2000 sites within the Zone of Influence (ZoI)

The following section provides information on the Natura 2000 sites in the vicinity of the proposed development site, which have the potential to be within the Zone of Influence (ZoI) of the construction, operation and decommissioning of a proposed wind farm site at Bracklin, Co. Westmeath. As explained in **Section 3.1**, a standard 15 km distance from the proposed development site is used as a potential zone of influence within which Natura 2000 sites should be screened for potential impacts. As shown in **Figure 3**, the proposed development site, including the grid connection route does not occur within or directly adjacent to any sites designated for nature conservation. There are seven SACs and two SPAs (Natura 2000 sites) located within 15 km of the proposed development, including:

- River Boyne and River Blackwater SAC (002299)
- River Boyne and River Blackwater SPA (004232)
- Lough Derravaragh SPA (004043)
- Mount Hevey Bog SAC (002342)
- Wooddown Bog SAC (002205)
- Lough Lene SAC (002121)
- Lough Bane & Lough Glass SAC (002120)
- White Lough, Ben Loughs & Lough Doo SAC (001810)
- Girley (Drewstown) Bog SAC (002203)

Consideration was given to an additional two Natura 2000 sites, which are located a significant distance beyond the 15 km screening radius. These two designated sites were assessed as potentially falling within the ZoI of the proposed development, due to a very distant (> 70 km) downstream hydrological connection via the River Boyne, and included:

- Boyne Coast and Estuary SAC (001957)

- Boyne Estuary SPA (004080)

As listed in **Table 3**, there are also a number of SPAs to the west of the proposed development that are beyond the 15 km search radius. These SPAs, are within 17 to 32 km of the proposed development and are all designated for wintering waterbird populations. Based on SNH (2016)[72] guidelines for assessing connectivity between designated sites and proposed developments, with consideration given to Zones of Sensitivity for selected species published in Mc Guinness *et al*. (2015)[73], these Natura 2000 sites can be considered as being beyond the Zone of Influence, which is noted as between 600 m and 5 km for whooper swans and 600 m and 5-8 km for Greenland white-fronted geese. However, it is acknowledged that there is a knowledge gap in assessing the relationship between avian populations associated with SPAs and how they utilise the wider area surrounding these designated areas, especially for more mobile species. For instance, Gill & Fuller (1999)[74] note that the majority of wintering golden plover and lapwing utilise lowland farmland where they are missed by existing monitoring schemes. This is especially the case in the Midlands of Ireland where there is an abundance of ephemeral wetlands (e.g. turloughs), expanses of exposed peat and large floodplains, parts of which periodically flood. This results in complex patterns of bird distribution, which varies across and between winter seasons. Therefore, an assessment of whether these SPAs and QIs should be considered within the ZoI of the proposed development was undertaken. This assessment is provided in **Section 5.6**, which summarises the findings of the ornithological baseline.

The potential for impacts upon ecological features along the haul route where modifications to areas may be required to facilitate the passage of large vehicles and components was considered. As listed in **Table A1.1** at **Appendix 1**, there is no potential for significant effects, which will be avoided by utilising the existing road network for the transportation of turbines to the site. Any works associated with haul route relate to modification of existing infrastructure, e.g. temporary removal of road signage, temporary hard surface of roundabouts and road widening. Road widening along the unnamed road leading the proposed site entrance is hydrologically connected to River Boyne and River Blackwater SAC/SPA and potential for significant effects are considered within the Application Site – red line boundary. Potential connectivity to the Lower River Suir SAC was discounted at one location where modifications have been proposed (Item No. 5.6.2), as the existing road network has resulted in the stream being re-directed (Rathpatrick 16R35) away from the roundabout.

4.3 Screening Matrix assessing likelihood of significant effects

A screening matrix (A), shown in **Table 1**, lists the Natura 2000 sites identified as being within the potential ZoI of the proposed development along with the QIs for these sites. This screening matrix provides the distance of the Natura 2000 sites from the proposed development and establishes the occurrence of any ecological or hydrological connections (source-pathway-receptor linkages). In the context of ecological/hydrological connectivity,

72 Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas* (*SPAs*) *Guidance* (Version 3). SNH

73 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow.

74 Gill, S. & Fuller, R.J. (1999). Winter Ecology of Golden Plovers and Lapwings: A Review and Consideration of Extensive Survey Methods. *BTO Research Report* No. 224. British Trust for Ornithology, The Nunnery, Thetford, Norfolk, UK

the source potential for impacts and likelihood of significant effects due to the proposed development on these Natura 2000 sites is identified. No reliance is placed on any mitigation measures to avoid, reduce or exclude the likelihood of significant effects. A second screening matrix (B), shown in **Table 2** provides information to determine which QIs should be considered within the ZoI of the proposed development and the likelihood of significant effects.

Table 1 uses a number of specific terms to conclude on the potential for significant effects. The term 'likely significant effect' (LSE) is used where a plan or project is likely to undermine any of the Site's conservation objectives. The term 'potential significant effect' (PSE) is used where a plan or project has an indicated potential to undermine any of the Site's conservation objectives, but where doubt exists about the risk of a significant effect in the current context. Nevertheless, where doubt exists about the risk of a significant effect, use of the precautionary principle requires this effect to be considered appropriately within the screening process. The term 'No Potential Significant Effect' is used where it can be concluded with confidence that there is no potential causal link (or source-pathway-receptor linkage).

As listed in

Table 3, there are a number SPAs to the west of the proposed development that are beyond the 15 km search radius. These SPAs, falling within 17 to 30 km of the proposed development, are all designated for wintering waterbird populations. Of the QI species listed for the SPAs several are considered sensitive to wind farm developments, for instance swans and geese species are noted as being particularly susceptible to collision risk due to their wing loading and resultant pattern of flight. In this respect, the proposed development has the potential to directly impact on wintering waterbirds ecologically linked to these SPAs, as well as having the potential to act as a barrier to the movement of commuting/migrating waterbirds and result in the displacement of birds from alternative foraging grounds beyond the SPAs.

4.4 Findings of the Screening for Appropriate Assessment

The proposed development is not connected with or necessary for the management of any Natura 2000 sites. As shown in **Figure 3**, the proposed development is not located within any Natura 2000 sites; however, seven SACs and two SPAs were identified as falling within the 15 km potential zone of influence around the proposed development.

The proposed development is hydrologically linked to two Natura 2000 sites, including the River Boyne and River Blackwater SAC and SPA, which are approximately 3.1 km and 8.1 km downstream of the proposal, respectively. The entire catchment of the proposed development drains into a channel that flows through the proposed wind farm site and adjacent to the proposed grid connection route. This channel joins the Stonyford River, via the Bollandstown (EPA ref: 07B45) and Cartenstown streams (EPA ref: 07C60), *c*. 2 km north of Ballivor, which is designated as part of the River Boyne and River Blackwater SAC and SPA (see **Figure 4** and **Figure 5**). No hydrological connectivity to the River Deel section of the SAC/SPA, west of the proposed development, was identified.

The River Boyne flows into the Irish Sea at Laytown, just beyond Drogheda on the border of Co. Louth and Co. Meath, where the estuary is designated as both SAC and SPA, specifically the Boyne Coast and Estuary SAC and Boyne Estuary SPA. Both these sites are

over 70 km downstream of the proposed development and there is not considered to be any reasonable likelihood of significant effects due to the long distance from the application site, and the massive dilution effects that would occur over this length of river.

Three SACs including White Lough, Ben Loughs & Lough Doo SAC, Lough Lene SAC and Lough Bane & Lough Glas SAC are hydrologically linked to the River Boyne and River Blackwater SAC and SPA, via the River Deel. The hydrological link between the proposed development and these SACs is upstream, via the Stonyford River, River Boyne and then River Deel. Any connection is a long distance upstream and therefore there was no realistic potential for significant effect to these Natura 2000 sites. Likewise, no potential significant effect was identified for Mount Hevey Bog SAC and Wooddown Bog SAC; as the habitats within these SACs are not hydrologically linked to the proposed development (and the habitats are rain-water fed regardless).

As listed in **Table 3**, there are six SPAs within 14 to 32 km of the proposed development where a range of wintering waterbirds and [A999] Wetlands and Waterbirds (waterbird assemblage) are designated as a QIs, including the closest SPA - Lough Derravarragh SPA. Based on SNH (2016)[75] and Mc Guinness *et al*. (2015)[76] these SPAs would all be considered beyond the ZoI of the proposed development. However, on a precautionary basis these sites were subject to further assessment to conclusively determine a lack of any source-pathway-receptor linkages with the potential to result in likely significant effects on SPA – see **Section 5.6**.

The Screening for Appropriate Assessment has concluded, without consideration of onsite conditions and in absence of mitigation, the likelihood of significant effects on three Natura 2000 sites could not be excluded on the basis of objective scientific information and that a Natura Impact Statement - NIS is required. These sites were identified as having potential ecological/hydrological connections with the proposed development and as such are considered to be within the potential Zone of Influence (ZoI). These Natura 2000 sites are:

- River Boyne and River Blackwater SAC [002299];
- River Boyne and River Blackwater SPA [004232];
- Lough Derravarragh SPA [004043].

In summary these three Sites were ‘screened in’ on the following basis:

- The proposed development is hydrologically connected to the River Boyne and River Blackwater SAC, via the Stonyford River; and without mitigation, has the potential to result in surface water impacts including sediment release and chemical/ hydrocarbon pollution, which could impact on the QIs of this site. As outlined in **Table 2**, QIs include: salmon, otter, river lamprey, alkaline fens and alluvial forests. Based on documented distribution for alkaline fen within the SAC there was no source-pathway-receptor linkages identified and therefore there was no potential significant effect on this QI.
- The proposed development is hydrologically connected to the River Boyne and River Blackwater SPA, via the Stonyford River; and without mitigation, has the potential to result in surface water impacts including sediment release and chemical/

75 Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas* (*SPAs*) *Guidance* (Version 3). SNH

76 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow.

hydrocarbon pollution which could impact on prey species taken by kingfisher, the only QI of this SPA. Direct impacts due to collision risk is considered highly unlikely to result in significant effects for this species, based on the rotor swept area specified and the lower-level flights typically taken by kingfishers as they move up and down water courses.

- The proposed development lies within 14.2 km of the Lough Deravaragh SPA, designated for whooper swan, pochard, tufted duck and coot, as well as the general water bird assemblage, which includes wide ranging waterbird species like golden plover and lapwing. As a windfarm proposal, there is potential for collision risk on QI bird species utilising in the wider area beyond the designated site. On a precautionary basis, wider area surveys and predicted collision risk generated for observed usage of the proposed development by QI species is used to determine potential for significant effects on wintering waterbird populations, specifically through linked to the SPA – see **Section 5.6**.

Without consideration given to the on-site conditions and embed mitigation measures (Best-Practice design stage mitigation), the screening for Appropriate Assessment has concluded that there were likely or possible significant effects on the following Natura 2000 sites:

- Likely Significant Effects on the River Boyne and River Blackwater SAC
- Possible Significant Effects on the River Boyne and River Blackwater SPA
- Possible Significant Effects on the Lough Derrvarragh SPA

Therefore, a Natura Impact Statement (NIS) is required, which is provided in **Section 6**.

Table 1: Screening Matrix A

Potential significant effects matrix for Natura 2000 sites with the potential to be significantly affected by the proposed development

Explanation of terms used in Significance of Impact Matrix:

Likely Significant Effect - Where a plan or project is likely to undermine any of the Natura 2000 site's conservation objectives;

Possible Significant Effect - Where a plan or project has an indicated potential to undermine any of the Natura 2000 site's conservation objectives, but where doubt exists about the risk of a significant effect in the current context. Nevertheless, where doubt exists about the risk of a significant effect, use of the precautionary principle requires this effect to be considered appropriately within the Article 6 assessment.

Sites highlighted in grey have the potential to be affected by the proposed development

Natura 2000 site (Site Code)	**Qualifying Interests (QI's) [QI code]** *** = Priority Habitats**	**Distance to Natura 2000 site from the closest point of the Application Site**	**Within the Zone of Influence?**	**Potential for Significant Effects and nature of potential impact**
River Boyne and River Blackwater SAC (002299)	• River lamprey (*Lampetra fluviatilis*) [1099] • Salmon (*Salmo salar*) [1106] • Otter (*Lutra lutra*) [1355] • Alkaline fens [7230] • Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* [91E0]	*Direct distance: 1.3 km to W towards River Deel section of SAC & 2.2 km E to the Stoneyford River section of SAC* *2.9 km to E from grid connection via hydrological link (EPA stream: Cartenstown – 07C60 to Stonyford River - see **Figure 4**).* *7.9 km via hydrological link from core construction and operational site at Bracklyn, measured from T10 (EPA streams: Bollandstown – 07B45 & Cartenstown – 07C60 to Stonyford River - see **Figure 4**)* *No hydrological link to the W via the River Deel identified*	Yes	**Likely Significant Effects –** ***Construction phase*** Potential water pollution (hydrocarbons, cement leachate and sediment) due to pollution incidents on site and if inappropriate construction practices result in sedimentation. ***Operational phase*** Potential water pollution (sediment, limited hydrocarbons) due to pollution incidents on site and if inappropriately designed infrastructure results in sedimentation. ***Decommissioning & restoration*** Potential water pollution (hydrocarbons and sediment) during the decommissioning and restoration works.
River Boyne and River Blackwater SPA (004232)	• Kingfisher (*Alcedo atthis*) [A229]	*Direct distance: 1.3 km to W of River Deel section of SPA & 2.2 km E to the Stoneyford River section of SPA* *3.1 km to E from grid connection via hydrological link (EPA stream: Cartenstown – 07C60 to Stonyford River - see **Figure 4**).*	Yes	**Likely Significant Effects –** ***Construction phase*** Potential water pollution (hydrocarbons, cement leachate and sediment) due to pollution incidents on site and if inappropriate construction practices result in sedimentation. ***Operational phase***

Natura 2000 site (Site Code)	Qualifying Interests (QI's) [QI code] * = Priority Habitats	Distance to Natura 2000 site from the closest point of the Application Site	Within the Zone of Influence?	Potential for Significant Effects and nature of potential impact
		8.1 km from core construction and operational site at Bracklyn (measured from T10) *8.1 km via hydrological link from core construction and operational site at Bracklyn, measured from T10 (EPA streams: Bollandstown – 07B45 & Cartenstown – 07C60 to Stonyford River - see **Figure 4**)* *No hydrological link to the W via the River Deel identified*		Potential water pollution (sediment, limited hydrocarbons) due to pollution incidents on site and if inappropriately designed infrastructure results in sedimentation. Direct impacts due to collision risk is considered highly unlikely to result in significant effects for this species, based on the rotor swept area specified and the lower-level flights typically taken by kingfishers as they traverse watercourses. ***Decommissioning & restoration*** Potential water pollution (hydrocarbons and sediment) during the decommissioning and restoration works.
Lough Derravarragh SPA (004043)	• Whooper Swan (Cygnus cygnus) [A038] • Pochard (Aythya ferina) [A059] • Tufted Duck (Aythya fuligula) [A061] • Coot (Fulica atra) [A125] • Wetland and Waterbirds [A999]	*14.2 km to the north west, measured from proposed operational site*	Yes	**Possible Significant Effects –** ***Construction phase*** Potential displacement of waterbird species associated with the SPA – due to separation distance it is considered unlikely any effects will be significant ***Operational phase*** Collision risk and potential displacement of waterbird species associated with the SPA. ***Decommissioning & restoration*** Potential displacement of waterbird species associated with the SPA – due to separation distance it is considered unlikely any effects will be significant
Mount Hevey Bog SAC (002342)	• Active raised bogs* [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depression on peat substrates of the Rhynchosporion [7150]	*8.2 km to the south*	No	**No Potential Significant Effect** Given the location of this proposed development (approximately 8.2 km away from this SAC) and the fact that the habitats within the SAC are not hydrologically linked (and the habitats are rain-water fed regardless), it is considered that there is no realistic potential for significant effect.

Natura 2000 site (Site Code)	Qualifying Interests (QI's) [QI code] * = Priority Habitats	Distance to Natura 2000 site from the closest point of the Application Site	Within the Zone of Influence?	Potential for Significant Effects and nature of potential impact
Wooddown Bog SAC (002205)	• Degraded raised bogs still capable of natural regeneration [7120]	*11.5 km to the south-west*	No	**No Potential Significant Effect** Given the location of this proposed development (approximately 11.5 km away from this SAC) and the fact that the habitats within the SAC are not hydrologically linked (and the habitats are rain-water fed regardless), it is considered that there is no realistic potential for significant effect.
Lough Lene SAC (002121)	• Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140] • *Austropotamobius pallipes* (White-clawed Crayfish) [1092]	*9.5 km to the north, north-west* *There is an upstream hydrological connection between the*	No	**No Potential Significant Effect** Given the location of this proposed development (approximately 9.5 km away from this SAC) and the fact that the habitats/species within the SAC are not hydrologically linked it is considered that there is no realistic potential for significant effect. Note: The hydrological link between the proposed development and the SAC, via the Stonyford River, River Boyne and then River Deel was considered, however this connection is a long distance upstream and therefore there is no realistic potential for significant effect
Lough Bane & Lough Glass SAC (002120)	• Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140] • Austropotamobius pallipes (White-clawed Crayfish) [1092]	*10.8 km to the north, north west*	No	**No Potential Significant Effect** Given the location of this project (approximately 10.8 km away from this SAC), and the fact that the habitats/species within the SAC are not hydrologically linked it is considered that there is no realistic potential for significant effect. Note: The hydrological link between the proposed development and the SAC, via the Stonyford River, River Boyne and then River Deel was considered, however this connection is a long distance upstream and therefore there is no realistic potential for significant effect

Natura 2000 site (Site Code)	Qualifying Interests (QI's) [QI code] * = Priority Habitats	Distance to Natura 2000 site from the closest point of the Application Site	Within the Zone of Influence?	Potential for Significant Effects and nature of potential impact
White Lough, Ben Loughs & Lough Doo SAC (001810)	• Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140] • Austropotamobius pallipes (White-clawed Crayfish) [1092]	*12.4 km to the north, north west*	No	**No Potential Significant Effect** Given the location of this project (approximately 12.4 km away from this SAC), and the fact that the habitats/species within the SAC are not hydrologically linked it is considered that there is no realistic potential for significant effect. Note: The hydrological link between the proposed development and the SAC, via the Stonyford River, River Boyne and then River Deel was considered, however this connection is a long distance upstream and therefore there is no realistic potential for significant effect
Girley (Drewstown) Bog SAC (002203)	• Degraded raised bogs still capable of natural regeneration [7120]	*13.9 km to the north east*	No	**No Potential Significant Effect** Given the location of this proposed development (approximately 13.1 km away from this SAC) and the fact that the habitats within the SAC are not hydrologically linked (and the habitats are rain-water fed regardless), it is considered that there is no realistic potential for significant effect.
Boyne Estuary SPA (004080)	• Shelduck (Tadorna tadorna) [A048] • Oystercatcher (Haematopus ostralegus) [A130] • Golden Plover (Pluvialis apricaria) [A140] • Grey Plover (Pluvialis squatarola) [A141] • Lapwing (Vanellus vanellus) [A142] • Knot (Calidris canutus) [A143] • Sanderling (Calidris alba) [A144] • Black-tailed Godwit (Limosa limosa) [A156] • Redshank (Tringa totanus) [A162] • Turnstone (Arenaria interpres) [A169] • Little Tern (Sterna albifrons) [A195]	*More than 70 km to the east via hydrological connection – EPA streams: Bollandstown – 07B45 & Cartenstown – 07C60 to Stonyford River to River Boyne to Boyne Estuary* *Direct distance of c. 55 km to ENE*	No	**No Potential Significant Effect** There is not considered to be any reasonable likelihood of significant effects due to the long distance from the proposed development site, and the massive dilution effects that would necessarily occur over this length of river (*c*. 70 km, source to receptor). This was considered likely to remain the case in the event of a worst-case scenario pollution incident or extensive land slippage at source, with regard also given to the dynamic nature of the receiving (estuarine) environment and relative sensitivities of the QIs for which the Natura 2000 sites are designated.

Natura 2000 site (Site Code)	Qualifying Interests (QI's) [QI code] * = Priority Habitats	Distance to Natura 2000 site from the closest point of the Application Site	Within the Zone of Influence?	Potential for Significant Effects and nature of potential impact
	• Wetland and Waterbirds [A999]			
Boyne Coast & Estuary SAC (001957)	• Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Annual vegetation of drift lines [1210] • Salicornia and other annuals colonising mud and sand [1310] • Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] • Embryonic shifting dunes [2110] • Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120] • Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	*More than 70 km to the east via hydrological connection – EPA streams: Bollandstown – 07B45 & Cartenstown – 07C60 to Stonyford River to River Boyne to Boyne Estuary* *Direct distance of c. 55 km to ENE*	No	**No Potential Significant Effect** There is not considered to be any reasonable likelihood of significant effects due to the long distance from the proposed development site, and the massive dilution effects that would necessarily occur over this length of river (*c*. 70 km, source to receptor). This was considered likely to remain the case in the event of a worst-case scenario pollution incident or extensive land slippage at source, with regard also given to the dynamic nature of the receiving (estuarine) environment and relative sensitivities of the QIs for which the Natura 2000 sites are designated.

Table 2: Screening Matrix B

Qualifying Interests for Natura 2000 sites within the zone of influence

Qualifying Interests in grey have the potential to be affected by the proposed development

Qualifying Interests (QI's) [QI code] * = Priority Habitats	Proximity of the Qualifying Interest to the proposed development site	Qualifying Interest within the Zone of Influence?
NATURA 2000 SITE: River Boyne and River Blackwater SAC (002299)		
River lamprey (*Lampetra fluviatilis*) [1099]	**Downstream hydrological connection to spawning sites**. The Stonyford tributary was considered to only support brook lamprey (O'Connor, 2006)[77]. River lamprey are present in the lower reaches of the Boyne River, downstream of Navan (NPWS, 2014)[78]. The proposed site is linked to the mid and upper reached of the River Boyne, via the Stonyford River. Applying the precautionary principle, this QI is taken to be within the zone of influence.	Yes
Atlantic salmon (*Salmo salar*) [1106]	**Downstream hydrological connection to spawning sites**. Salmon run the River Boyne almost every month of the year and the Boyne is considered important for this species, as it represents an eastern river which holds large three-sea-winter fish (NPWS, 2014). In-stream improvement works on the Stonyford River have created spawning habitat for salmon (Boyne Catchment Angling Association)	Yes
Otter (*Lutra lutra*) [1355]	**Hydrological connection to otter foraging habitat**. Otter can be found throughout the SAC (NPWS, 2014).	Yes
Alkaline fens [7230]	**No source-receptor pathway**. The main areas of alkaline fen in the SAC are concentrated in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough, which are approximately 10 km north of the proposed development. There is no hydrological link between this section of the SAC and the proposed development.	No
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* [91E0]	**Downstream hydrological connection to riverine woodlands**. Wet woodland fringes many stretches of the Boyne. The areas are small and there are few similar examples of this type of alluvial wet woodland remaining in the country, particularly in the north-east (NPWS, 2014). Pollution to surface waters is noted as having an impact on alluvial woodland in Ireland, however the occurrence is low (O'Neill *et al*., 2013)[79].	Yes
NATURA 2000 SITE: River Boyne and River Blackwater SPA (004232)		
Kingfisher (*Alcedo athis*) [A229]	**Hydrological connection to kingfisher foraging habitat**. The SPA encompasses several downstream kingfisher territories on the River Boyne (NPWS, 2010)[80]. Both the River Deel and Stonyford River are	Yes

77 O'Connor W. (2006) A survey of juvenile lamprey populations in the Boyne Catchment. *Irish Wildlife Manuals*, No. 24 NPWS, DoEHLG, Dublin, Ireland.

78 NPWS (2014). River Boyne and River Blackwater SAC (Site Code: 002299). Site Synopsis. Rev 13.Doc. Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002299.pdf [Accessed July 2021].

79 O'Neill, F.H. & Barron, S.J. (2013). Results of monitoring survey of old sessile oak woods and alluvial forests. *Irish Wildlife Manuals*, No. 71. NPWS, DoAHG, Dublin, Ireland

80 NPWS (2010). River Boyne and River Blackwater SPA (Site Code: 004232). Site Synopsis. Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004232.pdf [Accessed July 2019].

Qualifying Interests (QI's) [QI code] * = Priority Habitats	Proximity of the Qualifying Interest to the proposed development site	Qualifying Interest within the Zone of Influence?
	recorded as supporting possible kingfisher breeding territories (Crowe et al., 2008[81] as reported in Cummins *et al*., 2010[82])	
NATURA 2000 SITE: Lough Derravaragh SPA (004043)		
Whooper swan (*Cygnus cygnus*) [A038]	**Potential collision risk species**. A distance of 14.2 km from a site designated for whooper swans would generally be considered beyond the zone of influence, which is based on the typical wintering foraging range of 5 km[83], with Mc Guinness *et al*. (2015)[84] giving a distance of 600 m as the Zone of Sensitivity. Potential for Significant Effects considered on a precautionary basis.	Yes
Pochard (*Aythya ferina*) [A059] **Tufted duck** (*Aythya fuligula*) [A061] **Coot** (*Fulica atra*) [A125]	**No source-pathway-receptor linkages**. As reviewed in Langston & Pullan (2003)[85], these species are reported to be displaced by wind farm developments. However, displacement effects operate over a limited scale (< 500 m), therefore considering the distance between source and receptor (14.2 km) there is no realistic potential for significant displacement effects. Population level effects due to collision with onshore turbines have not been documented for these species and studies using radar found that pochard and tufted duck regularly flew through a wind farm at night under moonlit conditions and altered flight behaviour on darker or foggy nights, by flying at greater distances around turbines (Dirksen *et al*., 1998[86], as cited in Percival, 2003)[87]. Therefore, it is considered that there is no realistic potential for significant population level effects due to collision with turbines.	No
Wetland and Waterbirds [A999]	**Potential collision risk to birds forming waterbird assemblage**. As for whooper swan, potential for significant effects is considered on a precautionary basis, with possible significant effects on more mobile wetland bird species like golden plover and lapwing. Note: Inclusion of the Lough Derrabaragh SPA within this assessment means that by default ecological connectivity to other waterbird SPAs (as listed in **Table 3**) is also covered.	Yes

81 Crowe, O., G. Webb, E. Collins & Smiddy, P. (2008). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on two SAC river systems in Ireland*. A report commissioned by the NPWS & prepared by BirdWatch Ireland.

82 Cummins, S., Fisher, J., Gaj McKeever, R., McNaghten, L. & Crowe, O. (2010). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland*. A report commissioned by the NPWS & prepared by BirdWatch Ireland.

83 Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas* (*SPAs*) *Guidance* (Version 3). SNH

84 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow.

85 Langston, R.H.W. & Pullan, J. (2003). *Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues*. RSPB/BirdLife.

86 Dirksen, S., Spaans, A.L., & Winden, v.d.J. (1998). Nocturnal collision risks with wind turbines in tidal and semi-offshore areas. In Wind Energy and Landscape. Proc. 2nd European and African Conference on Wind Engineering, 1997., 99-108

87 Percival, S. M. 2003. *Birds and wind farms in Ireland: A review of potential issues and impact assessment*. Ecology Consulting, Coxhoe, Durham

Table 3: SPAs surrounding the proposed development

Natura 2000 site	Code	Distance to Natura 2000 site from the closest point of the proposed operational site	Qualifying Interest (QI) Grey indicates Possible Significant Effects on SPA populations due to operational wind farm – (collision, displacement and/or barrier effects)
Lough Derravarragh SPA	004043	14.2 km	Whooper Swan (Cygnus cygnus) [A038] Pochard (Aythya ferina) [A059] Tufted Duck (Aythya fuligula) [A061] Coot (Fulica atra) [A125] Wetland and Waterbirds [A999] – Waterbird assemblage
Lough Owel SPA	004047	17.9 km	Shoveler (Anas clypeata) [A056] Coot (Fulica atra) [A125] Wetland and Waterbirds [A999] – Waterbird assemblage
Lough Ennell SPA	004044	20.0 km	Pochard (Aythya ferina) [A059] Tufted Duck (Aythya fuligula) [A061] Coot (Fulica atra) [A125] Wetland and Waterbirds [A999] – Waterbird assemblage
Lough Iron SPA	004046	23.9 km	Whooper Swan (Cygnus cygnus) [A038] Wigeon (Anas penelope) [A050] Teal (Anas crecca) [A052] Shoveler (Anas clypeata) [A056] Coot (Fulica atra) [A125] Golden Plover (Pluvialis apricaria) [A140] Greenland White-fronted Goose (Anser albifrons flavirostris) [A395] Wetland and Waterbirds [A999] – Waterbird assemblage
Garriskil Bog SPA	004102	24.6 km	Greenland White-fronted Goose (Anser albifrons flavirostris) [A395]
Lough Sheelin SPA	004065	28.9 km	Great Crested Grebe (Podiceps cristatus) [A005] Pochard (Aythya ferina) [A059] Tufted Duck (Aythya fuligula) [A061] Goldeneye (Bucephala clangula) [A067] Wetland and Waterbirds [A999] – Waterbird assemblage
Lough Kinale & Derragh Lough SPA	004061	29.6 km	Pochard (Aythya ferina) [A059] Tufted Duck (Aythya fuligula) [A061] Wetland and Waterbirds [A999] – Waterbird assemblage
Glen Lough SPA	004045	32.3 km	Whooper Swan (Cygnus cygnus) [A038]

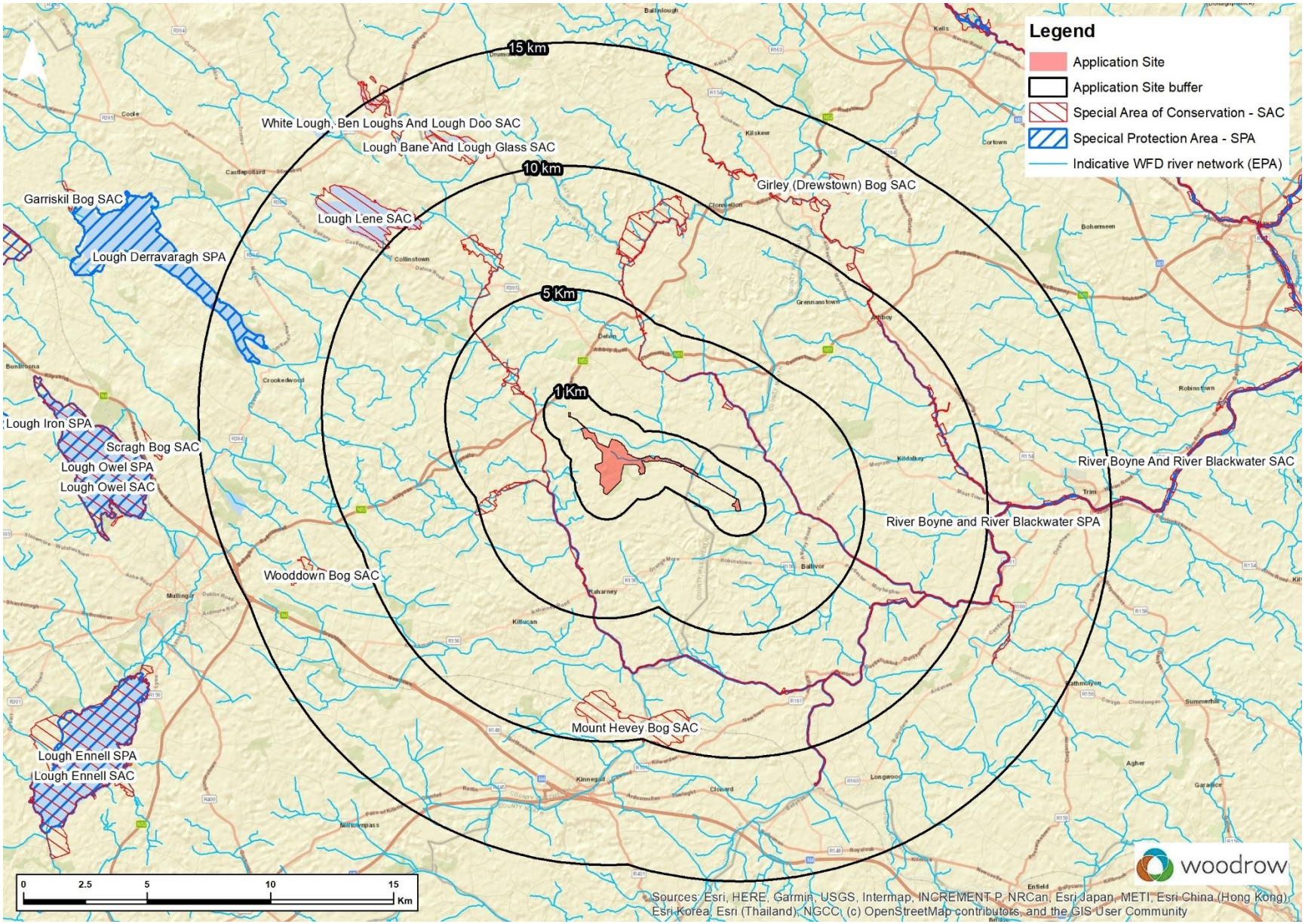

Figure 3: Natura 2000 sites within 15 km of the proposed development

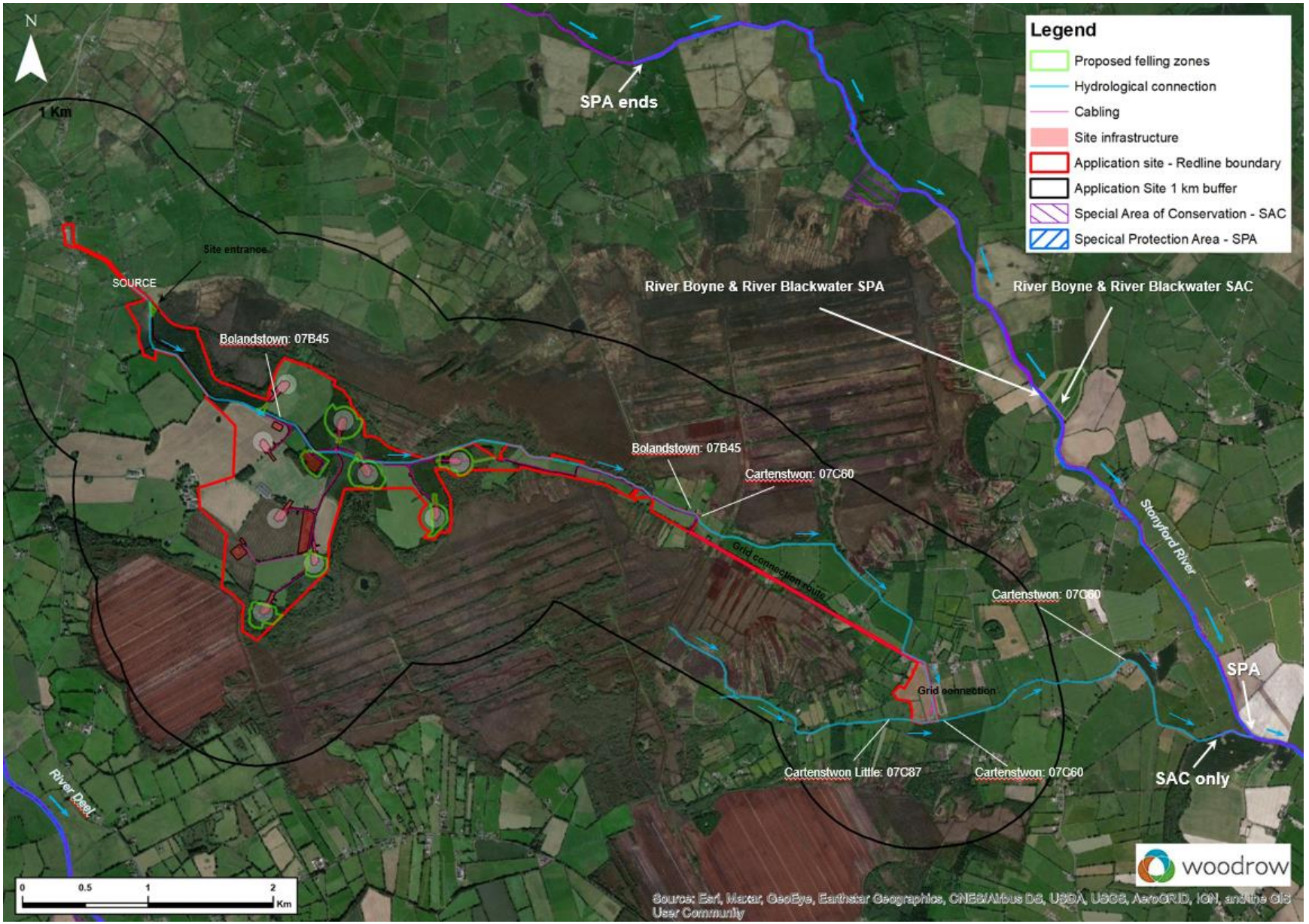

Figure 4: Simplified surface water map illustrating hydrological connection between the proposed development and Natura 2000 sites

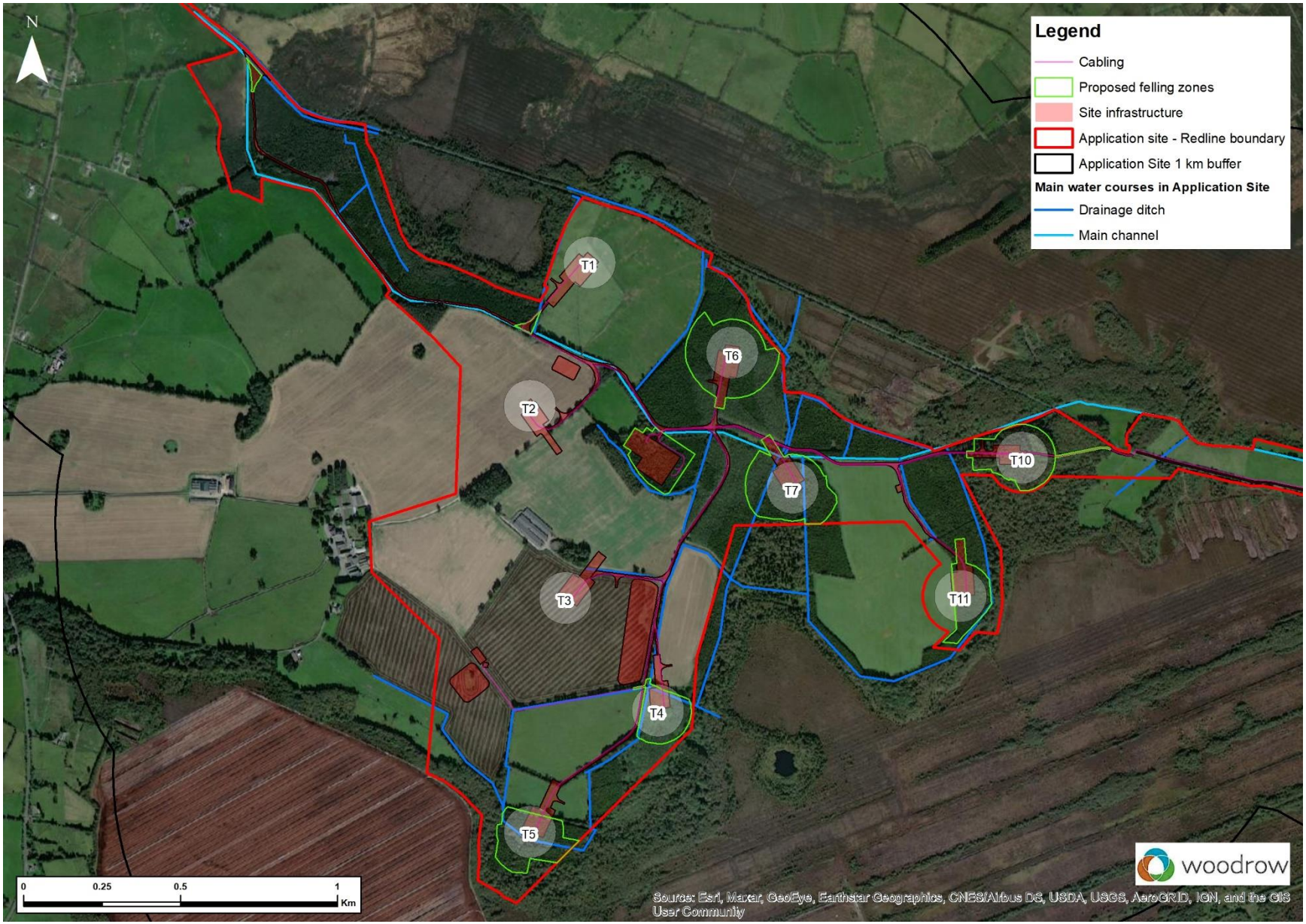

Figure 5: Simplified surface water map illustrating the drainage system within the proposed wind farm

5 SURVEY RESULTS

5.1 Mammals

Otters *Lutra lutra* are a Qualifying Interest of the River Boyne and River Blackwater SAC and are reported as occurring throughout the SAC (NPWS, 2014)[88]. Otter signs are reported for both the River Deel and Stonyford River, to the west and east respectively of the proposed development (Bailey & Rochford, 2006)[89].

During surveys for protected mammals, otter signs (spraints) were recorded in several locations along drainage channels within the proposed development site. No otter holts or layups were located within the proposed development site. Based on the signs observed it is considered that otters utilise the network of drains to commute through the area, and Bracklin Lough, which lies just outside the proposed development site, is likely to offer the only substantial foraging opportunities for otter. The lough is reported to have been stocked with fish.

The results from walkovers surveys are provided in **Appendix 5** and show the distribution of otter signs recorded within the proposed development site.

5.2 Freshwater ecology – fisheries assessment

The aquatic ecology survey report for the proposed development is provided in **Appendix 2**.

Salmon *Salmo salar* and river lamprey *Lampetra fluviatilis* are a Qualifying Interest of the River Boyne and River Blackwater SAC. The healthiest population of river lamprey are reported as occurring in the lower reaches of the Boyne River main channel downstream of Navan and the Stonyford tributary was considered to only support brook lamprey (O'Connor, 2006)[90]. Salmon run the River Boyne almost every month of the year and the Boyne is considered important for this species, as it represents an eastern river which holds large three-sea-winter fish (NPWS, 2014)[91]. In-stream improvement works on the Stonyford River are reported as having created spawning habitat for salmon (Boyne Catchment Angling Association).

The main drain/stream flowing through the proposed development site (EPA stream: Bolandstown – 07B45) was found to be unsuitable for spawning salmon and lamprey. The proposed development site is at the upper reaches of a tributary of the Stonyford River that is subject to periodic drainage maintenance works. Drainage also has a negative effect on the occurrence of white-clawed crayfish *Austropotamobius pallipes*; and therefore, it is considered unlikely that this species occurs in this watercourse. Salmon and lamprey spawning habitat and white-clawed crayfish are noted as occurring downstream of the proposed development. White-clawed crayfish have been recorded from the catchment of

88 NPWS (2014). Site Synopsis: River Boyne and River Blackwater SAC [Site Code: 00229]. National Park & Wildlife Service

89 Bailey, M. & Rochford J. (2006). Otter Survey of Ireland 2004/2005. *Irish Wildlife Manuals*, No. 23. NPWS, DoEHLG, Dublin, Ireland.

90 O'Connor W. (2006) A survey of juvenile lamprey populations in the Boyne Catchment. *Irish Wildlife Manuals*, No. 24 NPWS, DoEHLG, Dublin, Ireland.

91 NPWS (2014). Site Synopsis: River Boyne and River Blackwater SAC [Site Code: 00229]. National Park & Wildlife Service

the Stonyford River, with the closest existing downstream record coming from the Earl's Bridge Hydrometric area (Station Code: RS07S020400).

5.3 Habitat suitability assessments for other Annex II species

Initial scoping surveys, multi-disciplinary surveying and the desk-based study determined that, other than otter, there are no other species listed on Annex II of the Habitats Directive potential impacted by the proposed development and that are ecologically linked to Natura 2000 sites.

Based on a lack of suitable habitats no specific terrestrial invertebrate surveys were required for *Vertigo* species. The Kerry slug has a distribution in Ireland limited to the southwest of the country and has not been recorded in Co. Westmeath or Co. Meath (NPWS, 2019)[92].

For marsh fritillary, the closest designated site to the proposed development traditionally holding marsh fritillary butterflies is Scragh Bog SAC, which is 18 km SW of the proposed development site. There are recent records (2015) from the bog lying to the south of the proposed development site (see Biodiversity maps)[93], and an adult butterfly was recorded in this bog during bird surveys. In Ireland the occurrence of this species is largely restricted to locations where the larval foodplant devil's-bit scabious (*Succisa pratensis*) occurs (Harding, 2008[94] and Hickin, 1992[95]). The extent of devil's-bit scabious within the lands-made-available for the project was limited to a few very small patches and it was totally non-existent in areas occupied by the proposed development footprint. The closest significant stands of devil's-bit scabious were recorded around Bracklin Lough, *c*. 300 m from the closest turbine. Therefore, based on lack of suitable habitat within the potential Zone of Influence, no marsh fritillary web surveys were required and the proposed development site was assessed as unsuitable for this species.

In relation to aquatic invertebrates, the network of ditches and channels draining the proposed development site are within the River Boyne catchment, which does not support a freshwater pearl mussel population (NPWS, 2019). Therefore, no surveying or assessment was required for this species. As detailed in **Section 5.2**, no specific white-clawed crayfish surveys were undertaken beyond habitat assessment of the watercourses within the proposed development site. Based on NPWS (2019), there were no records for the 10-km covering the proposed development site [N65], although it was within the range for this species, which is known to occur in the catchment for the Stonyford River. However, the proposed development site is at the upper reaches of a tributary of the Stonyford River that is subject to periodic drainage maintenance works, which has a negative effect on the occurrence of this species. Therefore, it is considered unlikely that crayfish occur in the main ditch/stream flowing through the proposed development site. In addition, the predominately heavily shaded ditches and channels in the proposed development site, along with evidence of nutrient enrichment, are potential negative factors for the healthy occurrence of populations of this species.

92 NPWS (2019). *The Status of EU Protected Habitats and Species in Ireland*. Volume 3: Species Assessments. Unpublished NPWS report. Ed. by: Deirdre Lynn, D. & O'Neill, F.

93 Biodiversity maps available at: https://maps.biodiversityireland.ie/Map

94 Harding, J.M. (2008). Discovering Irish Butterflies and their Habitats.

95 Hickin, N. (1992). *The Butterflies of Ireland: A Field Guide*. Robert Rinehart, Cork

5.4 Habitat surveys

Appendix 4 provides habitats of the proposed development site and **Table A4.1** lists areas of habitat types affected by the footprint of the proposed development.

The proposed development site is highly modified, being dominated by commercial forestry plantations, improved agricultural grassland and tillage. The only Annex I habitat type listed as a Qualifying Interest (QI) for an SAC and identified as potentially occurring within the Zone of Influence of the proposed development, was Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* [91E0]. This wet woodland fringes stretches of the River Boyne and although areas appear small, there are few similar examples of this type of alluvial wet woodland remaining in the country, particularly in the north-east[96]. Alkaline fens [7230] is the only other QI habitat type listed for the River Boyne and River Blackwater SAC. However, there is no hydrological link between the proposed development and sections of the SAC supporting this habitat in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough, approximately 10 km north of the proposed development.

During surveys to map the habitat types within the proposed development site, as per Fossitt (2000), the only example of Annex I type recorded was [91D0] bog woodland[97], which occurred in a thin strip between T10 and T11. This small area of Annex I habitat is not designated within an SAC or other nationally/locally designated site. Annex I bog woodland is a rare habitat type in Ireland and usually occurs on stands with fairly high water-tables (Cross *et al*., 2010[98], Perrin *et al*., 2008[99]). Therefore, one of the main sensitivities of this habitat is alteration of water levels. As shown in **Plate 1**, this area is dominated by a birch *Betula pubescens* canopy and supports a dense bryophyte ground cover, meeting the Annex I characteristics outlined in Cross & Lynn (2013)[100]. Other species recorded included willow *Salix aurita*, broad buckler fern *Dryopteris dilatata,* soft rush *Juncus effusus*, purple moor-grass *Molinia caerulea*, bilberry *Vaccinium myrtillus*, ling heather *Calluna vulgaris*, and some areas had a dense bryophyte cover including *Polytrichum commune* and the peat mosses *Sphagnum fimbriatum* and *Sphagnum fallax*.

On the periphery of the proposed development the occurrence of other habitats potentially qualifying as Annex I have been identified including alkaline fen and the remnants of raised bog habitat. The oak-birch-holly woodland habitat corresponds to the QL Sessile oak-woodrush (*Quercus petraea – Luzula sylvatica*) woodland type (Cross *et al*., 2010)[101], and supports indicators of the Annex 1 Habitat Old Sessile Oak Woods [91A0] (O'Neil & Barron, 2013)[102].These habitats are not designated within SACs, but are recognised at the county

96 NPWS (2014). River Boyne and River Blackwater SAC (Site Code: 002299). Site Synopsis. Rev 13.Doc. Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002299.pdf [Accessed July 2021].

97 EC (2007): Interpretation manual of European Union habitats – EUR27.

98 Cross, J.; Perrin; P. & Little, D. (2010). *The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management*. Native Woodland Information Note No. 6. NPWS, BEC Consultants Ltd & Woodlands of Ireland

99 Perrin P., Martin J., Barron S. O'Neil F., McNutt K. & Delaney A. (2008) *National Survey of Native Woodlands 2003-2008*. Volume I: Main report. Botanical, Environmental & Conservation Consultants Ltd. report submitted to the NPWS

100 Cross, J. & Lynn, D. (2013) Results of a monitoring survey of bog woodland. *Irish Wildlife Manuals* No. 69. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

101 Cross, J.; Perrin; P. & Little, D. (2010). *The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management*. Native Woodland Information Note No. 6. NPWS, BEC Consultants Ltd & Woodlands of Ireland

102 O'Neill, F.H. & Barron, S.J. (2013) Results of monitoring survey of old sessile oak woods and alluvial forests. *Irish Wildlife Manuals*, No. 71. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

level within the Co. Westmeath BAP 2014-2020[103], as Bracklin Wood and Lisclogher Bog. Habitats listed for these sites include: raised bog, fen, bog woodland and oak-birch-holly woodland, with parts of the woodland classed as long-established woodlands (LEW – type I). LEWs have been continuously wooded since 1830, with the sub-category LEW (I) being used for stands where no evidence of antiquity could be found in older documentation (Perrin & Daly, 2010)[104].

Plate 1: Annex I bog woodland [91D0] south of T10

5.5 Non-native species

Appendix 4 provides maps showing the distribution of non-native plant species recorded during surveys. **Table A4.2** in **Appendix 4** provides a list of non-native species recorded within the proposed development site, along with the legal status of these species as invasive alien species (IAS), risk ratings, notes on propagation pathways and occurrence within the site.

No plant species listed under the Third Schedule of the European Communities (Birds and Habitats) Regulations 2011 as 'non-native species subject to restrictions under Regulations 49' were recorded within the proposed development site. The most abundant and widely distributed non-native species, aside from commercially planted conifers (mostly Sitka spruce and some larch) was cherry laurel *Prunus laurocerasus*. Other non-native species recorded within the wind farm site were (like cherry laurel) probably planted to provide cover

103 County Westmeath Biodiversity Action Plan 2014-2020. Available at: http://www.westmeathcoco.ie/en/media/Westmeath%20Biodiversity%20Action%20Plan%2020142020.pdf

104 Perrin, P.M. & Daly, O.H. (2010). A provisional inventory of ancient and long-established woodland in Ireland. *Irish Wildlife Manuals*, No. 46. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

for game birds and included snowberry *Symphoricarpos albus* and evergreen species of honeysuckle shrubs (*Lonicera* species) like Wilson's honeysuckle (*L. nitida*) and box-leaved honeysuckle (*L. pileata*). These non-native shrubs, cherry laurel in particular, have the potentially to negatively impact on woodland habitats within the development site, such the Annex I bog woodland occurring south of T10. The non-native species currently occurring within the proposed development site were not considered likely to impact on the integrity of any Natura 2000 sites, due to separation distances and lack of vector route (for the species occurring) to any designated sites.

5.6 Bird survey results

In order to inform the NIS, this section provides the relevant results from a two-year ornithological study conducted for the proposed development site between Oct-2018 and Aug-2020, which was conducted in compliance with SNH (2017) survey guidelines for assessment of potential ornithological impacts at onshore wind farms. An additional season of full SNH (2017) specification surveys were undertaken over another non-breeding season covering the period Oct-2020 to Mar-2021. The results from the additional season were reviewed and this provides useful information in support of the findings from the previous two winter seasons. Additional information has been incorporated into this assessment where relevant, including hen harrier observations of which none were recorded over the first two years. Detailed results of the ornithological baseline surveys are contained within **Appendix 6** and with the CRM report provided in **Appendix 7**. This section focuses on results generated for:

- Habitat suitability for kingfisher and potential for ecological linkages between the proposed development and the River Boyne and Blackwater SPA, which is located 3.1 km downstream of the grid connection and 8.1 km downstream of the proposed operational development (as measured from T10).
- The occurrence of waterbirds species in the environs of the proposed development to determine if there are any ecological linkages between bird usage and SPAs designated for the assemblages of waterbirds, as well as specific species, as listed in **Table 3**. These SPAs are distributed within 14 to 32 km from the proposed operational development site.
- The occurrence of bird species listed on Annex I of the Birds Directive recorded to determine the occurrence of SPAs within the potential zone of influence.
- As detailed in **Appendix 7** collision risk modelling was undertaken for target species (raptors and waterbirds) generating sufficient flight time within the collision risk zone of the proposed development (flight second at collision risk height within the 500 m turbine buffer)

Over the study period eight species listed on Annex 1 of the EC Bird's Directive recorded, including:

- Little egret
- Whooper swan
- Greenland white-fronted goose
- Golden plover
- Hen harrier
- Merlin

- Peregrine
- Gyrfalcon

During VP watches flight lines for seven species listed on Annex I of the Birds Directive were recorded. Apart from an *ad hoc* record of gyrfalcon, no additional Annex I species were detected during site walkovers or wider area surveys. Kingfisher, although not recorded, are assessed as the only QI species listed for the River Boyne and River Blackwater SPA.

The results of VP watches are summarised in **Table 4**, which provides numbers of observations and flight seconds within the 500 m turbine buffer in different height bands. The predicted collision risk for selected target species is shown in **Table 5.** Flight line maps are provided in **Appendix 6**.

5.6.1 Kingfisher

There is a potential hydrological connection between the proposed development and downstream kingfisher foraging habitat within River Boyne and River Blackwater SPA. The SPA encompasses several downstream kingfisher territories on the River Boyne (NPWS, 2010)[105]. Both the River Deel and Stonyford River are recorded as supporting possible kingfisher breeding territories (Crowe et al., 2008[106] as reported in Cummins *et al*., 2010[107])

It is considered likely that kingfishers commute along the network of streams and drains flowing into the SPA and could travel as far as the proposed development site. The larger drains were assessed as providing some potential to support prey for this species (invertebrates, small fish and frogs). Likewise, the bog pool (Bracklin Lough) adjacent to the proposed to the proposed developed site has the potential to support prey items.

Kingfisher habitat suitability surveys conducted along the main channel flowing through the proposed development found that this watercourse does not provide suitable banks for nesting kingfishers. For a couple of very short sections with steeper banks, the substrate was considered unsuitable for nest holes, being layers of hard/crusted gleys and friable gravels. Bracklyn Farm is at the 'headwater' of the arterial drainage system flowing into the SPA; and therefore, considering the limited habitat suitability within the 500 m turbine buffer, the predicted usage of the area by kingfisher would be anticipated to be periodic and relatively low. This is supported by the lack of kingfisher records during the study period. As such, the proposed development site is not considered important for kingfisher, and potential for significant effects on this species relate to downstream effects on water quality of the within River Boyne and River Blackwater SPA, in the absence of mitigation, affecting prey availability.

5.6.2 Whooper swan

As shown in **Table 3** whooper swans are a QI species listed for three SPAs to the west of the proposed development, including Lough Derrvaragh SPA. Whooper swans were only

105 NPWS (2010). River Boyne and River Blackwater SPA (Site Code: 004232). Site Synopsis. Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004232.pdf [Accessed July 2019].

106 Crowe, O., G. Webb, E. Collins & Smiddy, P. (2008). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on two SAC river systems in Ireland*. A report commissioned by the NPWS & prepared by BirdWatch Ireland.

107 Cummins, S., Fisher, J., Gaj McKeever, R., McNaghten, L. & Crowe, O. (2010). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland*. A report commissioned by the NPWS & prepared by BirdWatch Ireland.

recorded five times during VP watches, with just two flights recorded within the 500 m turbine buffer (amounting to 598 seconds), one of which was a flock of 7 birds commuting through the area at *c*. 10 m (below the collision risk zone - CRZ) on 19-Mar-2020. The other on-site observation was of 4 birds commuting at 30 to 40 m on 25-Oct-2020. The three observations just beyond the turbine buffer were records of small numbers of whooper swans (1 to 4 birds), one of which included a single bird foraging/loafing in a flooded field of improved grassland west of the turbine buffer and Bracklyn House. Similar flight behaviour was recorded during the third winter season (2020-21), with six flight lines recorded (2 to 11 birds) and only four with birds commuting through the buffer. No collision risk modelling was undertaken for this species as flight time in the CRZ was below the threshold of 200 seconds.

Wider area surveys have detected whooper swan flocks at three locations along the River Deel and one along the Stonyford River, including:

- Caddagh, north of the N52 near Lough Analla, 3-4 km NNW of the site: up to 60 birds were regularly recorded foraging in improved pasture on the eastern bank of the River Deel and associated with Lough Analla
- Killagh (2 birds) and Priesttown (2 birds), in improved pasture on the western bank of the River Deel within *c*. 2.5 to 3 km of Bracklyn - not regularly recorded in the area
- Cereal stubble field along the Stonyford River (N of Ballivor), *c.* 5.5 km E of the site: flock of *c.* 270 birds was recorded once on 11-Dec-2020 (area not always covered on wider area surveys)
- South of Raharney, approx. 6.5 km south of the 500 m turbine buffer: 80 to 100 birds associated with the ponds/lagoons of Shay Murtagh Precast Ltd. This is a well-known roost site and foraging area.

Aside from the record from the Stonyford River flock (*c.* 270 birds) numbers recorded have not exceeded Nationally Important thresholds (150 birds) over three winters.

Habitat suitability within the 500 m turbine buffer would be considered superficially good for whooper swans, with relatively large fields of improved grassland, cereal stubbles and root crops. However, a combination of the distance from potential roost sites and the efficiency with which fields are harvested (e.g. limited spilt grain and rapid re-seeding of stubble with turnip crops over the winter), are likely to be factors limiting usage of the site by whooper swans.

Overall, the proposed development site is not considered an important foraging or roosting area for whooper swans. Locations utilised in the wider area are considered to be beyond the zone of influence for this species. There is no regularly used flight paths between roosts and foraging through the 500 m turbine buffer. Small flocks (up to 11 birds) sporadically commute through the 500 m turbine buffer. Therefore, it can be objectively concluded that the proposed development site is beyond the zone of influence of any SPAs designated for whooper swan.

5.6.3 Greenland white-fronted goose

As shown in **Table 3**, Greenland white-fronted geese are a QI species listed for two SPAs to the west of the proposed development. There was only one observation of this species flying through the 500 m turbine buffer on 02-Oct-2020. This observation involved a flock of 42 birds recorded as being on autumn passage (migrating) and flew northeast through the

proposed development site at heights of > 175 m, which is just within the CRZ; although at times during the flight the flock, or birds within the flock, were judged to be slightly higher than the maximum proposed tip height (185 m). As a precaution the cumulative flight seconds for the flock were all assigned to the CRZ. There was another relatively high (*c*. 100 m) commuting flight that was tracked just beyond the 500 m turbine buffer on 15-Nov-2019 and involved a single bird travelling north. Collision risk modelling based on the single record was undertaken. The predicted collision rate (weighted and applying an avoidance rate of 99.5%) for Greenland white-fronted geese was 0.18 collisions over 30 years, equivalent to 1 bird every 169 years. This is considered well below background mortality for this species.

The lack of records over the following autumn passage window (2019), as well as no records for the return spring passage periods in 2019 and 2020, would suggest that Bracklyn is not located on a well-established or heavily utilised migration route. The additional winter 2020-21 surveys did not record any geese flights.

It should also be acknowledged that birds travelling overnight would go undetected using standard VP methodology, which only samples day-light hours. Studies using satellite tags to track species during spring migration (Glahder *et al*., 1999[108] & Fox *et al*. 2003[109]) indicate that a relatively wide migration corridor may be used, possibly extending over 100 km wide and birds were found to travel up the eastern part of country in early to mid-April, potentially covering an area that could overfly the proposed development site. Therefore, the proposed development can be considered as occurring on a dispersed migration route for Greenland white-fronted geese; however, during migration flights birds tend to fly high (up to 3 km) and are therefore likely to avoid the collision risk zone of the proposed turbines.

The wider area wintering water bird surveys did not record any Greenland white-fronted geese in the environs of the proposed development site. The closest significant flock is associated with Lough Derravarragh, Lough Owel, Lough Ennell and Lough Iron, which supported maximum counts of 217 birds over winter 2018-19 and 280 birds over winter 2019-20 (Fox *et al*., 2019[110] & Fox *et al*., 2020[111]). This complex of loughs (Midlands loughs) is located between *c*. 14 km and *c*. 26 km from the 500 m turbine buffer for proposed development. Lough Iron SPA and Garriskil Bog SPA are designated for Greenland white-fronted geese. However, distances between the Midlands loughs complex and the proposed development site were considered beyond the core winter foraging range (from night roosts) assigned to this species by SNH (2016)[112] as 5 to 8 km, i.e. sites designated for this species are beyond the zone of influence of the proposed development.

In summary, the proposed development is not important for any over wintering flocks of foraging or roosting Greenland white-fronted geese and is beyond the zone of influence for any known sites utilised by this species. The proposed development site can be considered

108 Glahder, C.M., Fox, A.D. & Walsh, A.J. (1999). Satellite tracking of Greenland White-fronted Geese. *Dansk Ornitologisk Forenings Tidsskrift* 93: 271-276.

109 Fox, A.D., Glahder, C.M. & Walsh, A.J. (2003) Spring migration routes and timing of Greenland white-fronted geese – results from satellite telemetry. *Oikos* 103:2 414-425

110 Fox, T., Francis, I., Norriss, D. & Walsh, A. (2019). *Report of the 2018/19 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

111 Fox, T., Francis, I., Norriss, D. & Walsh, A. (2020). *Report of the 20119/20 International census of Greenland white-fronted geese*. Greenland White-fronted Goose Study, Rønde, Denmark and Wexford, Ireland.

112 Scottish Natural Heritage (2016). Avoidance rates for the onshore SNH wind farm collision risk model. SNH.

as occurring on a diffuse migration route for Greenland white-fronts, with relatively small flocks likely to pass through the area sporadically, as birds disperse to wintering grounds over the autumn and possibly during the spring on return passage. Therefore, the proposed development site is considered of limited importance for this species and it can be objectively concluded that the proposed development site is beyond the zone of influence of any SPAs designated for Greenland white-fronted geese.

5.6.4 Golden plover

As shown in **Table 3**, golden plover are a QI species listed of the Lough Iron SPAs more than 20 km to the west of the proposed development site.

For the proposed development, small numbers (< 100 birds) and occasionally medium sized flocks (up to 500 birds) were recorded utilising the 500 m turbine buffer over the winter. The majority of flight line observations were of < 100 birds. Records were often associated with birds utilising foraging opportunities in the arable fields in the western part of the buffer, however, birds were not always present in the area. Wider area surveys did not locate alternative foraging/roosting sites within 2-5 km of the site and it is considered that usage of the areas is largely opportunistic by over wintering flocks that utilise a wide geographic area in a highly dispersed manner. The highest count of 520 birds was a flock recorded on a breeding season walkover (17 Apr 2019), suggesting that birds on passage may increase numbers marginally.

Numbers recorded over three winters have not exceeded Nationally Important thresholds (920 birds). The closest areas noted as supporting Nationally Important numbers are all more than 20 km from the proposed development, including Lough Iron (*c.* 24 km W), Tara Mines (26 km NE) and Lough Ramor (25 km north). Other important golden plover sites along the east coast (Dublin Bay, Baldoyle Bay, Dundalk Bay, Nany Estuary), Lough Ree and at the Curagh in Co. Kildare are more than *c.* 50 km from the proposed development.

Any affiliations of the golden plover utilising Bracklyn was not established and based on counts for IWeBS sites in the area a regional population estimate of 1,400 to 2,000 birds was used to access population level impacts. However, it is acknowledged that consideration at a regional or county population level is problematic as an accurate population estimate for this part of Westmeath/Meath is not available; and several thousand birds may periodically move into the region depending on weather and ground conditions. In this respect, given the highly mobile nature of inland flocks, it may not be appropriate to apply a regional population estimate to an area where birds are not particularly sedentary over the winter.

VP watches conducted for the proposed development generated 29 golden plover observations, which cumulatively amounted to 1,341,077 seconds of flight line data within the 500 m turbine buffer, all of which was determined to be at collision risk height. As detailed in **Appendix 7**, predicted collision risk (weighted and applying an avoidance rate of 98%) was 129 collisions over 30 years. Applying an annual adult survival rate of 0.73 (Sandercock, 2003; as cited by Robinson, 2005 in BTO BirdFacts)[113], it is estimated that the number of collisions required to produce a 1% increase over baseline mortality would be 218

113 Sandercock, B.K. (2003). Estimation of survival rates for wader populations: a review of mark-recapture methods. *Wader Study Group Bulletin* 100:163-173. As published on http://www.bto.org/birdfacts - BTO BirdFacts | Golden Plover, (accessed on 06-May-2021) citation: Robinson, R.A. (2005) *BirdFacts: profiles of birds occurring in Britain & Ireland*. BTO, Thetford

collisions/annum based on the Irish wintering population (80,707 birds)[114], or 3.7 to 5.4 collisions/annum based on the estimated regional/local wintering population (1,400 to 2,000 birds). Based on predicted collisions (4.3 collision/annum) the additional annual mortality on the regional/local population is estimated to have a negligible to low effect adding an 0.80 to 1.14% on annual mortality.

However, the collision risk model run for golden plover is considered precautionary in terms of avoidance rates. A species-specific avoidance rate is not provided for golden plover and therefore the default 98% rate was applied, as per SNH (2018)[115] guidelines. It has been suggested that the default rate may be appropriate for breeding population, as encountered in Scotland. However, post-construction monitoring studies indicate that higher avoidance rates should be applied for non-breeding golden plovers; and rates of 99.5 to 99.8% may generate more realistic modelled outputs, which are in line with avoidances rates applied for wintering geese (SNH, 2013)[116]. Therefore, in terms of predicted collision risk the impact assessment veers towards a negligible effect on the local population (< 1% population effect) and an assessment of Not Significant (as per Percival, 2003). Running the model using 99.5 and 99.8% avoidance rates generates lower predicted collision outputs of 1 collision every 0.9 and 2.3 years, equating to additional annual mortality of 0.2 to 0.08% on the local golden plover population.

Collision risk for wader species, including golden plovers are generally considered to be low due to manoeuvrability in flight (Mc Guinness *et al*., 2015)[117]. In terms of recorded turbine mediate morality Hötker *et al*. (2006), assessing 127 wind farms across Europe only cites four golden plover collisions. However, this review does not control for survey effort, scavenging rates or surveyor detection rates. A dedicated study systematically searching turbines for victims of collisions undertaken at wind farms on a bird migration route in northern Germany (Fehmarn) detected a total of three golden plover fatalities (Grünkorn, 2011[118] and Grünkorn, 2015)[119].

Overall, the proposed development site was considered to have local importance for this species over the winter, occasionally providing foraging opportunities in tillage fields for a relatively small number of golden plovers. Usage of the area is related to occurrence of foraging opportunities on exposed soil provided by arable farmland. Based on the negligible to low magnitude of effects anticipated in terms of collision risk and displacement on the local golden plover population, it can be objectively concluded that the proposed development site is beyond the zone of influence of any SPAs designated for this species or where golden plover form part of the waterbird assemblage (Wetlands & Waterbirds A999).

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114 Lewis, L. J., Burke, B., Fitzgerald, N., Tierney, T. D. & Kelly, S. (2019). Irish Wetland Bird Survey: Waterbird Status and Distribution 2009/10-2015/16. *Irish Wildlife Manuals*, No. 106. NPWS, Department of Culture, Heritage and the Gaeltacht, Ireland

115 SNH (2018). Avoidance Rates for the Onshore SNH Wind Farm Collision Risk Model. Scottish Natural Heritage.

116 SNH (2013). Avoidance rates for wintering species of geese in Scotland at onshore wind farms. Scottish Natural Heritage.

117 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow

118 Grünkorn, T. (2011). Bird fatalities at wind turbines - How many birds actually collide with wind turbines at a well-known hotspot of bird migration, the island of Fehmarn in northern Germany? Poster for Conference on wind energy and wildlife impacts (CWW-2011), Norway

119 Grünkorn, T. (2015). A large-scale, multispecies assessment of avian mortality rates at onshore wind turbines in northern Germany (Progress). Conference on wind energy and wildlife impacts (CWW-2015), Berlin

5.6.5 Little egret

In spite of the Annex I status, there are no SPAs designated for little egret in Ireland as this species is a recent colonist and the population has been steadily increasing and spreading across the country. A single bird was recorded commuting through the turbine buffer within the collision risk zone during VP watches on 07-Dec-2018. The arterial drains within the 500 m turbine buffer provide some potentially suitable foraging habitat for this species; however, usage of the proposed development site was not detected and this is likely to be a function of better foraging conditions occurring in the wider area. The watercourses (highly channelised streams) associated with the proposed development site were predominately steep banked, backed by plantations and overhung with scrub and trees, and these enclosed conditions are likely to make them less attractive to foraging little egret. This species was not recorded during wider area surveys; however, little egret can be under recorded, as birds tend to occur in low densities and are often obscured from view below the banks of rivers and drainage lines.

Overall, based on low recorded usage of the area, the proposed development site is not considered important for this species.

5.6.6 Waterbird assemblage

As listed in **Table 3**, there are six SPAs within 14 to 32 km of the proposed development where Wetlands and Waterbirds are designated as a QI, including Lough Derravarragh SPA.

As shown is **Table 4**, the abundance of wintering waterbirds and frequency of use was considered low during the two-year baseline study for the proposed development and this was mirrored by wider area surveys. Based on recorded densities of use and distances of the proposed development to the designated sites, it is considered that the proposed development site is beyond the zone of influence of any SPAs designated for Wetlands and Waterbirds and QI species, including species that make up the wintering waterbird assemblage - notably lapwing, golden plover and Greenland white-fronted geese. Over three winters, there was only one winter record of 16 lapwing flying within the CRZ.

5.6.7 Hen harrier

In relation to the proposed development, the closest SPAs designated for breeding hen harriers are the Slieve Blooms SPA and the Slieve Beagh SPA, which are located 53 km SW and 85 km N, respectively.

Hen harriers are an important Annex I species to consider in relation to wind farm developments. No hen harriers were recorded within or surrounding the 500 m turbine buffer during the two-year study. However, birds were observed on three dates during the third winter, including: 26 Nov 2020, 16/23 Dec 2020. Observations on 26 Nov 2020 and 16 Dec 2020 were recorded as an adult female and involved a bird hunting over the southern bog, spending some time in the 500 m turbine buffer. The bird observed on 23 Dec 2020 was different and was judged to be a juvenile female. It was recorded hunting over the cereal fields between VP3 and VP4.

- 16 Nov 20 14:02 Ad. Female @ 15-35m Hunting over south bog
- 16 Nov 20 14:25 Ad. Female @ 30-60m Hunting over south bog
- 26 Nov 20 08:48 Ad. Female @ 5-15m Hunting over south bog
- 26 Nov 20 09:30 Ad. Female @ 20-50m Hunting over south bog

- 23 Dec 20 09:49 Juv. Female @ 20-35m Hunting over arable land

A hen harrier habitat suitability assessment was conducted as part of this study and covered the area extending 2 km from the proposed turbine locations. The 500 m turbine buffer was considered to be largely unsuitable for breeding hen harrier, being dominated by tillage, improved grassland and closed thicket plantation, while the periphery of the buffer extending onto the raised bogs to the south and east did provide some cover that had the potential to be utilised by roosting birds. Within the wider area there were some suitable nesting and roosting cover located within re-vegetating raised bog to the south and east of the buffer. However, this was considered limited, especially for breeding as the habitat surrounding the bogs was dominated by improved grassland and unlikely to support the densities of ground nesting birds, such as meadow pipits, typically associated with breeding hen harriers. Wider area breeding raptor surveys and hen harrier winter roost searches covering suitable patches of habitat out to 2 km from the proposed turbine locations did not record any hen harriers, breeding or wintering (roosting).

The last National breeding hen harrier survey conducted in 2015 (Ruddock *et al*., 2016)[120] did not cover the 10-km square encompassing the proposed development site, as the habitat was considered largely unsuitable for the species. Based on the 2015 census, the closest confirmed breeding site to the proposed development was a single pair located *c*. 30 km away on the Westmeath-Longford border.

Considering the winter 2020-21 observations, usage of the 500 m turbine buffer remains exceptionally low and no roosts or breeding sites were detected within the 2 km turbine buffer. Therefore, beyond providing habitat for the occasional foraging bird over the winter, the proposed development site and surrounding area was not found to be important for hen harriers and is considered to be beyond the zone of influence for any SPAs designated for this species (SNH, 2016).

5.6.8 Merlin

In relation to the proposed development, the closest SPAs designated for merlin is the Wicklow Mountains SPA, which is located 60 km SE.

During the baseline study, single merlins were recorded on five dates over the winter 2018-19 and 2019-20, with only four observations involving flight lines within the 500 m turbine buffer. No merlin were recorded over the third winter (2020-21). As is typical for this species all flight lines were below 15 m (i.e. below the rotor swept zone). The combination of woodland and tillage fields within the 500 m turbine buffer attract relatively high concentrations of passerines over the winter, which in turn provides potential foraging opportunities for birds of prey like merlin. The bog land extending out from the 500 m turbine buffer along the southern and eastern boundary holds the only potential breeding habitat for this species within the 2 km turbine buffer. No breeding activity was recorded during wider area raptor surveys. During a hen harrier roost search on the evening of 30 Oct 2019, three merlin were recorded in the bog opposite the proposed site entrance. These birds disbanded and did not roost and no further activity was recorded in the area on subsequent visits.

120 Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). The 2015 National Survey of Breeding Hen Harrier in Ireland. *Irish Wildlife Manuals*, No. 93. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland

Usage of the 500 m turbine buffer was found to be low and limited to over-wintering birds. No roosts or breeding sites were detected within the 2 km turbine buffer. Therefore, beyond providing habitat for the foraging bird over the winter, the proposed development site and surrounding area was not found to be important for merlin. The proposed development is considered to be beyond the zone of influence for any SPAs designated for this species (SNH, 2016).

5.6.9 Peregrine

In relation to the proposed development, the closest SPAs designated for peregrine is the Wicklow Mountains SPA, which located 60 km SE.

Peregrine falcons were only recorded four times during the two-year study, with single hunting or commuting birds recorded twice within and twice just beyond the 500 m turbine buffer. The flat topography surrounding the proposed development site means there are no natural cliff breeding sites within 2 km and there are also no artificial breeding sites on quarry cliffs or high buildings adjacent to the site. In fact, nesting opportunities even within 10 km of the proposed development site were considered limited, which probably explains the relatively low levels of peregrine activity recorded in the general area. Peregrines were not recorded breeding within the 10 km square covering the proposed development site during the Bird Atlas 2007-11 (Balmer *et al*., 2013)[121] and were only recorded as possibly breeding in some of the adjacent squares.

Given the low-level usage recorded and lack of suitable nesting habitat, the proposed development site and its environs were not considered important for peregrine falcons. The proposed development is considered to be beyond the zone of influence for any SPAs designated for this species.

5.6.10 Gyrfalcon

A white phase gyrfalcon was recorded during the ecological scoping exercise in spring 2020. Gyrfalcons are very scarce visitors to Ireland, occasionally arriving from Greenland and are most regularly encountered in coastal counties. Given the inland location it is possible that this was an escaped or released falconry bird, rather than a genuine Greenland falcon.

The status of this species as a scare visitor to Ireland means there are no SPAs designated for Gryfalcon in Ireland.

121 Balmer, D. Gillings, S. Caffrey, B. Swann, B. Downie, I. & Fuller, R. (2013). *Bird Atlas 2007-11: The Breeding and Wintering Birds of Britain and Ireland*. British Trust for Ornithology

Table 4: Flight seconds for Annex I species and waterbirds recorded in 500m turbine buffer during VP watches (Oct-2018 to Aug-2020)

- Data for third winter of surveying (Oct-2020 to Mar-2021) have not been included
- Colours in cells listing the target species recorded during VP watches indicates conservation status in Ireland ***Red***, ***Amber*** or ***Green*** as listed on BoCCI 2021-2026 (Gilbert *et al*., 2021). Species marks with a * are listed on Annex I of the EU Birds Directive
- Max. CRZ = maximum collision risk zone, i.e. the maximum diameter of the rotor swept area based on blade diameter of 170 m and hub height of 100 m would result in a rotor swept area of 15 to 185 m. The Vestas V162 specified for the proposed development, with rotor diameter of 162 m and hub height of 104 m have rotor swept area of 23 to 185 m. Taking a precautionary approach, all flight seconds classed in Column B (16-24 m) are considered as being within the collision risk zone for the Vestas V162 that are specified for the proposed development; as the majority of the flights categorised in Column B were assigned height ranges that exceed 20 m, therefore bringing birds within or very close to the rotor swept area.

		Flight seconds recorded in height bands									
Species	**Observations (number of birds)**	**A. < 15m**	**B. 16-24m**	**C. 25-30m**	**D. 31-40m**	**E. 41-99m**	**F. 100-150m**	**G. 151-185 m**	**H. >185m**	**Percentage flight secs. in max. CRZ (15 to 185m)**	**Total flight secs. in turbine buffer**
Cormorant	3 observations (1 to 2 birds)				50	131				**100**	**181**
Little egret*	1 observation (1 bird)					55				**100**	**55**
Grey heron	7 observations (Single birds)			150	43	280	20			**100**	**493**
Mute swan	1 observation (1 bird)					75				**100**	**75**
Whooper swan*	2 observations (2 or 7 birds)	406		82	110					**32**	**598**
Greenland white-fronted goose*	1 observation (42 birds)							18,900		**100**	**18,900**
Teal	4 observations (1 to 4 birds)			352		15				**100**	**367**
Mallard	23 observations (1 to 4 birds)	77	9	292	150	1,160	170			**96**	**1,858**
Golden plover*	29 observations (1 to 200 birds, Ave: 40 birds)			430	3,672	227,295	1,094,030	15,650		**100**	**1,341,077**
Lapwing	9 observations (br. season 1 to 2 birds, flock of 16 once in winter)	101	194	705		8,743				**99**	**9,743**
Jack snipe	2 observations (Single birds - flushed)	3								**0**	**3**
Snipe	16 observations (1 to 9 birds, Ave: 2.5 birds)	49	64	570	56	324	655			**97**	**1,718**
Green sandpiper	2 observations (Single birds - flushed)									**0**	**0**
Black-headed gull	2 observations (Single birds)	35	120							**77**	**155**
Lesser black-backed gull	8 observations (1 to 15 birds, Ave: 4 birds)					4,610	90	1,280		**100**	**5,980**

		Flight seconds recorded in height bands									
Species	Observations (number of birds)	A. < 15m	B. 16-24m	C. 25-30m	D. 31-40m	E. 41-99m	F. 100-150m	G. 151-185 m	H. >185m	Percentage flight secs. in max. CRZ (15 to 185m)	Total flight secs. in turbine buffer
Unidentified gull species	1 observation (3 birds, juv. prob. LB)					120				**100**	**120**
Merlin*	5 observations (Single birds)	144								**0**	**144**
Peregrine*	2 observations (Single birds)			139	81					**100**	**220**

Table 5: Summary of predicted collisions – unweighted/weighted with avoidance rates applied

		Unweighted					*Weighted*				
		Collisions/year		Stats			Collisions/year		Stats		
Species		No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years	No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years
Golden plover		346.447	6.929	69.289	207.868	0.144	215.006	**4.300**	**43.001**	**129.004**	**0.233**
Greenland white-fronted goose		4.603	0.009	0.092	0.276	108.618	2.958	**0.006**	**0.059**	**0.177**	**169.039**
Lesser black-backed gull		2.403	0.012	0.120	0.360	83.230	1.190	**0.006**	**0.060**	**0.179**	**168.021**
Mallard		1.444	0.029	0.289	0.867	0.000	0.715	**0.014**	**0.143**	**0.429**	**69.963**
Snipe		1.395	0.028	0.279	0.837	35.831	0.656	**0.013**	**0.131**	**0.393**	**76.278**
Lapwing	Year-round	4.647	0.093	0.929	2.788	10.761	2.854	**0.057**	**0.571**	**1.713**	**17.518**
	Breeding	1.627	0.033	0.325	0.976	30.727	1.045	**0.021**	**0.209**	**0.627**	**47.829**
	Wintering	2.455	0.049	0.491	1.473	20.366	1.476	**0.030**	**0.295**	**0.885**	**33.882**

6 NATURA IMPACT STATEMENT

6.1 Overview of Natura Impact Statement (NIS)

Following the reporting structure required under Article 6(3) of the Habitats Directive, **Section 2** of this report provides a description of the proposed development. The Screening for Appropriate Assessment is laid out in **Section 4** and identifies all the Natura 2000 sites that are potentially be affected by the proposed development (i.e. within sites the zone of influence - ZoI) by employing the source-pathway-receptor model.

Section 6 gives details of the Qualifying Interests (QIs) for Natura 2000 sites within the ZoI of the proposed development, including the Conservation Objectives for these sites. This is followed by an assessment the potential effects on the QIs and a determination of whether or not the proposed development will adversely affect the integrity of any Natura 2000 site. **Section 7** provides an assessment of the potential for in-combination effects on those Natura 2000 site within the ZoI. Mitigation measures for such effects are identified in **Section 8**.

The results from desk-based studies and field surveys are detailed in **Section 5**, which is supported by further technical information provided in **Appendix 2** and **Appendix 4** to **Appendix 7**. **Section 3** covers survey methodologies, with **Appendix 3** providing information on survey effort and study areas for bird surveys.

Following an assessment of any likely residual effects, i.e. identifying any impacts that cannot be mitigated, as summarised by **Table 6** in **Section 9**, a conclusion which will determine whether the proposal is likely to have, either standalone or in-combination with other plans or projects, an adverse effect on the integrity of any Natura 2000 site is provided in **Section 10**.

6.2 Assessment of impacts & effects on Natura 2000 sites within the ZoI

This section outlines the impacts (both direct and indirect) which are likely to have an effect on those Natura 2000 site supporting QIs within the ZoI. An assessment of the likely effects that these impacts could have on these QIs is then undertaken.

The potential for effects on each Natura 2000 site is assessed in terms of those impacts that have the potential to affect the QIs of each Natura 2000 site. In this report, direct impacts constitute direct or primary impacts to Natura 2000 sites, for example habitat loss or mortality of QI species. Indirect or secondary impacts constitute pollution of water courses which may flow into a Natura 2000 site or sedimentation of a watercourse upstream of a site which is designated for pollution/sedimentation sensitive QIs.

6.2.1 River Boyne and River Blackwater SAC

Status of designated features within the SAC

The River Boyne and River Blackwater SAC supports important populations of three species listed on Annex II of the E.U. Habitats Directive, namely:

- **River lamprey** (*Lampetra fluviatilis*)
  - present in the lower reaches of the Boyne River
- **Salmon** (*Salmo salar*)

- run the River Boyne almost every month of the year and the Boyne is important as it represents an eastern river which holds large three-sea-winter fish

- **Otter** (*Lutra lutra*)
- occur throughout the SAC

The SAC also holds the priority Annex I habitat **Alluvial forests** with *Alnus glutinosa & Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* and while the overall area of wet woodland is small there are few similar examples of this type of alluvial wet woodland remaining in the country, particularly in the north-east. The semi-natural habitats, particularly the strips of woodland which extend along the river banks, and the marsh and wet grasslands, increase the overall habitat diversity and add to the ecological value of the site.

The main areas of **Alkaline fen** in the SAC are concentrated in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough, which are approximately 10 km north of the proposed development. There is no hydrological link between this section of the SAC and the proposed development. Alkaline fens develop on soils which are permanently waterlogged, with a calcareous water supply. As the proposed development will not affect the groundwater table, and will not result in any change to flooding regime along the sections of river within the SAC, no impacts on alkaline fens are expected as a result.

Conservation objectives

The conservation objectives for this site are:

> *"To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected."*[122]

Impacts of water pollution

The potential source-receptor pathway between the proposed development and this Natura 2000 site is by direct watercourse, with potential impacts considered to be limited to those associated with water quality changes due to sedimentation and pollutants entering waterbodies.

The Annex II species listed as QIs of the SAC, specifically salmon, lamprey and otter, are sensitive to water pollution. Reduction in water quality through sedimentation can result in inhibition of respiration in aquatic organisms, particularly salmonids. Siltation can result in smothering of fish eggs and affecting suitability of spawning locations (Salmon & Trout Conservation, 2017)[123]. The accidental release of toxic chemicals, e.g. hydrocarbons and materials like cement/concrete, into surface waters can directly poison fish and other aquatic organisms (Rice *et al*., 1984)[124], with salmonids notably sensitive to petroleum products

[122] Conservation Objectives: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002299.pdf

123 Salmon & Trout Conservation (2017) The impact of excess fine sediment on invertebrates and fish in riverine systems - Literature Review. Available at: https://www.salmon-trout.org/wp-content/uploads/2017/09/STC-The-impact-of-excess-fine-sediment-on-invertebrates-and-fish-in-riverine-systems.pdf

124 Rice, S.D., Moles, D.A., Karinen, J.F., Korn, S., Carls, M.G., Brodersen, C.C., Gharrett, J.A. & Babcock, M.M. (1984). *Effects of Petroleum Hydrocarbons on Alaskan Aquatic Organisms: A Comprehensive Review of All Oil-Effects Research on Alaskan Fish and Invertebrates*. Conducted by the Auke Bay Laboratory, 1970-81

(Gagnon & Holdway, 1999)[125]. Maitland *et al*. (2015)[126] note that lampreys are sensitive to a range of pollutants, with the relatively immobile juveniles in the substrate of riverbeds being particularly susceptible. Otters are known to be susceptible to a range of chemicals, including petroleum products (Peterson & Schulte, 2016)[127]. Prolonged deterioration in water quality would impact on food sources for otter, as well as salmon and lamprey. As top predators, otters are also vulnerable to bioaccumulation of toxins.

Alluvial forests are generally removed from the water environment, except in times of flooding, and while polluted surface waters are noted as having an impact on alluvial woodland in Ireland, the occurrence is low. In this instance, (even in the absences of embed mitigation to control on site water quality) given the scale of the development and the separation distance between source and receptor, this habitat is not considered to be at risk from water pollution. The main threats to alluvial forests include fragmented nature, abundance of alien invasive species and sub-optimal grazing regimes and drainage (O'Neill *et al*. 2013)[128]. It is considered that there is no reasonable potential ecological connectivity, as there is no link to land use within the SAC and therefore no potential for influencing grazing regimes or drainage.

Disturbance related impacts on otters

Mammal surveys found no otter holts or layups within the proposed development site, therefore there is no potential for direct disturbance of otters. Based on the level of otter signs recorded, usage of the proposed development site was low with animals considered likely to be periodically commuting through the area via the network of drains, which offer relatively poor foraging opportunities. Given the low usage of the area, the predominately nocturnal foraging habitats otters (i.e. active after construction hours) and the separation distance between the proposed development and the SAC, it is considered that there is no potential for Likely Significant Effect on otter due to indirect disturbance factors, in particular during construction and decommissioning when potential disturbance factors are at the highest. Overall mammal species are generally considered tolerant of operational wind farms and no indirect impacts are expected to result from the operating turbines or servicing activities.

Likely Significant Effects

Without consideration given to the on-site conditions (downstream dilution effects) and embedded mitigation measures (best-practice design stage mitigation), and applying the precaution principle - Likely Significant Effect due to deterioration in water quality on the following QIs is concluded:

- Salmon, river lamprey and otter,

Any potential for Likely Significant Effects can be ruled out for the following QIs of the SAC:

125 Gagnon, M.M. & Holdway, D. A. (1999). Metabolic Enzyme Activities in Fish Gills as Biomarkers of Exposure to Petroleum Hydrocarbons. *Ecotoxicology and Environmental Safety* 44, 92-99.

126 Maitland P., Renaud C., Quintella B., Close D., Docker M. (2015) Conservation of Native Lampreys. In: Docker M. (eds) Lampreys: *Biology, Conservation and Control*. Fish & Fisheries Series, vol 37. Springer, Dordrecht.

127 Peterson, E.K. & Schulte, B.A. (2016). Impacts of Pollutants on Beavers and Otters with Implications for Ecosystem Ramifications. *Journal of Contemporary Water Research & Education* 157:1, 33-45

128 O'Neill, F.H. & Barron, S.J. (2013). Results of monitoring survey of old sessile oak woods and alluvial forests. *Irish Wildlife Manuals*, No. 71. NPWS, DoAHG, Dublin, Ireland

- Alluvial woodland
- Alkaline fens (already 'screened out', but repeated here for clarity)

Source of impact

Construction phase

Water pollution (hydrocarbons, cement leachate and sediment) due to pollution incidents on site and if inappropriate construction practices result in sedimentation.

Operational phase

Water pollution (sediment, limited hydrocarbons) if inappropriately designed infrastructure results in sedimentation, minimal likelihood of pollution incidents onsite, e.g. occasional small scale accidental fuel/oil/lubricant spillages.

Decommissioning & restoration

Water pollution (hydrocarbons, concrete dust/fragments and sediment) during the decommissioning and restoration works.

6.2.2 River Boyne and River Blackwater SPA

Status of designated features within the SPA

Kingfisher (*Alcedo atthis*)

The River Boyne and River Blackwater SPA supports a nationally important population of kingfishers. There were 19 pairs recorded in 2010 and 20-22 territories recorded in 2008 (Cummins *et al.* 2010). The closest know breeding territories are on the Stonyford River and River Deel, which flow on the west and east side of the proposed development

Conservation of objectives

The conservation objectives for this SPA are:

> *"To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA".*[129]

Direct effects

Kingfisher habitat suitability surveys, as discussed in **Section 5.6.1** found no suitable nesting banks within the proposed development site, therefore there will be no direct disturbance of breeding birds. Direct impacts due to collision risk is considered highly unlikely to result in any significant effects for this species, based on low usage of the proposed development site, as well the rotor swept area specified and the lower-level flights typically taken by kingfishers as they traverse along watercourses.

Indirect effects

The proposed development is not anticipated to result in any change to flooding regimes along the sections of river within the SAC, where kingfisher nest and therefore no impacts to breeding sites are considered likely. As outlined in **Section 5.6.1**, usage of the proposed development site by kingfisher was not recorded and based on limited availability of good quality foraging habitat, any potential usage would be periodic. Therefore, no displacement

[129] Conservation Objectives: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004232.pdf

effects of birds from important foraging areas due to disturbance is anticipated, during either construction, operation or decommissioning.

Impacts of water pollution

The potential source – receptor pathway between the proposed development and this Natura 2000 site is by direct watercourse, with potential impacts considered to be limited to those associated with water quality changes. Potential impacts mainly relate to significant pollution events that may affect the birds directly or a gradual decline in the water quality that could impact on food availability, mainly in the form of small fish, as well as aquatic invertebrates. Kingfisher as a top predator may also be susceptible to bioaccumulation of toxins, if low pollution effects are sustained. Therefore, indirect impacts on kingfisher would possibly occur if water quality was significantly reduced and had an effect on food sources.

Likely Significant Effect

Without consideration given to the on-site conditions (downstream dilution effects) and embed mitigation measures (best-practice design stage mitigation), and applying the precaution principle - Likely Significant Effect on the follow QIs is concluded:

- Kingfisher

Sources of impacts

Construction phase

Potential water pollution (hydrocarbons, cement leachate and sediment) due to pollution incidents on site and if inappropriate construction practices result in sedimentation.

Operational phase

Water pollution (sediment, limited hydrocarbons) if inappropriately designed infrastructure results in sedimentation, minimal likelihood of pollution incidents on site, e.g. occasional small scale accidental fuel/oil/lubricant spillages.

Decommissioning & restoration

Potential water pollution (hydrocarbons, concrete dust/fragments and sediment) during the decommissioning and restoration works.

6.2.3 Lough Derravarragh SPA

Status of designated features within the SPA

This lough supports a wintering bird assemblage, with following species listed as QIs:

- **Whooper swan** (*Cygnus cygnus*)
- **Pochard** (Aythya ferina)
- **Tufted duck** (Aythya fuligula)
- **Coot** (Fulica atra)
- **Wetland and Waterbirds**

Mean peaks (1995/96-1999/2000) for QI species include: whooper swan (102), pochard (3,129), tufted duck (1,073) and coot (1,358). Other waterbird species making up the assemblage includes: mute swan (159), little grebe (42), great crested grebe (34), cormorant (34), wigeon (207), teal (52), mallard (195), pintail (6), shoveler (12), goldeneye (46), golden

plover (158), lapwing (1,079) and the lough is reported as occasionally supporting a small Greenland white-fronted goose roost.

Conservation objectives

The conservation objectives for this SPA are:

> *"To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA".*[130]

Direct impacts

Wind farm developments pose a collision risk to avian species, including the waterbird assemblages utilising SPAs. In this instance, wider area winter bird surveys (monthly area searches) and VP watch surveys are used to determine usages of the proposed development site (see **Section 3.2.5**). Specifically, in relation to avian collision risk this applies to flight seconds recorded with in the collision risk zone (CRZ), which is defined as flights occurring between 23 and 185 m and within the 500 m turbine buffer. Collision risk models (CRM) have been run using the flight seconds recorded for waterbirds species within the CRZ (**Table 4**). The CRM outputs are summarised in **Table 5** and are considered to be representative of a precautionary and worst-case scenario. For fully detailed CRM results refer to the **Appendix 7**. Species accounts in **Section 5.6** document bird usage of the proposed development site, including interpretation of how predicted collision rates are expressed in terms of population effects.

Across all the species assessed, the highest rate of predicted collision risk was for golden plover (see **Section 5.6.4**). Based on a precaution predicted collision rate of 4.3 collision/annum (weighted & applying 98% avoidance rate) and applying an annual adult survival rate of 0.73 (Sandercock, 2003; as cited by Robinson, 2005 in BTO)[131]; the additional annual mortality on the regional/local population (est. 1,400 to 2,000 birds) is estimated to add an 0.80 to 1.14% to annual background mortality. Based on Percival, (2003)[132] this is classed as a negligible to low population effect, with 1-5% population effect considered low and a < 1% effect being negligible.

As summarised below, for the rest of the waterbirds species recorded, any predicted collision rates were significantly lower than for golden plover and rates were found to be well below levels having a > 1% population effects, i.e. no significant additional effect on background mortality.

- Golden plover — 1 collision every 0.23 years (2.8 months)
- Greenland white-fronted geese — 1 collision every 169 years
- Lapwing — 1 collision every 34 years
  - wintering
- Lesser black-backed gull — 1 collision every 168 years
  - recorded during breeding season
- Mallard — 1 collision every 70 years

130 Conservation Objectives: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004043.pdff

131 Sandercock, B.K. (2003). Estimation of survival rates for wader populations: a review of mark-recapture methods. *Wader Study Group Bulletin* 100:163-173. As published on http://www.bto.org/birdfacts - BTO BirdFacts | Golden Plover, (accessed on 06-May-2021) citation: Robinson, R.A. (2005) *BirdFacts: profiles of birds occurring in Britain & Ireland*. BTO, Thetford

132 Percival, S. M. (2003). *Birds and wind farms in Ireland: A review of potential issues and impact assessment*. Ecology Consulting, Coxhoe, Durham

- Snipe — 1 collision every 76 years
- Whooper swan — No CRM output as only record in CZM for 192s

Other waterbird species recorded at low levels as listed in **Table 4** included: cormorant (181s), little egret (55s), grey heron (493s), mute swan (75s), teal (367s), Jack snipe (3s), green sandpiper (0s), black headed gull (155s).

Based on observed bird usage and the outputs from robust CRM, it can be concluded that there are will no significant population effects on waterbird population from collision risk due to the proposed development. Therefore, there is no potential for Likely Significant Effects on winter waterbird populations associated with the Lough Derravarragh SPA. Furthermore, as all waterbird species were accessed, potential for Likely Significant Effects due collision risk to waterbird QIs for other waterbirds SPAs (as listed in **Table 3**) can be ruled out.

Indirect impacts

Operational wind farm developments (as well as during construction and decommissioning) have the potential to displace avian species, including the wintering waterbird assemblages ecologically linked to the SPA. However, due to separation distance between source and receptor, Likely Significant Effects due to displacement of waterbird species/assemblages ecologically linked to SPAs can be ruled. This is confirmed by the findings of the ornithological study conducted for the proposed development, as detailed in the species accounts in **Section 5.6**.

Likely Significant Effects

Based on the findings of the ornithological study conducted for the proposed development, including assessment of collision risk, it can be concluded that the potential for Likely Significant Effects on avian receptors (specifically waterbirds) ecologically linked to Natura 2000 sites can be ruled out.

6.3 Summary of potential effects

It has been established that, unmitigated, the proposed development poses a level of risk to the features of interests for two Natura 2000 sites. These are the River Boyne and River Blackwater SAC (002299) and the River Boyne and River Blackwater SPA (004243).

Any Likely Significant Effects on the wintering waterbird assemblages of Lough Derravarragh SPA can be ruled out (and therefore by default Likely Significant Effects for all other SPAs designated for waterbirds within 14 to 32 km of the proposed development, can also be ruled out).

The site is also hydrologically connected to the Boyne Coast and Estuary SAC (001957) and the Boyne Estuary SPA (004080). However, taking account of the distance of these sites from the proposal via a hydrological connection (>70 km), and the size and nature of the proposal, there is no realistic potential for any effect on these Natura 2000 sites from the proposal, even considering any potential for cumulative effects – see **Section 7**.

The risks to the River Boyne and River Blackwater SAC and SPA relate to deterioration in water quality stemming from the following sources:

- Soil erosion and surface sediment runoff to tributaries of the Stonyford River during excavations at the site. This could result if felling operations, construction of stream

crossings, excavations and earthworks at the site were carried out in inappropriate ways or in inappropriate conditions, e.g. instream works without consultation with IFI, storing excavated soil in proximity to watercourses or carrying out excavations in the vicinity of watercourses during periods of heavy rain – *PHASE*: construction and decommissioning.

- A major spillage, or long-term leakage, of hydrocarbons or other chemicals on the site. This could occur if fuels, lubricants or other chemicals are not managed appropriately, taking suitable precautions – *PHASE*: construction and decommissioning, with lower risk volumes during operational phase considered unlikely to add significantly to existing/background levels of human activity in the area.
- Inappropriate usage/spillage of wet cement (concrete) onsite causing runoff into watercourses – *PHASE*: construction and to a lesser extent decommissioning, when cement dust and concrete fragments may become entrained in surface waters if excavated, stored and removed off site inappropriately.
- Sub-standard re-instatement works, especially sections along work sections adjacent to watercourse. Post-construction, the areas felled, if left exposed will result in increased sediment loads in runoff – *PHASE*: construction, operational and decommissioning
- Poorly designed, engineered and/or constructed wind farm infrastructure, resulting in increased runoff and sedimentation, specifically drainage associated with turbine hardstands and access tracks – *PHASE*: operational.
- Transportation of invasive alien species (IAS) onto the site, which are released into watercourses and become established downstream in the SAC/SPA, e.g. fragments of Japanese knotweed or giant hogweed seeds can have serious deleterious effects in riverine ecosystems. Unscreened quarried material is the most likely vector for non-native species to enter the proposed development site – *PHASE*: construction and decommissioning, especially if the site becomes infested with IAS.

7 CONSIDERATION OF 'IN-COMBINATION' IMPACTS

Potential in-combination effects on Natura 2000 sites, to which proposed activities on the proposed development may contribute, are included as part of the assessment process. CIEEM (2018) states that:

> *"other development projects (besides the one being assessed) can influence the baseline and need to be taken into account. This will be the case in circumstances where another development has been consented or recently constructed and is predicted to have an impact on an ecological feature being considered as part of an environmental assessment. The baseline may also be affected where another development has an ongoing incremental 'operational' phase effect"*.

In-combination effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location (CIEEM, 2018). Different types of actions can cause cumulative impacts and effects. These types of impacts may be characterised as;

- Additive/incremental – in which multiple activities/projects (each with potentially insignificant effects) add together to contribute to a significant effect due to their proximity in time and space (CIEEM, 2018).
- Associated/connected – a development activity 'enables' another development activity e.g. phased development as part of separate planning applications. Associated developments may include different aspects of the project which may be authorised under different consent processes. It is important to assess impacts of the 'project' as a whole and not ignore impacts that fall under a separate consent process (CIEEM, 2018).

In-combination effects are required to be considered at Screening for Appropriate Assessment Stage, and as part of the Appropriate Assessment itself.

7.1 Associated developments/activities

There are not considered to be any associated/connected developments related to this proposal and it is considered that all elements of the proposed project have been sufficiently covered, including the proposed haul route and the grid connection route.

The felling to be undertaken will be the subject of a felling licence application to the Forest Service in accordance with the Forestry Act 2014 and the Forestry Regulations 2017. In accordance with the Forest Service's policy on granting felling licenses for wind farm developments, a copy of the relevant planning consent is required to be submitted with the felling licence application which, as a result, cannot be applied for until such time as planning permission is obtained for the Proposed Development.

In accordance with the Forest Service's published policy on granting felling licences for wind farm developments, areas of forestry which have been felled to accommodate turbine bases, access roads and any other wind farm-related uses must be replaced by replanting at an alternative site. As part of the felling licence application process, it will be necessary for the Applicant to identify appropriate replacement lands. These lands can be located anywhere within the Republic of Ireland and will be subject to a separate environmental assessment and technical approval process as part of the felling licence consenting process. The Applicant can confirm that no felling will take place within the proposed development site

until such time as a felling licence has been obtained incorporating the technical approval of the identified replacement lands to be afforested.

7.2 Additive/incremental impacts

The potential for additive/incremental impacts on Natura 2000 resulting from construction, operation and decommissioning of the proposed development is considered to be limited to changes in water quality within the drain/stream flowing through the proposed development site (Bolandstown - EPA code: 07B45). This watercourse is hydrologically connected to two downstream Natura 2000 sites via the Stonyford River, specifically the River Boyne and River Blackwater SAC and River Boyne and River Blackwater SPA. In addition, approximately 70 km downstream of the proposed development the estuary of the River Boyne and coastal waters are designated within the Boyne Coast and Estuary SAC and Boyne Estuary SPA.

Collision risk to QI species of SPA in the surround areas was also considered. The likely significant effects due to cumulative impacts on bird are considered to be limited to the influence of other wind farms, together with the proposed development, on displacement, collision or barrier impacts on birds.

Potential for significant cumulative effects on Natura 2000 sites from collisions/displacement

Based on the low-density of operational and consented wind farms within 50km of the proposed development and in the vicinity of the SPAs covering the Midlands loughs complex (Lough Ennell SPA to Lough Sheelin SPA), likely significant additive/incremental effects on QI species/waterbird assemblage of SPAs, due to displacement and collision risk can be ruled out on the basis of low observed usage of the proposed development site by QI species. The outputs from the collision risk model concluded that there are no potential significant population effects on waterbird populations arising from collision risk associated with the proposed development. In addition, the separation distances between the SPAs covering the Midlands loughs complex and operational/contented wind farms, are beyond the zone of influence/zones of sensitivity for waterbird species, as detailed in SNH (2016)[133] and Mc Guinness *et al*. (2015)[134].

Analysis of ornithological data collected from the proposed development and the proposed Ballivor Wind Farm, VP watch data in particular, would be required to provide a robust assessment of the likely cumulative effects on birds from both developments. In isolation, the dimension and spacing of the turbine array for the proposed development (9 No. turbines clustered over *c*. 3 km) does not form a significantly elongated or dense barrier effect to bird populations utilising or moving through the area. The proposed development is not considered to be on a significant migration route or regularly utilised flight line between any roost/breeding sites and foraging areas. Based on wintering waterbird and breeding raptor surveys conducted in the wider area surrounding the proposed development (5km and 2km, respectively, i.e. encompassing parts of Ballivor Wind Farm) and examining habitat availability across the Ballivor Wind Farm site, the areas of both proposed sites combined

133 Scottish Natural Heritage (2016). *Assessing Connectivity with Special Protection Areas* (*SPAs*) Guidance (Version 3 – June 2016). SNH

134 Mc Guinness, S., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015*). Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. BirdWatch Ireland, Kilcoole, Wicklow

are considered unlikely to contribute significantly to disruption of migrating birds or birds using regular flight paths from roosts to foraging areas. Modelling based on ornithological studies for wind farms in Germany where large number of turbines are widely dispersed across farmland, suggests that the cumulative effects of avian collision risk for some sensitive bird populations, e.g. red kite (Schaub, 2012)[135], may be limited by clustering turbines; as would be the case for the proposed development and the proposed Ballivor Wind Farm combined.

The additive effects of the 9-turbine proposed development, in-combination with the 26-turbines proposed for the Ballivor Wind Farm, are considered likely to result in a cumulative effect on some local bird populations. Based on the outputs from collision risk models conducted for the proposed development (see **Appendix 7**) local populations of wintering golden plovers are a QI waterbird species for which significance of effects (as determined using Percival, 2003) may be increased as a result of cumulative consideration. Additional mitigation measures may be required to offset cumulative effects. Working in tandem with mitigation measures proposed for the proposed development, the EIAR for the Ballivor Wind Farm should identify and mitigate for any significant effects on local bird populations. Therefore, it is anticipated that cumulative operational effects on local bird populations will be adequately addressed through mitigation measures proposed for the respective development. This highlights the importance of an appropriate monitoring programme and associated potential mitigation, should a situation arise whereby usage levels by species prone to collision risk increases as a result of ex situ or cumulative factors.

In relation to additive/incremental impacts on waterbird assemblages ecologically linked to Natura 2000 sites, due to displacement and collision risk from existing wind farms consideration was given to the currently operational wind farms and those consented/under construction, including:

• Yellow River WF - Operational target date: 2023	Co. Offaly	17 km SW*	29-turbines	Construction
• Coole WF - Subject to Judicial Review	Co. Westmeath	25 km NW*	15-turbines	Consented
• Cloncreen WF - Operational target date: 2022	Co. Offfay	30 km S*	21-turbines	Construction
• Mount Lucas WF	Co. Offfay	30 km SSW*	28-turbines	Operational
• Liffey Meats WT	Co. Cavan	31 km NNW*	1-turbine	Operational
• Teevurcher	Co. Meath	35 km NNE	5-turbines	Operational
• Moanvane WF	Co. Offaly	40 km SW*	12-turbines	Consented
• Gartnaneane WF	Co. Cavan	41 km NNE*	10-turbines	Operational
• Dunmore/Collon WF	Co. Louth	41 km NE*	4-turbines	Operational
• Mountain Lodge-Bindoo-Carrickallen-Edrans complex	Co. Cavan	45 km N*	65-turbines	Operational

*Distances are taken from turbine locations at the proposed development site to closest operational turbine/part of consented site

135 Schaub, M. (2012). Spatial distribution of wind turbines is crucial for the survival of red kite populations. *Biological Conservation* 155: 111-118

Potential for significant cumulative effects on Natura 2000 sites from water pollution

EPA Catchments (2018)[136] reports the following sources for pressure on water quality across the Boyne catchment - agriculture, peat drainage and extraction, domestic waste water, mines/quarries diffuse urban, urban waste water, hydromorphology. There are several pre-planning/proposed development sites within the Boyne catchment, with just one consented wind that is currently under-construction. If other wind farms (within the Boyne Catchment) are under construction or being decommissioned at the same time as the proposed development there is potential for cumulative impacts on water quality. Proposed/consented wind farm sites within 20 km of the proposed development include:

- The Ballivor Wind Farm[137], which is a pre-planning proposal for the construction of 26 turbines on bogland adjacent to the proposed development with all proposed turbines located within the River Boyne catchment.
- The Yellow River Wind Farm[138], which is a consented site entering the construction phase, due for completion in 2023 and is *c*. 17 km to the southwest of the proposed development, with 11 of the permitted 29 turbines located in the River Boyne catchment.

Therefore, within a 20 km radius of the proposed development there is potential for 46 turbines to be under construction within the Boyne River catchment (nine for the proposed Bracklyn WF, 11 for the Yellow River WF and 26 for the proposed Ballivor WF).

Other proposed/consented wind farms located within the Boyne catchment include:

- Maighne Wind Farm, with the sub-sites of Drehid-Hortland (21 turbines), windmill (3 turbines) and Ballynakill (10 turbines), located in the southern extent of the catchment, between Enfield and Edenderry in Co Kildare/Co. Meath. This proposal has altered since the original submission and now appears to be being progressed as separate sites, e.g. Drehid WF (12-turbines).

The proposed Ballivor Wind Farm would drain into some of the same local watercourses as the proposed development which form the Stonyford River subcatchment. The Yellow River Wind Farm (currently under construction) is within the River Boyne catchment and the Mongagh River-Castlejordan River-Yellow River subcatchment drains into the River Boyne approximately 25.5km upstream of the Stonyford River subcatchment. Other wind farms located within the River Boyne catchment include the Teevurcher Wind Farm and Gartnaneane Wind Farms are located in the northern most part of the River Boyne catchment, within the Moynalty and Blackwater [Kells] subcatchments, respectively. Both these subcatchments flow into the River Boyne via the River Blackwater [Kells] approximately 30.5km downstream of the Stonyford catchment. The Maighne Wind Farm as originally proposed consisted of several sub-sites located *c*. 20 km of SSE the proposed development between Enfield and Edenderry (Co Kildare/Co. Meath), including Drehid-Hortland (21 turbines), Windmill (3 turbines) and Ballynakill (10 turbines), which are located in the southern extent of the Boyne catchment, either draining into the head waters of the

136 EPA Catchments (2018). Boyne Catchment Assessment 2010-2015 (HA 07). Catchment Science & Management Unit Environmental Protection Agency, Dec. 2018, V.3

137 Pre-planning information for Ballivor Wind Farm is available at https://www.ballivorwindfarm.ie/ (Accessed July 2021)

138 SSE Renewables website used for information on the status of the Yellow River Wind Farm – Available at: https://www.sserenewables.com/onshore-wind/in-development/yellow-river/ (Accessed July 2021)

River Boyne or into the Blackwater [Longwood]. The Maighne Wind Farm proposal has altered since the original submission and is now being progressed as separate sites, e.g. Drehid WF (12-turbines) and all these sub-sites are located > 30km upstream of the upstream of the Stonyford River subcatchment.

Locally (in the environs of the proposed development), potential for cumulative impacts on water quality comes from diffuse sources including rural housing, the existing road network, forestry operations (track upgrades and felling), agricultural activities and peat extraction. Based on EPA Maps[139], there are no Section 4 discharges to water linked to the stream/drain (EPA code: 07B45); and the only site in the area with an Industrial Emissions (IE) licence is Clondrisse Pig Farm. The pig farm is an IPPC (Integrated Pollution Prevention Control) site and waste water is stored on site, rather than discharged into receiving waters under licence. Based on the National Planning Application Database[140], there are no planning applications or existing planning consents in Co. Westmeath/Co. Meath, with downstream connectivity to the watercourse (EPA code: 07B45) that drains the proposed development; and therefore, no potential for additive/incremental effects on local water quality in combination with other proposed developments.

It is anticipated that control measures proposed to limit pollution to surface waters, as outlined in **Section 8** will ensure the proposed development has no realistic potential to contribute to cumulative impacts either at the construction, operational or decommissioning phases.

It is considered that the proposed development in-combination with existing and planned developments has some potential to have additive/incremental impacts on water quality within these downstream Natura 2000 sites. Therefore, taking a precautionary approach, in the absence of mitigation there is potential for Possible Significant Effects on downstream designated sites and water reliant QIs. Given the relative scales of the works/activities proposed any additive/incremental impacts will be more pronounced over the construction phase of the proposed development.

139 EPA Maps Accessed May-2021

140 National Planning Application Map Viewer - My Plan Accessed May-2021

8 MITIGATION

8.1 Mitigation of water quality impacts

It has been highlighted in preceding sections that, although likelihood of impact is low, there is potential for impact on downstream SACs and SPAs through changes in water quality, notably as a result of the introduction of contaminants (including sediment and chemical pollutants) during primarily the construction stage, with the potential for ongoing sediment input during the operational phase in the absence of appropriate mitigation. This includes the cumulative effects on water quality from other wind farm developments proposed within the catchment of the River Boyne.

The mitigation measures detailed below are intended to remove any risk either of events that have the potential to result in an impact alone, but also remove the risk of ongoing low-level inputs that may result in an ongoing impact on the Natura 2000 sites in combination with other projects or potential land use inputs.

8.1.1 Construction Stage: Water quality mitigation

The mitigation measures proposed are designed to avoid impacts upon local watercourses and groundwater. If these measures are implemented in full, they will ensure avoidance of impacts upon downstream Natura 2000 sites, specifically River Boyne and River Blackwater SAC and SPA and the Qualifying Interests (QIs), including: river lamprey, Atlantic salmon, otter and kingfisher. By default, these measures will also eliminate the risk of deterioration in water quality with the potential to result in possible significant effect to the Boyne Estuary SPA and Boyne Catch and Estuary SAC.

Mitigation outlined in this NIS includes:

- Works for stream crossings will be carried out during the working window for instream works. This working window is defined by Inland Fisheries Ireland (IFI) as July to September to avoid vulnerable spawning salmonids/lamprey that may be present in downstream environments outside of this window. Any works outside this period would require a derogation under the Local Authorities (Works) act, 1949.
- There will be no crossing of rivers or streams by machinery during the construction phase and all machinery must stay within the works corridor and utilise designated access routes.
- There will be no direct dewatering to watercourses onsite during the construction phase. All outflows from drainage associated with construction will be by diffuse overland drainage at appropriate locations and through settlement ponds.
- For locations where works will be undertaken within water protection buffer zones (i.e. within 10 m of watercourses) double silt fences will be installed around the watercourse to prevent sediment/silt infiltration into the watercourse.
- Cement leachate, hydrocarbon oils and other toxic poisonous materials will require full containment and should not be permitted to discharge to any waters, and control measures to be in place will include:
  - Appropriate bunded storage area for storage of fuels/oils, with onsite storage of hydrocarbons to be kept to a minimum
  - Mobile double skinned fuel bowser will be used for re-fuelling on-site

- No refuelling will be permitted at works locations within the 50 m hydrological buffer
- Spill kits will be readily available to deal with any accidental spillage
- There is an outline emergency plan for the construction phase to deal with accidental spillages
- Ready-mixed concrete will be brought to site, with no batching of wet-cement products occurring on site
- Where possible pre-cast products will be installed, including all watercourse crossings
- Use of wet-cement products within the hydrological buffer will be avoided, insofar as possible
- Lined cement washout ponds will be used for chute cleaning, with minimal use of water take will imported onto the site
- No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be permitted

- Wastewater emanating on-site (sewage, waste-water from site office) will be taken off-site for disposal/treatment at controlled facilities. To this effect, welfare facilities for construction site workers will include self-contained port-a-loos with an integrated waste holding tank. No water will be sourced on the site, nor will any wastewater be discharged to the site.

A Sustainable Drainage Systems (SuDS) will be implemented to manage surface water taking account of water quantity (flooding), water quality (pollution) and biodiversity (wildlife and plants). This SuDS will adopt the following elements:

- Open constructed drains for development run-off collection and treatment;
- Infiltration interception drains for upslope 'clean' water collection and dispersion;
- Flow attenuation and filtration check dams to reduce velocities, with consideration given to gradient with drains to determine spacing requirements;
- Settlement ponds and buffered outfalls to control and store development runoff to allow settlement prior to discharge at Greenfield runoff rates. No outflow will be permitted directly into natural watercourses;
- The site drainage and attenuation system will be installed prior to the main construction activities, and includes excavation of drainage ditches and installation of settlement ponds and soakaways. The site-specific drainage scheme is required to attenuate hydraulically (flow) and hydrochemically (pollutants) the projected increase in runoff of *c*. 20.4 m^3/day (worst-case scenario) that would arise from the hardstands created by the proposed development.

Measures to ensure adequate management of soil/peat deposition areas in order to avoid impacting on water quality include:

- Both proposed spoil deposition areas are located outside the 50 m stream buffer zone
- Silt fences, straw bales and biodegradable matting will be used to control surface water runoff for deposition areas

- Deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff

Other measures include:

- In order to avoid run-off of silt-laden water impacting upon water quality within watercourse adjacent to the works corridor, reinstatement works including measures to re-vegetate disturbed areas through re-seeding and/or placement of saved turves will be undertaken immediately after construction works.
- During construction turves will be stored separately from spoil (soil/rock). Separate storage of turves will ensure vegetation is not significantly damaged while stored and that turves can be replaced as a top-mat to facilitate rapid re-instatement of the surface vegetation, whereby avoiding the risk of silt laden surface waters impacting on water quality.
- To ensure control measures are implemented appropriately an Ecological Clerk of Works (ECoW) and Environmental Manager will be employed for the duration of the construction works.
- Monitoring of water quality during construction will be undertaken.

The measures listed above will be adopted within the Construction Environmental Management Plan (CEMP) for the proposed development, which will include detailed maps and plans showing the designs and locations for the mitigation measures specified, and will also clearly indicate the buffer zones to water courses.

8.1.2 Operational Stage: Water quality mitigation

Following the completion of construction, a full review of construction stage temporary drainage will be undertaken by the appointed contractor (in conjunction with the Project hydrologist/Site Engineer and the Project ECoW), with a view to removing any drainage infrastructure that is no longer required during the Development's operational phase.

Mitigation measures to protect water quality during the operational phase of the proposed development will include:

- Up-gradient interceptor drains, with water re-distributed over the ground by means of a level spreader.
- Swales/road side drains to collect runoff from operational infrastructure, including transverse drains ('grips') to direct water to swales and check dams to intercept silts at source, with water channelled to settlement ponds.
- Settlement ponds will be designed in accordance the greenfield runoff rate requirements and will buffer volumes of runoff discharging from the drainage system during periods of high rainfall.
- Overall, the site-specific drainage scheme is required to attenuate the projected increase in runoff of *c*. 20.4 m^3/day (worst-case scenario) that would arise from the hardstands created by the proposed development.
- Site water runoff quality will be monitored during the operational phase of the Development. the early stages of the operational phase will require a relatively high frequency of monitoring; however, the frequency of monitoring can gradually reduce thereafter – presuming there are no issues with the quality of discharging water at that point in time.

9 ASSESSMENT OF RESIDUAL IMPACTS AND EFFECTS

Table 6 lists those Natura 2000 sites and corresponding QIs within the ZoI of the proposed development and provides a summary of the impact assessment, including the likely impacts and potential significance of effects in the absence of mitigation. Then a summary of proposed mitigation measures is provided and the assessment of any residual effects is summarised.

As indicated in **Table 6**, on the proviso that all proposed mitigation measures are implemented in full, it is considered that there is no potential for adverse effects on the integrity of Natura 2000 sites.

10 CONCLUSIONS OF NATURA IMPACT STATEMENT

A Screening for Appropriate Assessment (AA) was conducted which is detailed in **Section 4**. Screening for AA is employed to highlight (in view of best scientific knowledge and with consideration the Conservation Objectives of Natura 2000 sites within the zone of influence, while applying the 'Precautionary Principle') if a plan or project, either individually or in combination with other plans or projects, is likely to have a significant effect on a Natura 2000 site. Following that assessment, it was considered that, in the absence of appropriate mitigation, the likelihood of significant effects on the River Boyne and River Blackwater SAC and River Boyne and River Blackwater SPA as a result of water quality impacts and possible significant effects on the Lough Derravarragh SPA could not be excluded, due to the uncertain effects of collision risk and displacement on QI species of wintering wetland birds.

As a result, a report for Appropriate Assessment (NIS) was subsequently compiled to establish (in view of best scientific knowledge, taking consideration of the Conservation Objectives for the affected Natura 2000 sites, and applying the 'Precautionary Principle') if there were likely to be any adverse effects upon the integrity of these Natura 2000 sites as a result of the proposed development. The Natura Impact Statement (NIS) is provided in **Section 6** and includes sufficient information for the competent authority to carry out the appropriate assessment, including the provision of ecological information in **Section 5** and supporting appendices.

The proposed development does not occur within any Natura 2000 site. Consequently, there is no potential for the proposed development to result in direct impacts on any Natura 2000 sites.

Despite separation distances beyond the ZoI published for selected QIs (see SNH, 2016 and Mc Guinness *et al*., 2015) in view of uncertainty due to the absence of definitive information of bird distribution and therefore applying the precautionary principal, the Lough Derrvaragh SPA was considered within the potential ZoI of the proposal development. This was done to investigate the specific sensitivities of QIs (wintering waterbirds) to wind farm developments through collision and displacement effects. A two-year ornithological study was undertaken, including collision risk modelling (see **Appendix 7**) and based on the findings of this study, it can be concluded that the potential for Likely Significant Effects on avian receptors (specifically waterbirds) ecologically linked to Natura 2000 sites in the wider area can be fully excluded and no mitigation measures were recommended. Ongoing ornithological monitoring is required to identify any effects resulting from cumulative factors, such as

construction of the Ballivor Wind Farm proposed for the lands surrounding the application site.

The proposed development is hydrologically connected to the River Boyne and River Blackwater SAC and River Boyne and River Blackwater SPA. These sites have QIs which are, to varying degrees, sensitive to water quality issues, including: river lamprey, salmon, otter, alkaline fens, alluvial forests and kingfisher. Without consideration of the on-site conditions and proposed mitigation measures to protect water quality Likely Significant Effects could not be excluded. The proposed development site is also hydrologically connected to the Boyne Coast and Estuary SAC and the Boyne Estuary SPA. However, taking account of the distance of these sites from the proposal via a hydrological connection (>70 km), and the size and nature of the proposal, there is no realistic likelihood for any effect on these Natura 2000 sites from the proposal.

This NIS has identified the particular types of effect that have potential for adverse impact on the integrity of the River Boyne and Blackwater SAC and the River Boyne and Blackwater SPA. **Section 8** of the NIS sets out mitigation measures that will ensure avoidance of these effects; so that the structure and functions of the SAC and SPA are not affected, thus demonstrating that mitigation will be sufficient to avoid adverse impacts. Mitigation measures detailed in the NIS, have been transposed into the Outline Construction Environmental Management Plan for the proposed development (see **Appendix 8**). The implementation of these control measures on site means that it can be concluded, in the light of best scientific knowledge, that there will be no significant effects, either individually or in combination with other plans or projects, adversely affecting the conservation interests or conservation objectives of the River Boyne and Blackwater SAC and the River Boyne and Blackwater SPA, i.e. the integrity of these, or any other Natura 2000 sites. It is therefore concluded that the proposed development will not, beyond reasonable scientific doubt, adversely affect the integrity of any Natura 2000 site either directly or indirectly.

Table 6: Residual effect - Summary of impacts and effects on Natura 2000 sites within the ZoI of the proposed development and proposed mitigation

Natura 2000 site (Site code)	QIs within the Zone of Influence	Potential Impact(s)	Significance of Effects on QI within the ZoI	Mitigation Measures	Significance of Residual Effects on QI within the ZoI
River Boyne and River Blackwater SAC (002299)	**River lamprey** *Lampetra fluviatili*) [1099] **Salmon** *Salmo salar* [1106] **Otter** *Lutra lutra* [1355] Note: The QI habitat Alkaline fens was 'screened out' due to no source-receptor pathway and Likely Significant Effects from water quality impacts on Alluvial forests were ruled out in the NIS due to the limited extent of the source-pathway-receptor linkage	Water quality impacts	**Likely Significant Effects** Potentially significant at international scale	Surface water Management Plan within OCEMP, including: • Sediment Control Measures • Hydrocarbon Control Measures. • Cement Control Measures. • Pollution control at works locations • Works monitored by Ecological Clerk of Works	No potential for adverse effects on integrity
River Boyne and River Blackwater SPA (004232)	**Kingfisher** *Alcedo athis* [A229]	Water quality impacts	**Possible Significant Effects** Potentially significant at international scale	Surface water Management Plan within OCEMP, including: • Sediment Control Measures • Hydrocarbon Control Measures. • Cement Control Measures. • Pollution control at works locations • Works monitored by Ecological Clerk of Works	No potential for adverse effects on integrity
Lough Derrvaragh SPA (004043)	**Whooper swan** (*Cygnus cygnus*) [A038] **Wetland & Waterbirds [A999]** Note: The proposed development has been assessed for all waterbird species within the assemblages recorded for Natura 2000 sites within 14 to 32 km Note: Pochard, tufted duck and coot were 'screened out' due to separation distance, lack of suitable habitat & low collision risk documented for these species	Collision risk	**Not significant** – based on observed site usage over 2-years	None required	No potential for adverse effects on integrity
		Displacement	**Not significant** – based on observed site usage over 2-years	None required	No potential for adverse effects on integrity

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APPENDIX 1: SURVEY FOR TURBINE COMPONENT HAUL ROUTE

Table A1.1: Assessment of potential for source-pathway-receptor on haul route

Cross-references with Route assess survey report, included below

ID No.	Location	Alteration	Works	Source-pathway-receptor	Natura 2000 site(s)	Distance
5.6.1	Belview (Waterford) Port	Minor	Removal of signage, barrier, fence	None	Lower River Suir SAC	0.39 km
5.6.2	Waterford Bypass	Major	Widening of road	Potential hydrological connection via stream Rathpatrick 16R35 no longer exists at roundabout	Lower River Suir SAC	3.04 km
5.6.3	Waterford Bypass	Minor	Removal of signage and street lamps	None	n/a	
5.6.4	Waterford Bypass	Major	Widening of road	None	n/a	
5.6.5	Waterford Bypass	Minor	Removal of signage and street lamps	None	n/a	
5.6.6	Waterford Bypass	Major	Widening of road on roundabout	None	n/a	
5.7.1	Mulligar Bypass	Major	Widening of road	None	n/a	
5.9.1	N52/L1504 junction	Major	Hedgerow removal	None	n/a	
5.9.2	L1504	Minor	Single tree removal	None	n/a	
5.9.3	L1504	Minor	Overhead lines	None	n/a	
5.9.4	L1504/Dumper depot junction	Major	Wall removal	None	n/a	
5.9.5	Dumper depot exit	Major	Tree removal at exit, plus pruning along unnamed road	None	n/a	
5.9.6	Dumper depot to site entrance along unnamed road	Major	Upgrade of road, including widening and pruning of vegetation	Road side drains hydrologically connected via to Natura 2000 sites	River Boyne and River Blackwater SAC/SPA	c. 11 km
5.9.7	Right bend on unnamed road	Major	Road widening	None - no road side drains with downstream connectivity	n/a	
5.9.8	Vertical crest on unnamed road	Major	Overhead lines - tree pruning required	None - no road side drains with downstream connectivity	n/a	
5.9.9	Right bend on unnamed road	Major	Road widening	Road side drains hydrologically connected via to Natura 2000 sites	River Boyne and River Blackwater SAC/SPA	c. 11 km
5.9.10	Site entrance	Major	Construction works assessed as part of Application Site	Road side drains hydrologically connected via to Natura 2000 sites	River Boyne and River Blackwater SAC/SPA	c. 11 km

COLLETT

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Route Access Survey
340497 – Vestas V162

Bracklyn Wind Farm

Galetech
October 2020

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Contents

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Report for
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Galetech Energy
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Attendees of Survey
Steven Mangham

Time / Date of Survey: 29th October 2019

General weather conditions: Mixed

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Document Revisions

No	Date	Details
340497-V162	12/10/2020	Updated with V162 Blade
340497-V162 REV 1	30/04/2021	Updated as per client req.
340497-V162 REV 2	12/05/2021	Updated comments in section 5.9 as per client req.

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1. Executive Summary

1.1. This report comprises of a study of the road route as detailed here in for the road transport of V162 Blade Components to the proposed Bracklyn Wind Farm, near Bracklyn, County Westmeath.

1.2. One route has been assessed from the Port of Waterford to the proposed site.

1.3. No other turbine components have been assessed as part of this assessment.

Third party land

1.4. Third party land is required at the junction of the N52 and the L1504.

Road widening

1.5. Road widening within highways owned land is required at numerous locations on the route:

- N29 / R711 Roundabout.
- N25 / R680 Roundabout (Option 2).
- N9 / M9 Roundabout.
- N4 / N52 Roundabout at Mullingar.
- L1504 / Dumper Depot junction.
- Throughout unnamed road to meet the Vestas Road Specification

Modifications to street furniture

1.6. Modifications to street furniture will be required along the route at a high number of locations:

- Exit from the port of Waterford – Road signs, fence and barrier to be removed.
- N29 / R711 Roundabout – Road signs to be removed.
- N29 / N25 Roundabout – Road signs and lamp posts to be removed.
- N25 / R680 Roundabout (Option 1) - Road signs and lamp posts to be removed.
- N25 / R680 Roundabout (Option 2) - Road signs and lamp post to be removed.
- N25 / N9 Roundabout - Road signs and lamp posts to be removed.
- N9 / M9 Roundabout – Road signs to be removed.
- N4 / N52 Roundabout at Mullingar – Lamp posts and road signs to be removed.
- N52 / L1504 Junction – Road signs and hedge to be removed.
- L1504 / Dumper Depot junction – Wall and trees to be removed.
- Dumper Depot junction / Unnamed Road junction – Trees to be removed.
- Right hand bend on unnamed road – Two telegraph poles to be removed.

Vertical Alignment and Height Clearances

1.7. Verticals crests along the route can be navigated by raising the neck of the trailer.

Structural Assessment

1.8. No structural assessments where undertaken as part of this route survey. Once the tower dimensions have been selected, it is advised that a dummy permit be issued to determine whether there are any structural issues on the route.

Other areas of note

1.9. The area within the port is to be cleared of all obstructions to allow rear projection to oversail.
1.10. Trees and pole at the proposed exit from the Dumper Depot will require removal to allow a new exit to be constructed.
1.11. A turning manoeuvre will be required at the N4/N52 Roundabout to allow the loaded blade vehicle to navigate onto the N52.
1.12. A turning manoeuvre will be required at the N25 / R680 roundabout (Option 2). This is to reduce the amount of lamp posts that require to be removed.

2. Introduction

2.1 Collett & Sons Ltd. were commissioned by Galetech Energy to undertake an abnormal loads route access study to assess the transportation of Wind Turbine components to the proposed Bracklyn Wind Farm, near Bracklyn, County Westmeath.

2.2 The road routes as detailed herein are for the road transport of the V162 Blade component identified in Section 4.

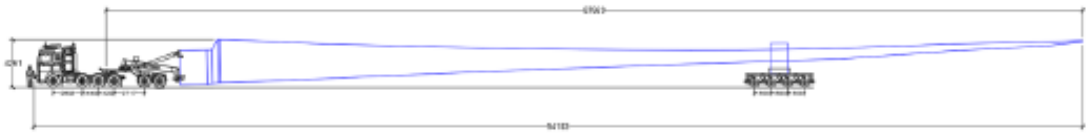
2.3 The purpose of this report is to detail access from the Port of Waterford.

3. Candidate Abnormal Loads

3.1. The blade specification was instructed by Galetech Energy.

4. Abnormal Indivisible Load Profiles

4.1. The abnormal load components are assessed based on weight, length, width and height and loaded to the most appropriate vehicle the weights and dimensions of these are detailed below. The loading diagrams are detailed in Appendix 1.

4.2.	340497-A
V162 Blade Component	
	
	Loaded vehicle dimensions
Overall vehicle Length	91.48m
Rigid Length	87.66m
Width	4.50m
Height	4.26m
Gross Vehicle Weight	79.00Te
Maximum axle weight	8.00Te

5. Route Assessment Overview

5.1. This section of the report illustrates the route assessed for the delivery of V162 Blade Component only from Port of Waterford to the proposed site entrance of Bracklyn Wind Farm.

5.2. For the purpose of this report, one route to the site was surveyed. All the routes surveyed in this report have been identified by Collett.

5.3.

Route

Start Location	Port of Waterford	Distance of Route	Km	Miles
Via:	N29/N25/M9/M50/N4/M4/N52/L1504		273	170

- Exit Port of Waterford onto the N29.
- At roundabout, take the 3rd exit onto N29.
- At roundabout, turn left onto N25.
- At roundabout, take the 4th exit onto N25.
- Continue on N25 and take the exit onto N9.
- At the roundabout, turn right onto M9.
- Continue on M9 and merge onto M7.
- Continue on M7 and merge onto N7.
- Continue on N7 and take the exit onto M50.
- Continue on M50 and take the exit onto N4.
- Continue on N3 and merge onto M4.
- Continue on M4 and merge onto N4.
- Take the exit at M4 J16 and then turn right at roundabout onto N52.
- Continue on N52 and then turn right at junction onto L1504.
- Continue straight into Dumper Depot and then onto unnamed road
- Continue on unnamed road to proposed site entrance at: OSI N 59923 59791.

5.4. Map Overview

5.5. Amendment Categorisation

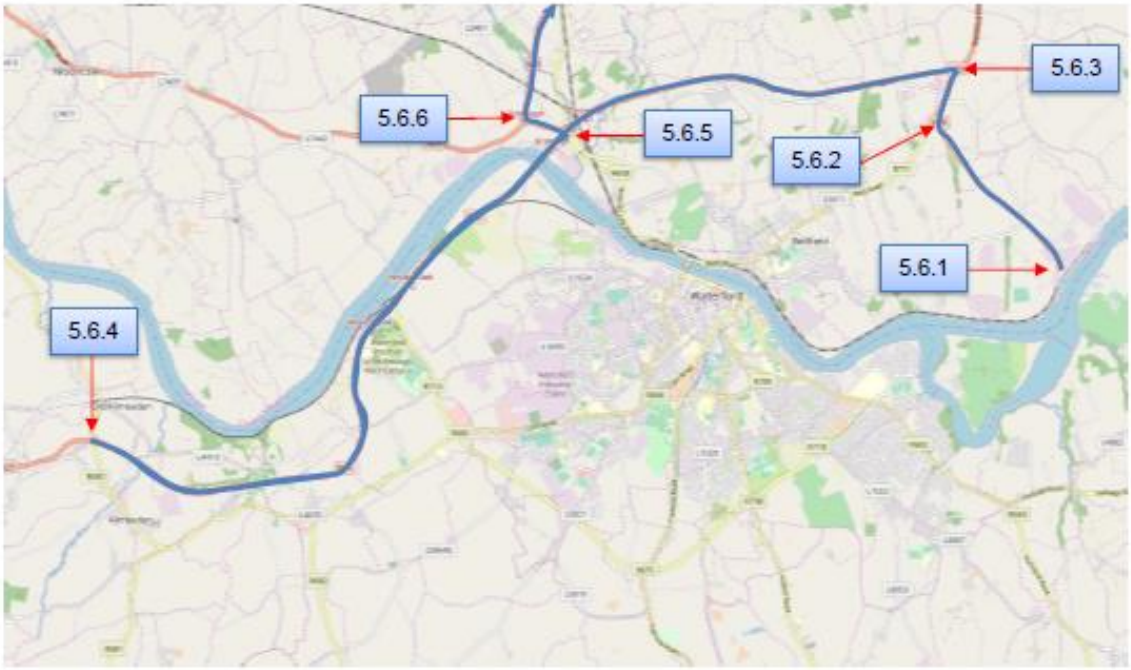
For the purposes of this report, the route amendments have been identified into 3 categories.

Major Amendments – Third Party Land, Road Widening
Minor Amendments – Modifications to Street Furniture, Pruning, Contraflow Manoeuvre, Manual Steering
No Amendments - Location is suitable as assessed during this survey

The categories have been colour coded for each report item as per the below key.

KEY					
	Major Amendments		Minor Amendments		No Amendments

5.6. Map extract of survey locations



ITEM NUMBER	5.6.1	LOCATION	EXIT PORT OF WATERFORD ONTO THE N29
DIRECTION	Continue at this location		
GRID REFERENCE	S 65780 12965		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that the fence and road sign on the offside is to be removed. Blade is required to contraflow the exit gate house to reduce the amount of modifications required. Road signs on nearside of railway crossing required to be removed to allow rear projection of blade to oversail. The barrier on the offside is to be removed. The area in the port is to be cleared of containers. Swept path analaysis is reccommended to confirm the above.	 Direction of N29  Exit from the port

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

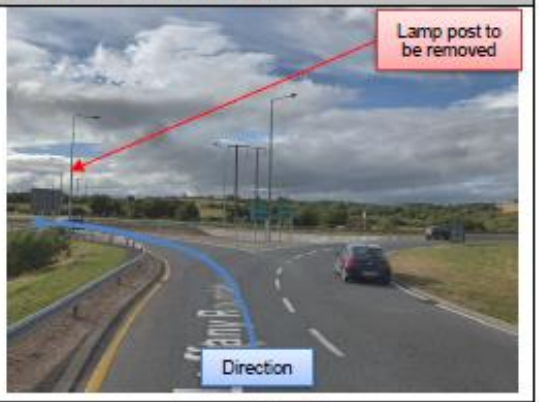
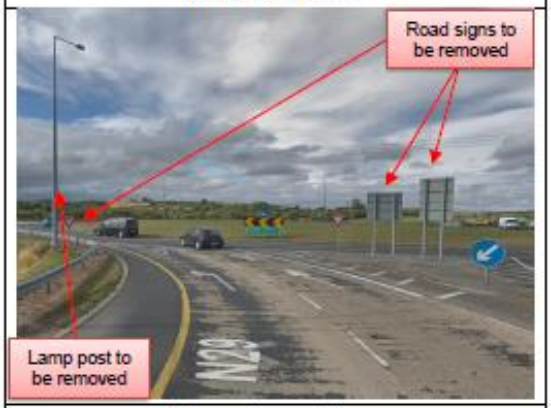
ITEM NUMBER	5.6.2	LOCATION	N29/R711 ROUNDABOUT
DIRECTION	Take the 3rd exit at the roundabout		
GRID REFERENCE	S 63927 15153		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that road widening is required on the central reservation to avoid the removal of lamp posts. Road signs on central reservation required to be removed. Rear projection of blade oversailing on coming carriageway. Swept path analaysis is reccommended to confirm the above.	 View of roundabout  View of roundabout

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

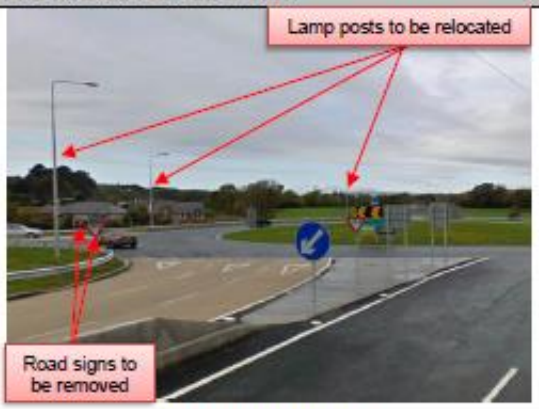
ITEM NUMBER	5.6.3	LOCATION	N29/N25 ROUNDABOUT
DIRECTION	Take the 1st exit at the roundabout		
GRID REFERENCE	S 64149 15861		

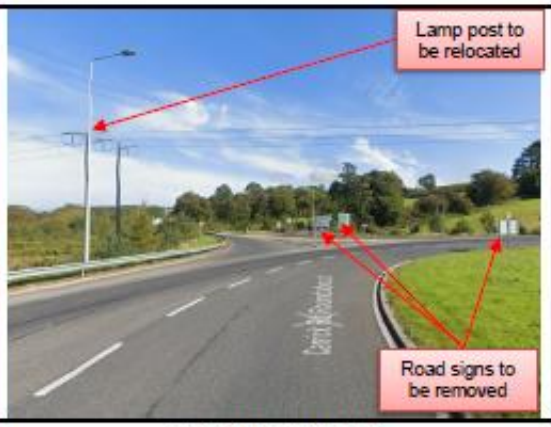
MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that the road sign and lamp posts on the nearside is to be removed. Road signs on the offside to be removed. Blade oversailing on coming carriageway. Swept path analaysis is reccommended to confirm the above.	 View of Direction  View of roundabout

Aerial View of Location

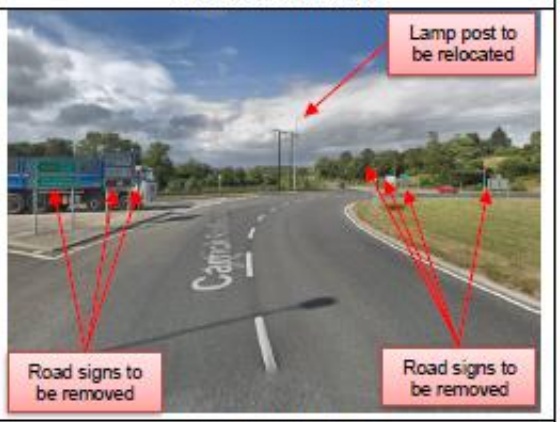
FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

ITEM NUMBER	5.6.4	LOCATION	N25/R680 ROUNDABOUT (OPTION 1)
DIRECTION	Circumnavigate the roundabout		
GRID REFERENCE	S 51422 10214		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that road signs on central reservation and splitter island are required to be removed. All Lamp posts on outside of roundabout required to be removed to allow rear proejction fo balde to oversail. Swept path analaysis is reccommended to confirm the above.	 View of roundabout



View of roundabout



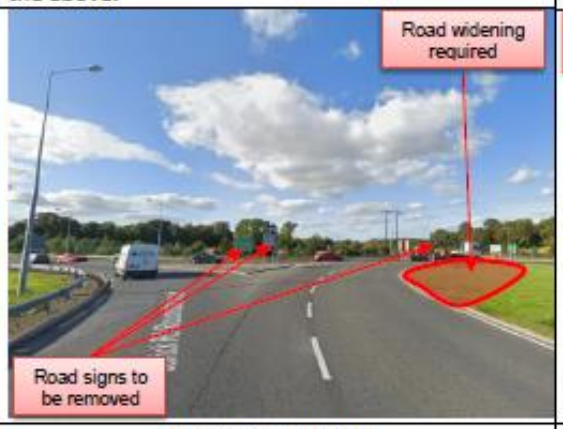
View of roundabout


Aerial View of Location

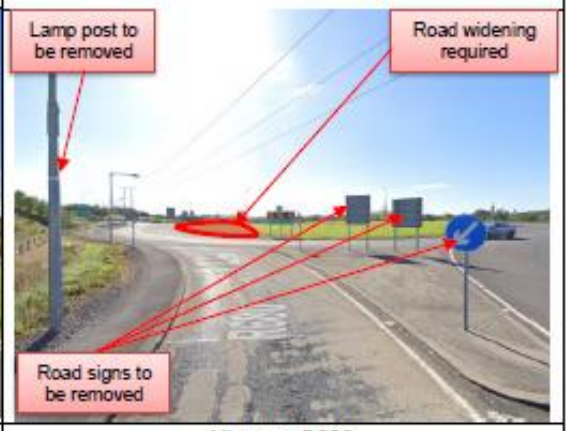
FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

ITEM NUMBER	5.6.4	LOCATION	N25/R680 ROUNDABOUT (OPTION 2)
DIRECTION	Circumnavigate the roundabout		
GRID REFERENCE	S 51422 10214		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that road widening is required on central reservation. A three-point turn manoeuvre is required to reduce the amount of street furniture required to be removed. Multiple road signs required to be removed on splitter islands and on central reservation. One lamp post is required to be removed on nearside of R680. Swept path analaysis is reccommended to confirm the above.	 View of roundabout



View of roundabout

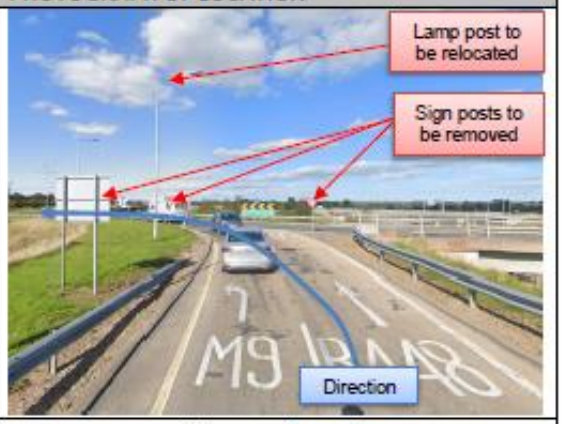


View on R680

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

ITEM NUMBER	5.6.5	LOCATION	N25/N9 ROUNDABOUT
DIRECTION	Turn left at junction		
GRID REFERENCE	S 58290 14812		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that lamp posts to be relocated on the nearside. Sign posts to be removed on both sides of the road. Swept path analaysis is reccommended to confirm the above.	 View on slip road  View of N25

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

ITEM NUMBER	5.6.6	LOCATION	N9/M9 ROUNDABOUT
DIRECTION	Take the 2nd exit at the roundabout		
GRID REFERENCE	S 57784 15057		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Visual inspection indicates that lamp post on the nearside to be relocated. Sign posts to be removed on the nearside and road signs to be removed on the nearside and offside. Swept path analaysis is reccommended to confirm the above.	 View of entrance to roundabout

View on roundabout

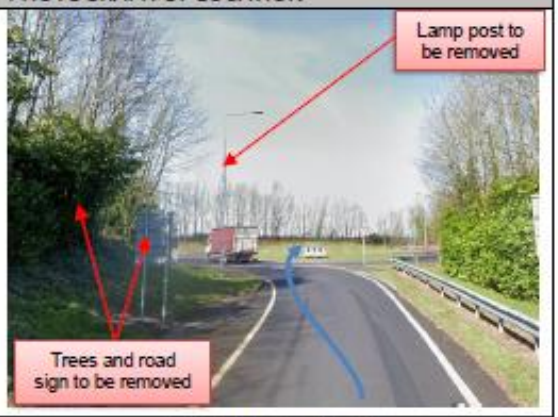
View of exit of roundabout

Aerial View of Location

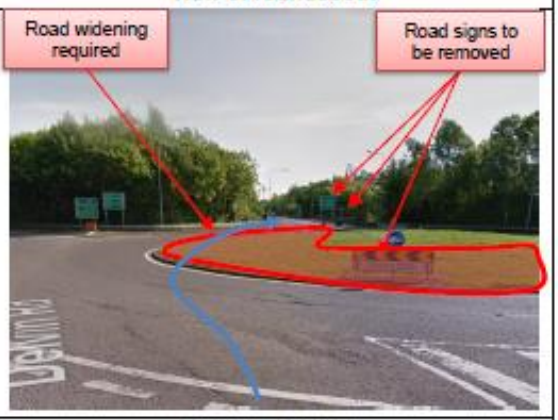
FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

5.7. Map extract of survey locations

ITEM NUMBER	5.7.1	LOCATION	N4/N52 ROUNDABOUT
DIRECTION	Take 3rd Exit at the roundabout		
GRID REFERENCE	N 45699 54063		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Loaded blades vehicle is to drive straight across at the roundabout onto on slip, then reverse back onto Delvin Road then drive straight over roundabout onto N52. Road widening is required on the central island of the roundabout. Road signs on central island of the roundabout and on Delvin Road splitter island. Lamp post on nearside of roundabout entry to be removed. Pruning of trees required at this location.	 View of roundabout

View of splitter island

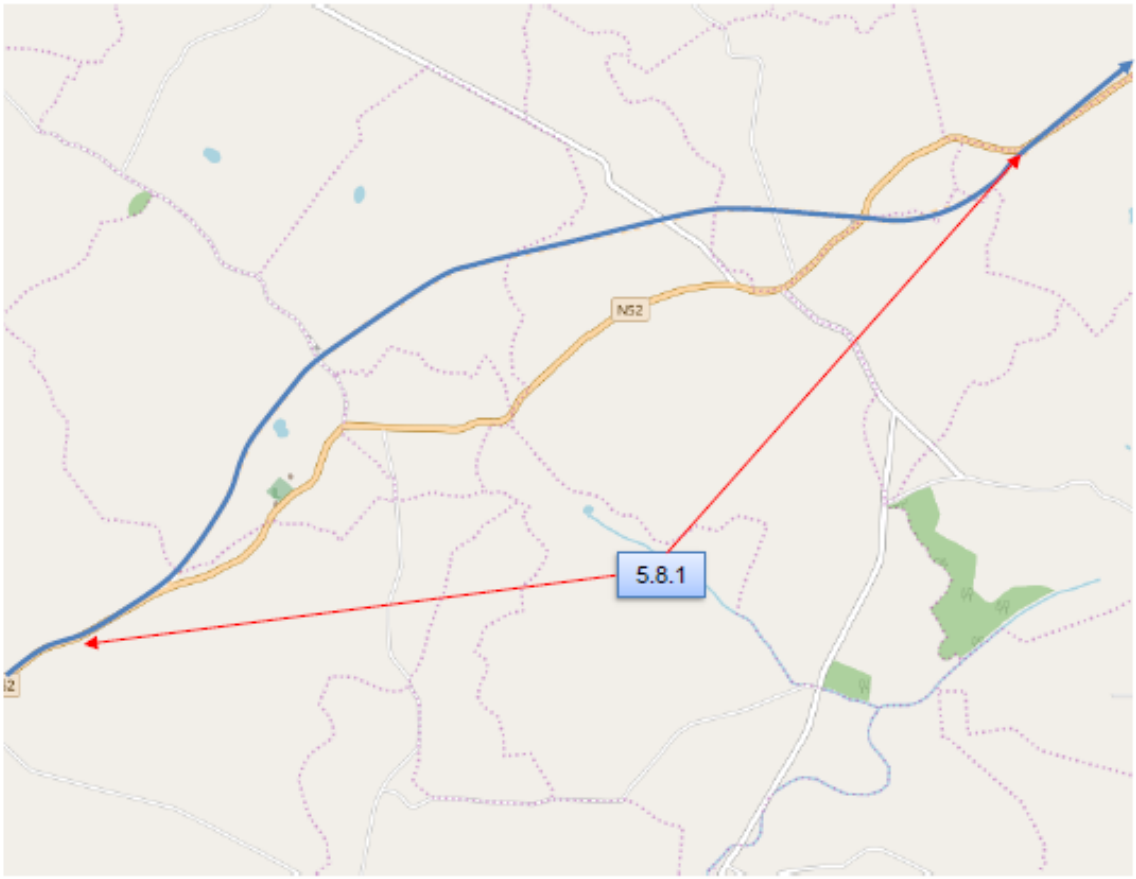


View of direction

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-100		

5.8. Map extract of survey locations

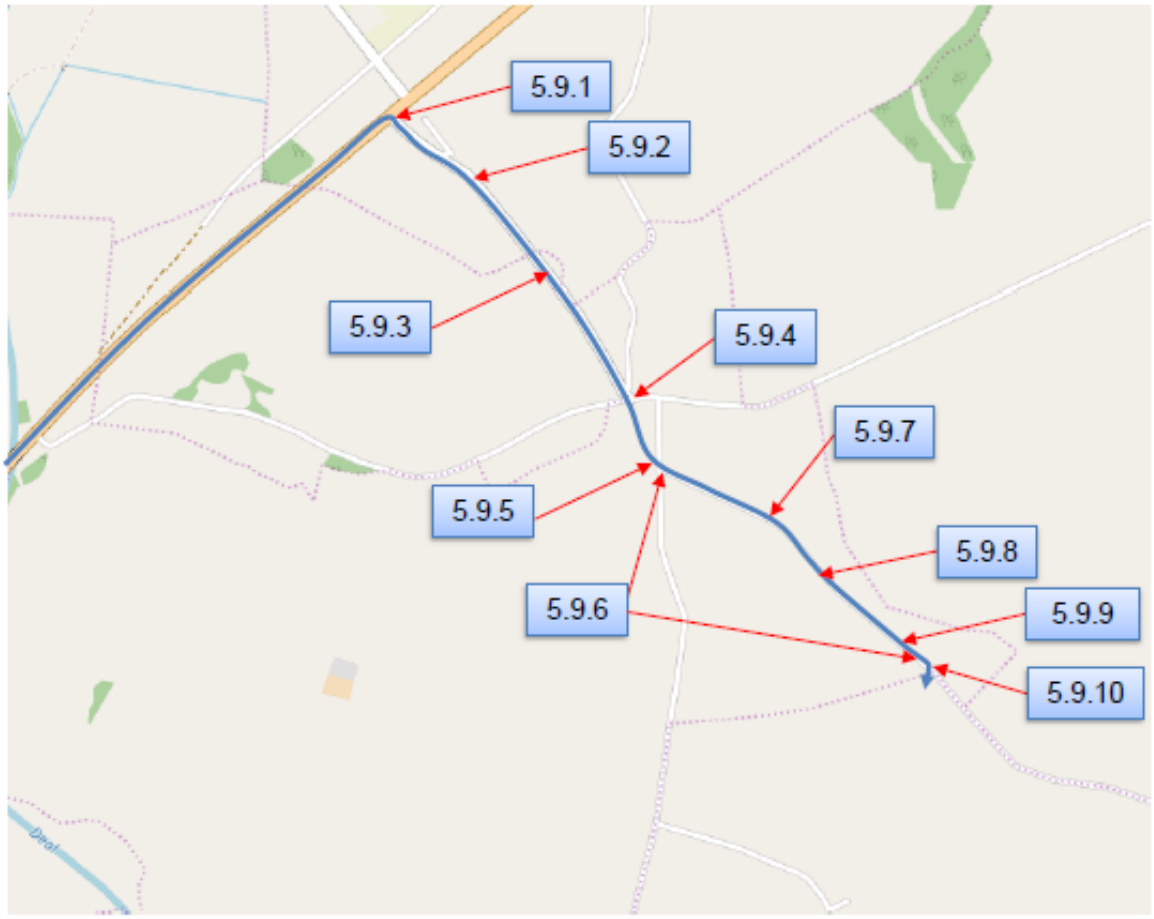


ITEM NUMBER	5.8.1	LOCATION	N52 TURIN CROSS NEW ROAD
DIRECTION	Continue at this location		
GRID REFERENCE	N 53129 57445		
MODIFICATION AND DESCRIPTION		PHOTOGRAPH OF LOCATION	

New bypass road being constructed on N52

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	Choose an item.
RELATED DOCUMENT NUMBERS			

5.9. Map extract of survey locations



ITEM NUMBER	5.9.1	LOCATION	N52/L1504 JUNCTION
DIRECTION	Turn right at this junction		
GRID REFERENCE	N 58727 60984		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Swept path analysis indicates third party land required on the eastern side of the junction. Hedgerow to be removed to allow access to third party land. Road signs on nearside of the L1504 to be removed. Manual steering required to assist navigation.	 View of N52  View of junction

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-110		

ITEM NUMBER	5.9.2	LOCATION	RIGHT BEND ON L1504
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 58894 60856		
MODIFICATION AND DESCRIPTION		PHOTOGRAPH OF LOCATION	
Swept Path Analysis indicates a tree is to be removed on the nearside to allow the rear projection of the blade to oversail. Manual steering utilised to assist navigation.			
		View of N52	
			
Aerial View of Location			
FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-120		

ITEM NUMBER	5.9.3	LOCATION	VERTICAL CRESTS ON L1504
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59011 60714		
MODIFICATION AND DESCRIPTION		PHOTOGRAPH OF LOCATION	
Vertical Analysis indicates that Loaded blade component will navigate this vertical crest with the neck of clamp raised. Once the rear projection of blade is on the vertical crest it rises to above 5m, overhead cables are to be checked at this location to avoid the projection colliding with them.			
		View of N52	
			
Aerial View of Location			
FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Vertical Analysis
RELATED DOCUMENT NUMBERS	340497-125V/127V		

ITEM NUMBER	5.9.4	LOCATION	L1504/DUMPER DEPOT JUNCTION
DIRECTION	Continue straight at this junction		
GRID REFERENCE	N 59242 60391		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Wall and trees on the offside of the access to the Dumper Yard to be removed to allow access. Ground within Dumper Yard to be assessed and, if required, upgraded to accept suitable axle loadings as per the Vestas specification.	 View of dumper depot entrance  View of direction

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-130		

ITEM NUMBER	5.9.5	LOCATION	DUMPER DEPOT/UNNAMED ROAD JUNCTION
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59321 60238		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
A New exit from the Dumper Yard is to be constructed to allow the loaded blade vehicles to navigate from the Dumper Yard onto the unnamed road. Trees will require removal to allow construction of the exit. Trees on the unnamed road will require pruning to create and envelope that meets the Vestas Specification.	 View of right hand bend

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-140		

ITEM NUMBER	5.9.6	LOCATION	FULL LENGTH OF UNNAMED ROAD
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59389 60202		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
The full length of the road from the Dumper Yard to site will require upgrading to the Vestas road specification. These modifications will include road widening to the minimum stated road widths for straight sections and for bends, as well as pruning of vegetation to ensure the stipulated clear envelope is available for the turbine components. Trees on the unnamed road will require pruning to create and envelope that meets the Vestas Specification. Road widening to take place on the southern (right hand side) of the road	 View of vertical

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-SPA X		

ITEM NUMBER	5.9.7	LOCATION	RIGHT BEND ON UNNAMED ROAD
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59588 60109		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Road widening is required on the nearside of the road to allow the loaded blades to navigate this bend. Trees on the unnamed road will require pruning to create and envelope that meets the Vestas Specification. Road widening to take place on the southern (right hand side) of the road	 View of proposed site entrance

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	N/A
RELATED DOCUMENT NUMBERS	340497-150		

ITEM NUMBER	5.9.8	LOCATION	VERTICAL CREST ON UNNAMED ROAD
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59696 59983		
MODIFICATION AND DESCRIPTION		PHOTOGRAPH OF LOCATION	

Vertical Analysis indicates that Loaded blade component will navigate this vertical crest with the neck of clamp raised.

Once the rear projection of blade is on the vertical crest it rises to 6.81m, overhead cables are to be checked at this location to avoid the projection colliding with them.

Trees overhanging the road will be required to be pruned to avoid damaging the blade.

View of proposed site entrance

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Vertical Analysis
RELATED DOCUMENT NUMBERS	340497-155V		

ITEM NUMBER	5.9.9	LOCATION	RIGHT BEND ON UNNAMED ROAD
DIRECTION	Continue straight at this location		
GRID REFERENCE	N 59919 59790		
MODIFICATION AND DESCRIPTION		PHOTOGRAPH OF LOCATION	

Road widening required on the nearside of the bend to allow loaded blades to navigate.

Road widening to take place on the southern (right hand side) of the road

View of proposed site entrance

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	YES	TYPE	Swept Path Analysis
RELATED DOCUMENT NUMBERS	340497-160		

ITEM NUMBER	5.9.10	LOCATION	PROPOSED SITE ENTRANCE
DIRECTION	Turn right into site		
GRID REFERENCE	N 59977 59722		

MODIFICATION AND DESCRIPTION	PHOTOGRAPH OF LOCATION
Site entrance to be constructed in accordance with the Vestas specification. Swept path analysis is recommended to confirm the proposed design of the site entrance.	
	View of proposed site entrance

Aerial View of Location

FURTHER INVESTIGATION UNDERTAKEN?	NO	TYPE	N/A
RELATED DOCUMENT NUMBERS	N/A		

6. Important Notes

6.1. The recommendations in this report are made from a purely transport orientated view, and do not consider any political issues in terms of land ownership, or any other precincts raised that may otherwise be restrictive.

6.2. The information contained in this report is privileged and confidential and is for the exclusive use of the client nominated herein.

6.3. A Police escort or pilot car will be required in order to assist with traffic control for the entire route surveyed.

6.4. Permits will be required for the movement of all loads. These permits are at the discretion of the Local Authority (L.A). Therefore, approval of these permits by the L.A is a major consideration before any movements can be undertaken.

6.5. It is recommended to have adequate warning signs implemented to warn other road users at critical points.

6.6. All hedges, shrubs, bushes, trees and overhanging branches along the nominated routes must be trimmed to allow a suitable minimum envelope.

6.7. All street furniture, signage etc. along the nominated route must be removed to allow a suitable minimum envelope on the road. Other specific street furniture has been nominated in this report to facilitate over-sailed and swept areas.

6.8. The turbine manufactures transport guidance notes will state the minimum road width required for the transport of components. Any roads below this stated width will require widening to reflect this.

6.9. In areas where land take or road widening is required, the road construction must be formed to the minimum specification suitable for the transfer of axle loadings up to 16Te, the road construction must be formed to the minimum specification contained in the selected manufacturers transport and erection guidance notes.

6.10. Overhead utility cables have not been measured as part of this survey and correspondence with the utility companies regarding cable heights and possible remedial solutions should be undertaken prior to any delivery.

6.11. It should be noted that all assessments and inspections have been done so with the intention of producing information to highlight anticipated problems. This includes highlighting of potential land take requirements, possible street furniture implications, and highway alignment issues.

6.12. Land take is usually referred to when land is required from private land owners; road widening is usually referred to when land is required within highways boundaries. However, the details of the nominated land take and road widening contained in this report are highlighting the expected areas of concern, and can only be confirmed by swept path analysis. The boundaries between private land and highways property are assumed by using obvious demarcation such as fence lines/hedges etc. It should be noted that actual boundaries between highways and private land are not substantiated in this report and can only be authenticated by carrying out land searches.

6.13. All inspections and assessments are made for the road movement of loaded trailer equipment carrying specific storage tank components. These dimensions are based on the turning circles and specification of Collett & Sons trailer equipment.

6.14. All route inspections and assessments, and subsequent conclusions and recommendations are deemed accurate by Collett & Sons Limited at the date that this report is created. We cannot be held responsible for the development of future road schemes or alterations to the routes surveyed that may leave this report inaccurate.

6.15. This report is based solely on a preliminary visual inspection. Nothing in this report shall be construed in any way as committing Collett & Sons Limited to being able to deliver to site using this route before further structural analysis has been undertaken, and any accommodation/remedial works undertaken which are to Collett & Sons satisfaction.

APPENDIX 2: AQUATIC ECOLOGY SURVEY REPORT

Statement of authority

Aquatic and fisheries assessment surveys were conducted by Patrick Quinn who was assisted by Nicole Fleming, with this reporting compiled by Patrick Quinn.

Patrick Quinn is a Senior Ecologist with Woodrow Sustainable Solutions Ltd. He has completed an honours B.Sc. in Environmental Science, a degree in Environmental Protection and a Higher Certificate in Science in Fisheries Management. Patrick is an associate member of the Chartered Institute of Ecology and Environmental Management and also the Institute of Fisheries Management. He regularly carries out reporting on Appropriate Assessments carried out by statutory authorities. Furthermore, he has experience in habitat surveys, bird surveys for a number of large infrastructure schemes, commercial and residential projects. Patrick is also an experienced Ecological Clerk of Works (ECoW) for transmission line and wind farms construction.

Patrick Quinn – Qualifications:
B. Sc. (Hons) Environmental Science, Institute of Technology, Sligo, 2015
B. Sc. Environmental Protection, Institute of Technology, Sligo, 2014
HC Fisheries Management, Institute of Technology, Sligo 2012

Coverage, survey effort & methods

Aquatic surveys were conducted at 7 no. locations within, and adjacent to, the proposed development site on 14 &15 October 2020 and included the follow methodology:

- An ecological assessment of the watercourses within and draining the proposed development site (notably with respect to white-clawed crayfish, salmon and lamprey suitability) was conducted at key locations. Sections of waterbodies directly affected by the proposed development (i.e. crossing points) were walked and assessed using the Life Cycle Unit (LCU) Approach, where aquatic habitats are classified according to type: nursery, holding, spawning; and quality: excellent (1) to marginal (4), as detailed in Kennedy,1984[141] and O'Connor & Kennedy, 2002[142];
- River Hydromorphology Assessment Techniques (RHAT) were also undertaken. RHAT allows for the classification of watercourse hydromorphology based on a departure from naturalness and assigns a morphological classification directly related to that of the WFD: high, good, moderate, poor and bad, based on semi-qualitative and quantitative criteria;
- While conducting stream assessments, banks and drains were searched for signs of otter activity and were assessed for kingfisher suitability; and
- At 4 no. sample points, biological scoring of the streams associated with the proposed development site was carried out to provide for Q-rating of each watercourse. This was undertaken using macro-invertebrate sampling (kick-

141 Kennedy G.J.A. (1984) Evaluation of techniques for classifying habitats for juvenile salmon (*Salmo salar* L.) *Proceedings of the Atlantic Salmon trust workshop on stock enhancement*.

142 O'Connor L. & Kennedy, R.J (2002). A comparison of catchment-based salmon habitat survey techniques on three rivers in N. Ireland. Fisheries Management & Ecology, 9, 149-161

sampling). As detailed in Toner *et al*. (2005)[143], macro-invertebrate samples were converted to Q-ratings and assigned to WFD status classes. Basic water quality parameters were measured using portable meters to provide a baseline profile of chemical quality in the principal watercourses. These included temperature, pH, dissolved oxygen, conductivity and turbidity.

A map showing the locations of aquatic assessments in relation to the proposed development is provided at **Figure A2.1**.

143 Toner P., Bowman J., Clabby K., Lucey L., McGarrigle M., Concannon C., Clenaghan C., Cunningham P., Delaney J., O'Boyle S., MacCárthaigh M., Craig M. & R. Quinn et al. (2005) *Water Quality in Ireland 2001–2003*. EPA – Environmental Protection Agency, Johnstown Castle, Co. Wexford

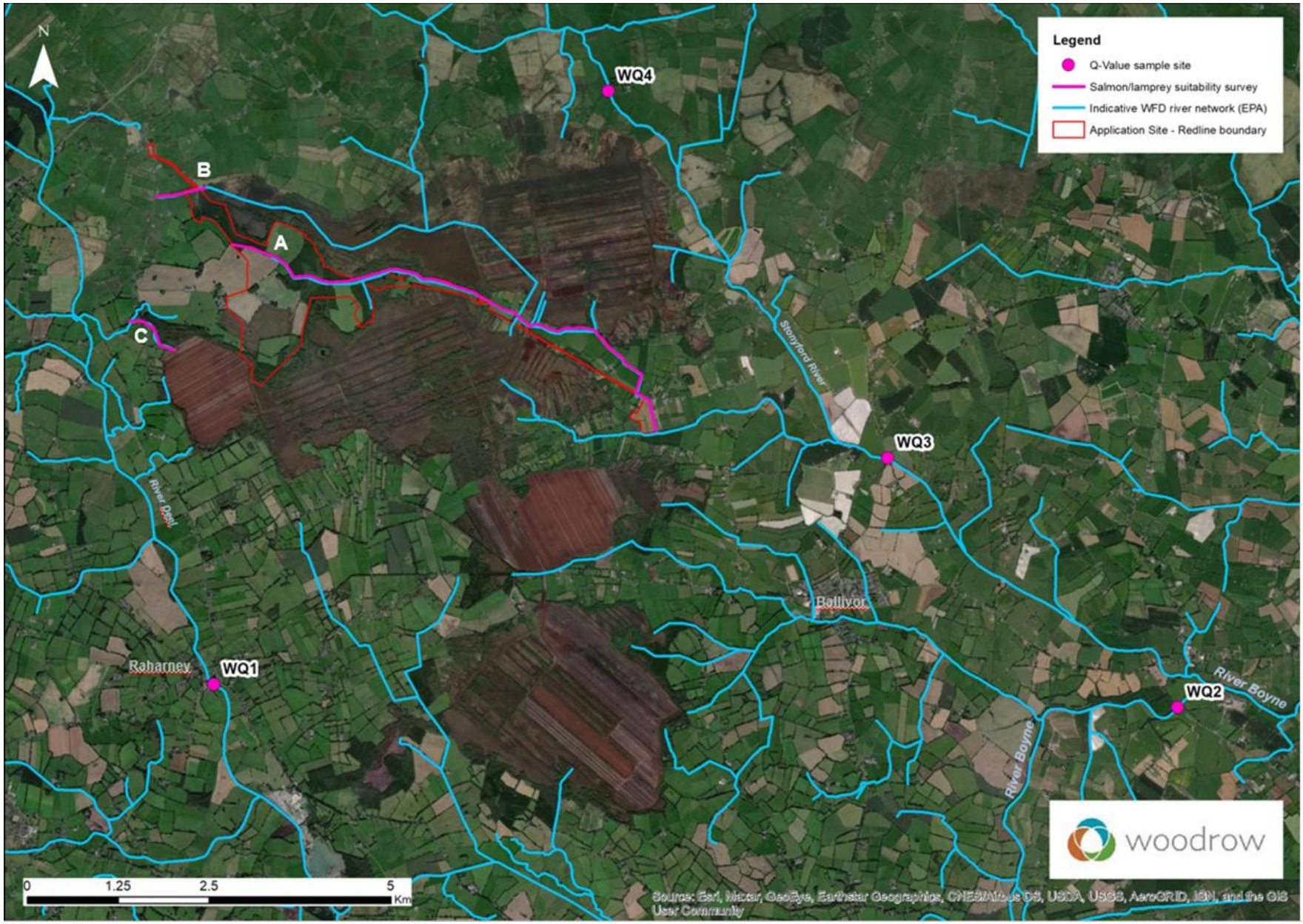


Figure A2.1: Aquatic assessment map for the proposed development

A. Water Quality site 1 - River Deel flowing through Raharney village

B. Water Quality site 2 within the River Boyne

C. Water Quality site 3 within the Stonyford River

D. Water Quality site 4 located upstream of the Stonyford River

E. Salmon suitability site A within the wind farm site

F. Salmon suitability site B adjacent to site entrance

G. Salmon suitability site C located west of the Application Site boundary

A. Water Quality site, **B**. Water Quality site 2, **C**. Water Quality site 3, **D**. Water Quality site 4, **E**. Salmon suitability site A, **F**. Salmon suitability site B, **G**. Salmon suitability site C

Figure A2.2: Images showing location of aquatic surveying

Results

The baseline aquatic assessments for the proposed development site are listed in **Table A2.1**. An aquatic assessment map of the existing aquatic environment in relation to the proposed development is provided in **Figure A2.1**, which can be cross referenced with information in **Table A2.1** and **Table A2.2**. **Figure A2.2** provides images showing locations of aquatic surveying.

As indicated in **Table A2.2**, the main drainage channel (modified stream) flowing through the proposed development site (Watercourse A[144]) was found to be unsuitable for spawning salmon and lamprey. The proposed development site is at the upper reaches of a tributary of the Stonyford River that is subject to periodic drainage maintenance works. Drainage has a negative effect on the occurrence of white-clawed crayfish; and therefore, it is considered unlikely that species occurs in this watercourse.

Salmon and lamprey spawning habitat and white-clawed crayfish are noted as occurring downstream of the proposed development. White-clawed crayfish have been recorded from the catchment of the Stonyford River, with the closest existing downstream record coming from the Earl's Bridge Hydrometric area (Station Code: RS07S020400). Salmon and river lamprey are listed as Qualifying Interests (QIs) of the River Boyne and River Blackwater SAC. The healthiest population of river lamprey are reported as occurring in the lower reaches of the Boyne River main channel downstream of Navan and the Stonyford tributary was considered to only support brook lamprey (O'Connor, 2006)[145]. Salmon run the River Boyne almost every month of the year and the Boyne is considered important for this species, as it represents an eastern river which holds large three-sea-winter fish (NPWS, 2014)[146]. In-stream improvement works on the Stonyford River have created spawning habitat for salmon (Boyne Catchment Angling Association).

Other native fish species recorded from the Stonyford River include brown trout and eels, and non-native species including stoneloach and minnow (O'Connor, 2006). Other notable species occurring in the Boyne catchment that are reliant on health fish stocks include otters and kingfishers, which are QIs of the River Boyne and River Blackwater SAC and SPA, respectively.

144 Watercourse A forms part of the Boyne Arterial Drainage Scheme (Reference: C1/32/7/3). This channel is classified as a 1st order stream by the EPA mapping (Indicative flow network: EPA ref: Bolanstown – 07B45). This highly channelised stream flows east through the site becoming a 2nd order stream before exiting the site to the east of the proposed turbine location for T10. The channel then joins a 3rd order stream as it crosses into Co. Meath (EPA ref: Cartenstown – 07C60), which flows adjacent to the point of grid connection and into the Stonyford River.

145 O'Connor W. (2006) A survey of juvenile lamprey populations in the Boyne Catchment. *Irish Wildlife Manuals*, No. 24 NPWS, DoEHLG, Dublin, Ireland.

146 NPWS (2014). Site Synopsis: River Boyne and River Blackwater SAC [Site Code: 00229]. National Park & Wildlife Service

Table A2.1: Water Quality Results

Water Quality Site	WQ1	WQ2	WQ3	WQ4
Date surveyed	15 Oct. 2020	15 Oct. 2020	15 Oct. 2020	15 Oct. 2020
River/Stream name	Deel River	Boyne river	Stonyford	Stonyford (upstream)
River sub-basin	Deel [Raharney]_040	Boyne_060	Stonyford_040	Stonyford_040
River/Stream order	4th Order	6th Order	4th Order	4th Order
EPA code	07D01	07B04	07S02	07S02
Q-Value	Q4	Q4	Q3-4	Q3-4
WFD Class	A	A	A	A
WFD Status	Good	Good	Moderate	Moderate
Dissolved O_2 %	96.5	99.4	106.3	105.7
Dissolved O_2 mg/l	10.95	11.25	12.02	11.97
pH.	8.35	8.30	8.29	8.28
Conductivity	767	772	771	785
Turbidity NTU	1.0	1.0	1.6	0.3
Temperature	10.10	10.40	10.30	10.30
Figure Ref.	Figure A2.2 Image A	Figure A2.2 Image B	Figure A2.2 Image C**Error! Reference source not found.**	Figure A2.2 Image D

Table A2.2: Salmon/Lamprey Habitat Suitability Results

Salmon suitability sites	A	B	C
Date surveyed	14 Oct. 2020	14 Oct. 2020	14 Oct. 2020
River/stream name	Bolandstown	Cartenstown	Graffanstown
River sub-basin	Stonyford_040	Stonyford_040	Deel (Raharney)_030
River/Stream order	1st Order	1st Order	1st Order
EPA code	07B45	07C60	07G10
Salmon suitability	No	No	No
Substrate	Silty, Sandy, Fine	Sandy	Silty, Sandy Fine
Description	Abundant vegetation growth along steep drainage banks upstream. Livestock crossing further downstream. Nutrient enrichment	Abundant vegetation growth with gradual sloping drainage banks with rich grass growth. Very little flow movements due to drainage being blocked by illegal dumping.	Abundant vegetation growth along steep drainage banks upstream.
Anthropogenic impacts	Agriculture, Forestry	Illegal dumping, Forestry, Road infrastructure	Agriculture
Flow	Slow	Slow	Slow
Figure Ref.	Figure A2.2 Image E	Figure A2.2 Image F	Figure A2.2 Image G

References

Kennedy G.J.A. (1984) Evaluation of techniques for classifying habitats for juvenile salmon (*Salmo salar* L.) *Proceedings of the Atlantic Salmon trust workshop on stock enhancement*.

O'Connor W. (2006) A survey of juvenile lamprey populations in the Boyne Catchment. *Irish Wildlife Manuals*, No. 24 NPWS, DoEHLG, Dublin, Ireland.

O'Connor L. & Kennedy, R.J (2002). A comparison of catchment-based salmon habitat survey techniques on three rivers in N. Ireland. Fisheries Management & Ecology, 9, 149-161

NPWS (2014). Site Synopsis: River Boyne and River Blackwater SAC [Site Code: 00229]. National Park & Wildlife Service

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APPENDIX 3: ORNITHOLOGICAL STUDY AREA & SURVEY EFFORT

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Table A3.1: Vantage (VP) point locations at Bracklyn, Co. Westmeath

Vantage Point	Irish grid reference	Lat.	Long.	X (ITM)	Y (ITM)	Details
VP 1	N 61384 56748	53.557263	-7.074359	661330	756770	On area of re-vegetated raised bog orientated to N covering T3, T4, T5, T11
VP 2	N 63284 58251	53.570543	-7.045391	663229	758273	On edge of remnant of raised bog orientated to NE covering T7, T10, T11
VP 3	N 60537 57999	53.568606	-7.086900	660482	758021	On farm track, orientated to SSW covering T3, T4, T5, T7, T10, T11
VP 4	N 60465 58605	53.574060	-7.087866	660411	758628	High point in cereal field, orientated to ENE covering T1, T2, T3, T6, T7

Figure A3.1: Viewshed at 20m above ground level – Vantage point 1

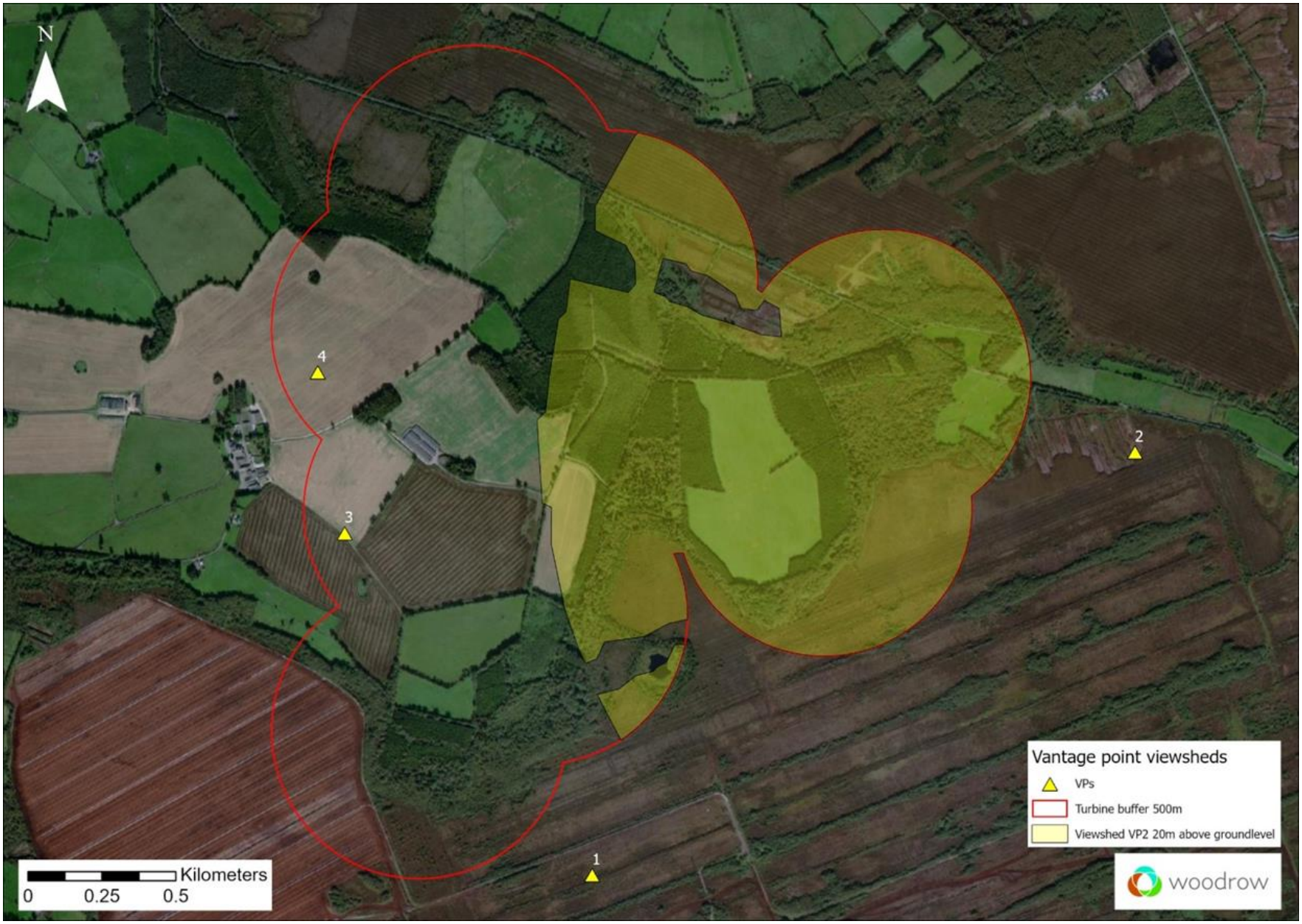

Figure A3.2: Viewshed at 20m above ground level – Vantage point 2

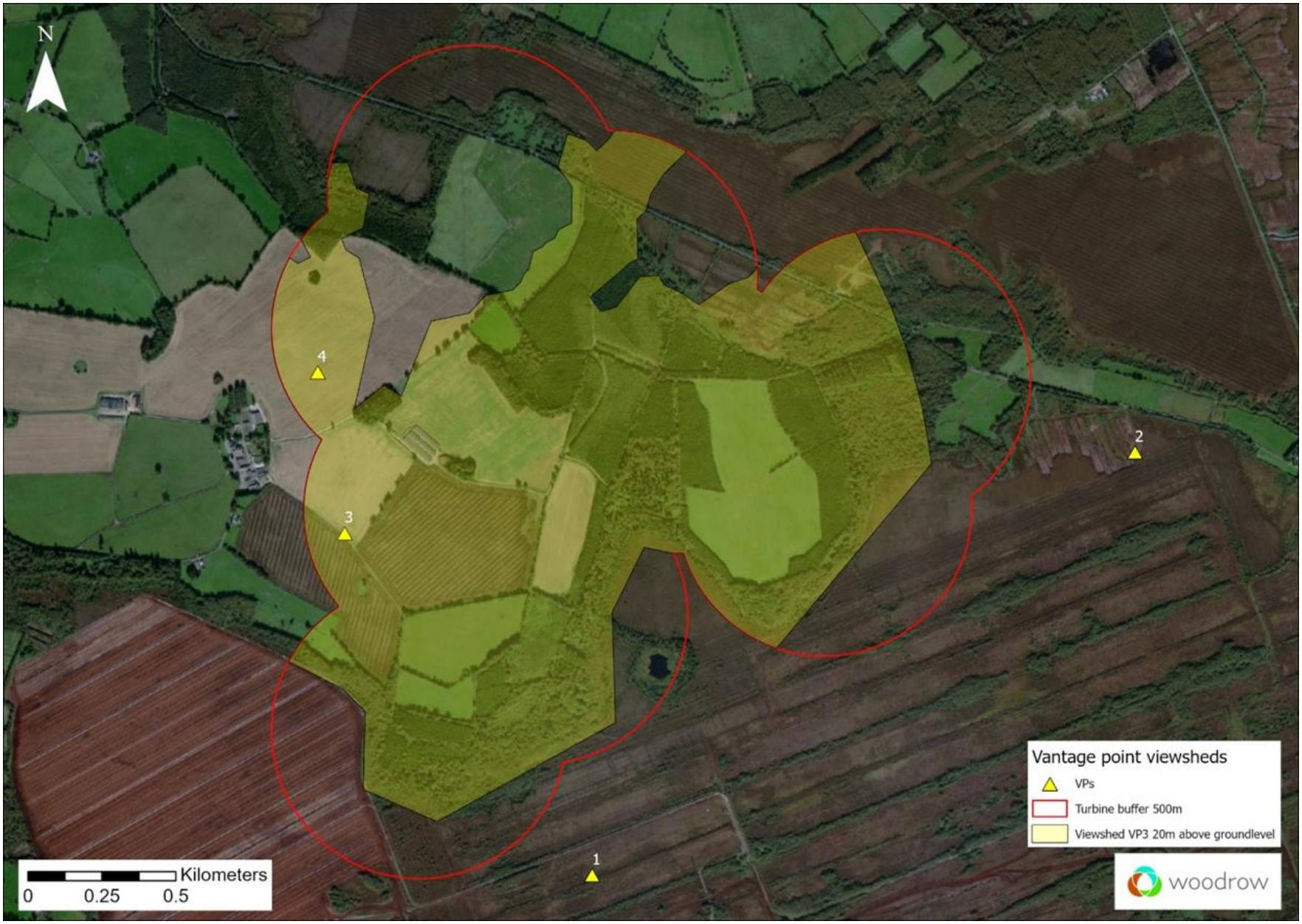

Figure A3.3: Viewshed at 20m above ground level – Vantage point 3

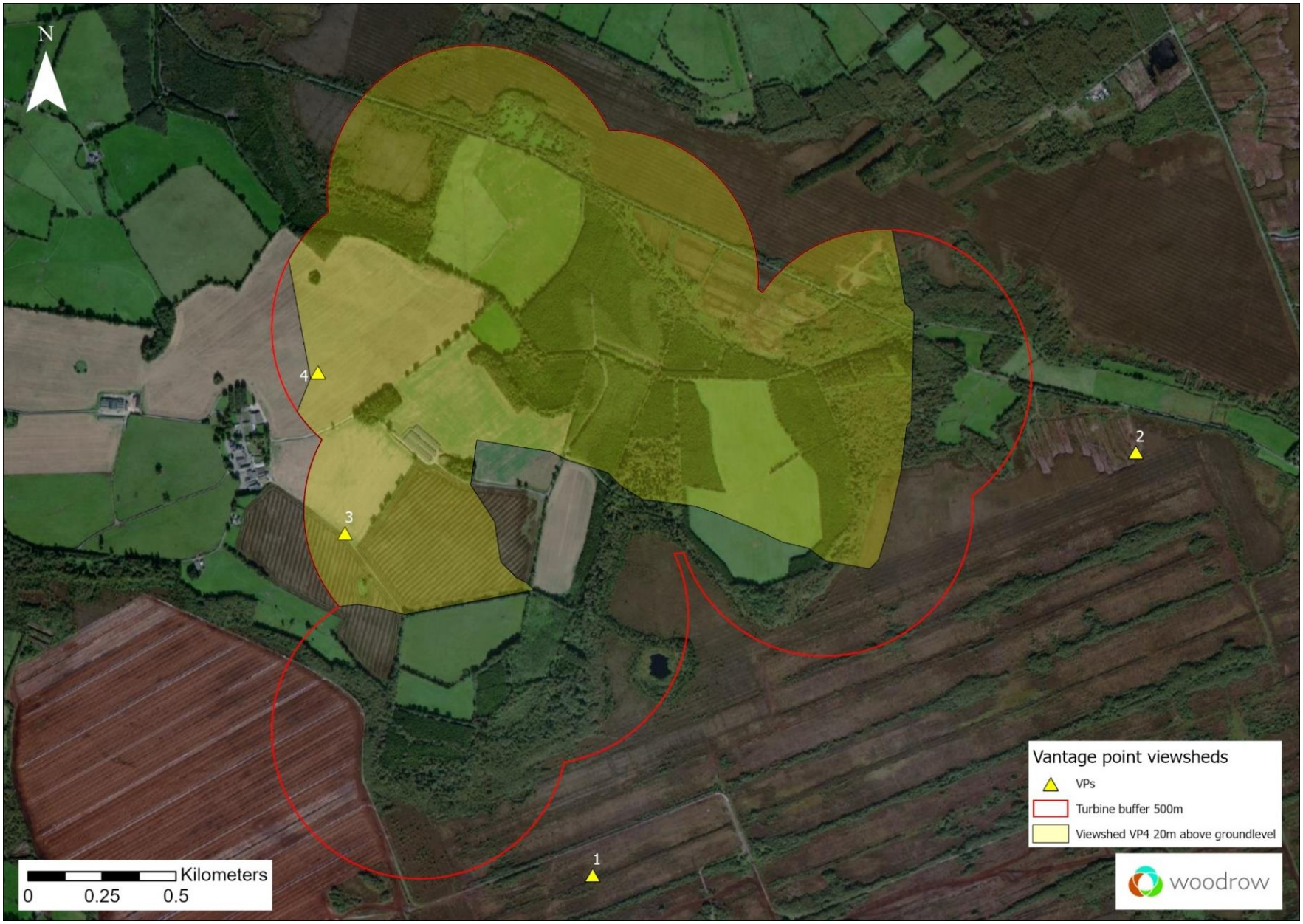

Figure A3.4: Viewshed at 20m above ground level – Vantage point 4

Table A3.2: Vantage point survey effort – Non-breeding season 2018-19

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	25/10/2018	3.00	1045	K	KW	3	W	good	8	10	dry	none	none	none
1	13/11/2018	3.00	1215	No target sp.	KW	2	SSE	good	5	8	damp	none	none	none
1	26/11/2018	3.00	1330	K	KW	1	E	good	2-4	7	wet	none	none	none
1	01/12/2018	3.00	1000	SN, T	MT	1	W	poor	8	10	wet	none	none	fog
1	05/12/2018	3.00	1000	(ML, K before start) SN heard from VP	KW	1	SW	poor	8	10-13	wet	none	none	low cloud, mist, fog
1	13/12/2018	3.00	930	K	KOC	2-3	SE	good	8	5	none	light rain	peat harvesting and train noise	none
1	08/01/2019	3.00	930	K, PE	KOC	1	NW	good	2-6	8	none	none	some machinery noise, also a toy plane noise	none
1	25/01/2019	3.00	1130	No target sp.	HPD	3	W	good-mod	8	10	dry	a few light showers	none	light showers/ misty rains occasionally
1	08/02/2019	3.00	1030	No target sp.	HPD	5-6	W	mod	8	8	damp	heavy showers	none	rain heavy at times, mod visibility
1	19/02/2019	3.00	1115	BZ, SN	KW	1	S	good	8	10-11	wet	showers	none	showers
1	19/02/2019	3.00	1415	K	KW	1	S	good	8	10-11	none	none	none	none
1	15/03/2019	3.00	1045	No target sp.	KW	4-6	W	good	5-7	8	wet	showers	none	none
2	25/10/2018	3.00	1430	BZ, SN	KW	3-4	W	good	7	10	dry	none	none	slight glare in SW
2	13/11/2018	3.00	830	SH	KW	2	SSE	good	6	8	damp	none	none	none
2	27/11/2018	3.00	1000	BZ	KW	1-3	SE-S-SW	mod	6-8	8	wet bog	showers	road works on road parallel to VP and plantation	rain and low cloud
2	01/12/2018	3.00	1345	SN, T	KW	1	W	mod	8	10	wet bog	none	none	low cloud
2	05/12/2018	2.50	1400	BZ	KW	1	SW	poor	8	12-14	wet	none	none	fog, low cloud
2	13/12/2018	3.50	1240	CA, K	KOC	2-3	SE	good	8	6	wet	none	none	none
2	08/01/2019	3.00	1310	K, GP	KOC	2	NW	good	6-7	8	none	none	farm machinery noise	none
2	25/01/2019	3.00	1134	K	MT	3	W	good	8	9	wet/damp	passing bands of light misty drizzle	shooting, model craft flying 1235-1252	none
2	28/01/2019	3.00	1030	BZ, GI, K	MT	2	W	good	1-3	8	wet bog	none	none	none
2	08/02/2019	3.00	1030	SH	KW	4-5	SW	good	4-8	7-8	wet bog	showers	none	none
2	21/02/2019	3.00	1030	BZ, GP, K	KOC	4	S	good	7-8	12	none	none	none	none
2	07/03/2019	3.00	1410	K, MA	KOC	4-3	NW	good	1-4	7	none	none	none	none
3	14/11/2018	2.25	1415	K	KW	4	SSW	good-mod	8	12	damp	none	none	low cloud
3	26/11/2018	3.00	945	BZ, SH	KW	1	E	good	1	3-7	wet	none	none	brief glare east 1115-1130
3	07/12/2018	3.00	1200	BZ, ET, K, MA, SH	KOC	4-6	SW	good	2	7	none	none	none	none
3	17/12/2018	3.00	1000	BZ, GI	KOC	3-4	S	good	8	5-9	wet	showers	none	none
3	21/12/2018	3.00	908	BZ	MT	1-2	SW	mod	8	5-6	damp	prolonged spells of misty drizzle	none	low cloud, misty drizzle, light mist

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
3	03/01/2019	3.00	1250	CA, K, M	KOC	1-3	S-SE	good	8	7	none	none	none	**none**
3	17/01/2019	3.00	1330	BZ, SH	KW	1	WSW	good	8	5-6	wet	none	none	none
3	23/01/2019	3.00	1335	BZ, ML	CL	2	NW	good	8		dry	some drizzle	none	none
3	28/01/2019	3.00	1400	BZ, K	KW	2-3	NW	good	3-8	6-7	wet	showers	none	none
3	04/02/2019	3.00	1350	BZ, K, SH	KOC	3-1	W	good	1-4	8	none	none	none	none
3	21/02/2019	2.00	1355	BZ, K, MA	KOC	4	S	good	3-6	12	none	none	none	none
3	26/02/2019	3.00	1130	BZ, K, SH	KW	1-2	SW	good	1	13	wet	none	none	glare to SW
3	08/03/2019	3.00	1145	BZ	HPD	4-5	SW	mod-poor	7-8	10	damp	showers throughout	none	misty/rain/showers - mod vis throughout
4	25/10/2018	3.00	1030	SH, WS	HD	2-3	W	good	8	12	dry	none	none	none
4	25/10/2018	3.00	1415	BZ, SN	HD	2	W	good	8	12	dry	none	group in beet field (c.30 people) from 1545-1615	none
4	14/11/2018	3.00	1045	BZ	KW	4	SSW	mod	8	12	damp	none	none	none
4	27/11/2018	3.00	1330	BZ, SH	KW	3-2	SW	good	3-4	10	none	yes	none	low cloud, rain
4	07/12/2018	3.00	830	BZ, GP, SH, WS	KOC	4-5	SW	good	4	6	none	short showers	none	none
4	17/12/2018	3.00	1315	BZ	KW	4-5	S	good	8	9-10	wet	none	none	none
4	21/12/2018	3.00	900	BZ, GP, SH	HPD	2	SW	good-poor	8	6	damp	misty drizzle	none	mist and light drizzle
4	03/01/2019	3.00	920	BZ, K, SH	KOC	2-3	SE-S	good	7-8	5-7	none	none	none	none
4	23/01/2019	3.00	1022	BZ	CL	2	NW	good	8	3	none	drizzle	none	none
4	04/02/2019	3.00	1020	BZ, GP, K, SH, SN	KOC	3	W	good	4-7	7	none	none	none	none
4	21/02/2019	1.00	1550	BZ, GP, L, PE	KOC	4	S	good	5-8	11	none	none	none	none
4	26/02/2019	3.00	1440	BZ	KW	1-3	SW	good	1	15	dry	none	model aeroplane	none
4	07/03/2019	3.00	1040	BZ	KOC	4-5	NW	good	3-7	6	none	showers	none	none

Table A3.3: Vantage point survey effort – Breeding season 2019

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	19/03/2019	3.00	1230	BZ, K	HPD	3-4	W	good	7-8	14	dry	light showers, mostly dry	model aeroplane 1400-1430	none
1	25/03/2019	2.00	1000	BZ, MA, SN	KW	1	N	good	5-7	10-12	wet bog	none	none	none
1	22/04/2019	4.00	1445	BZ	KW	1-4	SE	good	2-7	19-21	dry	none	none	none
1	23/04/2019	2.00	1445	K	CL	3-4	E	good	0-1	15	none	none	BNM trains 1530-1545	haze- but good vis
1	08/05/2019	3.00	900	MA	KW	4	NE	good	8	9-10	wet	light showers	walker	none
1	21/05/2019	4.00	1000	BZ	KW	1	W	good	3-6	18	none	none	none	none
1	04/06/2019	3.00	1630	BZ	KW	1-2	NE	good	8	11-12	wet	persistent showers	none	none
1	21/06/2019	3.00	1630	BZ	DM	2	SW	good	7-6	15	none	none	none	none
1	04/07/2019	3.00	730	BZ, SH	DM	2	S-SW	good	2-4	10-17	none	none	none	none

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	16/07/2019	3.00	725	No target sp.	DM	2	S-SW	good	6-8	15	none	light shower	none	none
1	14/08/2019	3.00	900	BZ, SH	DM	1-3	SW-W	good-mod	7-8	16-17	none	mostly dry, some drizzle	none	none
1	26/08/2019	3.00	1400	BZ, K	DM	2-3	SW	good	1-3	20	none	none	none	none
2	19/03/2019	3.00	1230	GP, JS, SN	KW	2-3	WSW	good-mod	5-8	10	wet	none	model aeroplane	none
2	25/03/2019	2.00	1230	SH, SN, MA	KW	1	N	good	7-8	11-14	wet	none	none	none
2	16/04/2019	2.00	1100	BZ, GP	KOC	3	SE	good	8	7	wet	some light drizzle	none	light mist
2	22/04/2019	2.00	1200	BZ	KW	4	SE	good	0-2	20-22	none	none	none	none
2	23/04/2019	3.00	700	BZ, K, MA	HD	2	E	good-mod	7-6	12-14	dry/ damp	yes	digger to NE of VP on road since 725	none
2	08/05/2019	3.00	1230	BZ, MA	KW	4-5	NE	good	8	10-11	wet	light showers	digger working on bog	none
2	21/05/2019	3.00	1500	BZ	KW	1-3	W	good	5-7	17-18	none	none	model aeroplanes being flown east of site	none
2	10/06/2019	3.00	1615	No target sp.	KW	2-3	NE	good	3-5	13-14	none	none	none	none
2	27/06/2019	3.00	1645	H, K	DM	6-5	E	good	0	20-18	none	none	none	none
2	10/07/2019	3.00	730	SH	DM	3-4	SW	good-mod	6-8	16-17	none	drizzle	none	none
2	25/07/2019	3.00	800	BZ, K, SH	DM	7-8	SE	good	7-8	18-21	none	none	none	none
2	16/08/2019	3.00	1230	BZ, K, SH	DM	4	SW	good	4-7	21-19	none	none	none	none
2	27/08/2019	3.00	1230	No target sp.	DM	8	S	good	8	19	none	mostly dry, 1 shower	none	none
3	19/03/2019	3.00	1600	L, SH, WS	KW	3-4	WSW-SW	good	2-8	7-10	wet	none	none	none
3	25/03/2019	2.00	1440	L	KW	1	NW	good	8	12-13	dry	none	none	none
3	16/04/2019	2.00	1545	BZ, K	KOC	7	SE	good	6-8	10	none	none	machinery noise	some haze
3	23/04/2019	3.00	1045	BZ, GP, L, LI	HD	2	E-ENE	good	5-8	11-13	dry	light rain	none	none
3	16/05/2019	5.00	1400	BZ	KW	2-3	SE	good	8	15-18	dry	none	none	none
3	24/05/2019	3.00	1430	BZ, K, Gulls	KOC	2-3	NW	good	7-8	16	none	none	none	none
3	04/06/2019	3.00	1245	BZ	KW	1	ENE	good-mod	8	11-12	wet	showers, persistent	none	none
3	27/06/2019	3.00	1315	BZ, K	DM	6	E	good	1-2	19-20	none	none	none	none
3	10/07/2019	3.00	1145	BH, LB, SH	DM	3-2	SW	good	7-8	18-21	none	none	none	none
3	25/07/2019	3.00	1135	No target sp.	DM	8-7	SE-S	good-mod	7-8	21-20	none	mostly dry, light shower	none	none
3	16/08/2019	3.00	900	BZ, K, SH	DM	4	SW	good	5-8	15-20	none	mostly dry - passing showers	none	none
3	29/08/2019	3.00	1230	BZ, K	DM	6-7	SW	good	6-7	14	none	mostly dry, 1 shower	none	none
4	19/03/2019	3.00	1600	H, WS	HPD	4	W	good	3-7	12	dry	none	none	none
4	25/03/2019	2.00	1645	SN	KW	1	NW	good	8	10-11	dry	none	tractor spreading fertiliser	none
4	16/04/2019	2.00	1325	BZ	KOC	2-3	SE	good	8	8	wet	none	none	none

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
4	23/04/2019	3.00	1015	BZ, GP, L	CL	3	NE	good-mod	8	10	dry	slight drizzle	none	haze, slightly misty drizzle
4	16/05/2019	3.00	1400	BZ, K	HPD	3	E	good	8	14	dry	none	none	none
4	16/05/2019	2.00	1700	BZ, K	HPD	3	E	good	8	14	dry	none	none	none
4	24/05/2019	3.00	1100	BZ, K	KOC	1-3	NW	good	8	17	none	none	none	none
4	10/06/2019	3.00	1300	BZ	KW	1-3	NE	good	4-6	13-14	none	showers	none	none
4	27/06/2019	3.00	945	BZ	DM	6	E	good	1-2	17-19	none	none	none	none
4	04/07/2019	3.00	1115	BZ	DM	3	W	good	5-7	19-20	none	none	none	none
4	16/07/2019	3.00	1115	BZ, SH	DM	2-3	SW	good	5-7	18-21	none	none	none	none
4	14/08/2019	3.00	1245	BZ, SH	DM	2-3	W	good	5-7	19-20	none	none	none	none
4	27/08/2019	3.00	850	BZ, SH	DM	5-8	S	good	5-8	14-19	none	none	none	none

Table A3.4: Vantage point survey effort - Non-breeding season 2019-20

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	01/10/2019	3.00	915	BZ, GP, K, MA, SN	DM	3-4	N	good	8	11	none	none	none	none
1	14/10/2019	3.00	1600	SN	DM	3-2	SE	good	7-8	13-12	none	light showers most of day	none	none
1	29/10/2019	3.00	830	GP, K	DM	3	E	good	1-2	7-10	none	none	none	none
1	14/11/2019	3.00	845	SH, SN	DM	4	N	good	1-2	3-6	none	none	none	none
1	27/11/2019	3.00	845	SN	DM	2	NE-N	good	6-8	8-9	none	light rain for 30 mins	BNM machine passed through	none
1	11/12/2019	3.00	815	BZ, MS, SN	DM	3	SW	good	1-3	3-4	none	none	none	none
1	20/12/2019	3.00	815	SN	DM	2	SW	mod	8	3-4	none	none	none	fog
1	09/01/2020	3.00	845	SN, T	DM	1	N-NW	good	7-8	2-3	none	none	none	none
1	24/01/2020	3.00	915	T	DM	2-3	SW	good	7-8	6-7	none	none	none	none
1	13/02/2020	3.00	845	GP, MA, SH, SN, T	DM	3-4	NW	good	5-7	4-7	none	none	none	none
1	25/02/2020	3.00	900	BZ, K	DM	3-4	W	good	3-7	3-4	none	none	none	none
1	09/03/2020	3.00	845	MA, T	DM	3-4	SW-S	good-mod	8	5-6	none	some rain	none	rain
2	02/10/2019	3.00	845	SN	DM	2	NW-N	good	4-6	7-10	none	none	none	none
2	16/10/2019	3.00	800	ML	DM	2-3	SW	good	0	7-9	none	none	none	none
2	30/10/2019	3.00	845	BZ, GP, PE, SH	DM	4	E	good	3-5	8-10	none	none	none	none
2	15/11/2019	3.00	1230	BZ, CA, K, WG	DM	4-3	N	good	0-3	6-7	none	none	none	none
2	28/11/2019	3.00	830	BZ, SN	DM	2-1	NW	good	4-7	5-7	none	none	none	none
2	13/12/2019	3.00	845	K, SN	DM	4-5	W	good	4-6	6-7	none	none	none	none
2	23/12/2019	3.00	815	BZ, SH, SN, WS	DM	3-4	W-SW	good	1-4	6-7	none	none	none	none

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
2	10/01/2020	3.00	900	LB, SN	DM	2-3	S	good	3-4	1-5	none	none	none	none
2	27/01/2020	3.00	945	No target sp.	DM	2-3	S	good	2-4	2-5	none	none	none	none
2	14/02/2020	3.00	1330	BZ, GP	DM	3-4	SW	good	4-7	11-9	none	none	none	none
2	26/02/2020	3.00	900	MA, SN	DM	3-4	W	good	4-7	2-5	none	1 shower	none	none
2	10/03/2020	3.00	945	BZ, MA, SN	DM	5	W	good	6-8	11	none	1 shower	none	None
3	02/10/2019	3.00	1215	K, WG	DM	2	W	good	6-7	11-12	none	none	none	none
3	16/10/2019	3.00	1130	BZ, K, MA, SH	DM	3	SW	good	0-3	11-13	none	none	none	none
3	30/10/2019	3.00	1215	BZ, GP	DM	4	E	good	5-7	10	none	none	none	none
3	15/11/2019	3.00	845	BZ, GP, K	DM	3	N	good	0-2	3-6	none	none	none	none
3	28/11/2019	3.00	1200	BZ	DM	1-2	N-NE	good	7-8	7-8	none	light showers	none	none
3	13/12/2019	3.00	1215	BH	DM	4	W	good	2-5	7-6	none	light shower	none	none
3	23/12/2019	3.00	1145	BZ, GP	DM	3	SW	good	2-3	7-8	none	none	none	none
3	10/01/2020	3.00	1230	BZ, GP	DM	3-4	S	good	4-7	5-7	none	none	none	none
3	27/01/2020	3.00	1315	GP	DM	3-4	S	good	5-8	5-4	none	2 showers	none	none
3	14/02/2020	3.00	1000	BZ	DM	4-5	SW	good-mod	4-8	9-10	none	1 shower	none	rain shower
3	26/02/2020	3.00	1230	BZ, GP, K	DM	4	W	good	4-5	6-5	none	none	none	none
3	10/03/2020	3.00	1315	BZ, MA	DM	5-4	W	good	6-7	11-9	none	1 shower	none	None
4	29/10/2019	3.00	1200	BZ, GP, K	DM	4	E	good	2-3	9-10	none	none	none	none
4	01/10/2019	3.00	1245	BZ, GP	DM	4	W	good	8-6	10	none	none	none	none
4	14/10/2019	3.00	1230	BZ, SH	DM	3	SE	good	8-6	13	none	none	none	none
4	14/11/2019	3.00	1215	GP	DM	4	N	good	1-2	6	none	none	none	none
4	27/11/2019	3.00	1215	BZ, SH	DM	2	N-NE	good	7-6	9	none	none	none	none
4	11/12/2019	3.00	1145	BZ	DM	4	W	good	1-2	5	none	none	none	none
4	20/12/2019	3.00	1145	SN	DM	2	SW	mod	8	4	none	none	none	fog
4	09/01/2020	3.00	1215	GP, SN	DM	1-2	NE-N	good	6-7	3-5	none	none	none	none
4	24/01/2020	3.00	1245	BZ, K	DM	2-3	SW	good	8	7-8	none	none	none	none
4	13/02/2020	3.00	1215	BZ, K	DM	3	NW	good	6-8	7-9	none	none	none	none
4	25/02/2020	3.00	1230	BZ, SH	DM	3-4	W	good	5-7	4	none	light showers	none	none
4	09/03/2020	3.00	1215	No target sp.	DM	4-3	S-SW	good-mod	8	6-7	none	Rain	none	rain

Table A3.5: Vantage point survey effort – Breeding season 2020

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	20/03/2020	3.00	1530	BO, BZ, K	JK	3	NE	good	5-6	8	Wet	None	none	none
1	21/04/2020	3.00	945	BZ	DM	4	E	good	1-2	11-13	none	none	none	none
1	27/04/2020	3.00	830	BZ, H, MA, SH,	DM	2	N	good	2-3	8-12	none	none	none	none

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
1	05/05/2020	3.00	815	BZ, K, MA	DM	4	E	good	4-7	8-11	none	none	none	none
1	21/05/2020	3.00	800	BZ, K	DM	2-3	W-NW	good	3	11-15	none	none	none	none
1	09/06/2020	3.00	1700	BZ, K	DM	1	W	good	7-8	13	none	none	none	none
1	22/06/2020	3.00	1145	K, SN	DM	4-5	S	good	8	18-20	none	none	none	none
1	17/07/2020	3.00	1230	No target sp.	DM	4	SW	good	8	18	none	light showers	none	none
1	28/07/2020	3.00	1200	BZ	DM	4-3	W	good	6-7	15-16	none	none	none	none
1	10/08/2020	3.00	1530	No target sp.	DM	2	NE	good	7-8	18-17	none	none	none	none
1	17/08/2020	3.00	800	K, PE	DM	3	NE	good-mod	8	15-17	none	light rain at start	none	drizzle
1	24/08/2020	3.00	1500	H, K	DM	2	SE	good	7-8	17	none	dry with 1 shower	none	none
2	20/03/2020	3.00	1000	BZ	JK	6	E	good-mod	5-6	8	Wet	none	none	None
2	22/04/2020	3.00	830	BZ, MA, SH	DM	3-5	NE	good	4-7	9-12	none	none	none	none
2	28/04/2020	3.00	830	BZ, MA, SN	DM	1-2	NE	good	2-5	9-12	none	none	none	none
2	06/05/2020	3.00	800	BZ, K	DM	2-3	SE	good	1	9-14	none	none	none	none
2	29/05/2020	3.00	1000	BZ, SH	KOC	4-5	SE-S	good-mod	4-5	22	dry	none	fire brigade putting off some few small flames of fire on the bog near road	heat haze
2	10/06/2020	3.00	1700	BZ, H, SH	DM	2	NW	good	7-8	12-10	none	light showers	none	none
2	24/06/2020	3.00	1630	No target sp.	DM	1-2	NW	good	8	19-18	none	none	none	none
2	20/07/2020	3.00	830	BZ, K	DM	2	NW	good	1-4	12-14	none	none	none	none
2	29/07/2020	3.00	800	BZ, GE, K	DM	1-2	SW	good	7-8	12-15	none	none	none	none
2	07/08/2020	3.00	1600	GE, K	DM	3	W	good	5-7	21-19	none	none	Large model airplane 1st quarter hour	none
2	14/08/2020	3.00	830	No target sp.	DM	3	NE	good	7-8	17-19	none	none	none	none
2	21/08/2020	3.00	1245	BZ, LB	DM	5-6	SW	good	5-7	18-17	none	light showers	none	none
3	27/03/2020	3.00	1000	BZ	JK	3	NE	good	5-6	10	Dry	None	None	None
3	22/04/2020	3.00	1200	BZ, SH	DM	3	NE	good	3-4	14	none	none	none	none
3	28/04/2020	3.00	1200	BZ	DM	2	NE	good	3-7	13-14	none	none	none	none
3	06/05/2020	3.00	1130	BZ, K	DM	3-5	SE	good	1	14-16	none	none	none	none
3	27/05/2020	3.00	1300	BZ	DM	1	SW-W	good	2-3	20-21	none	none	none	none
3	10/06/2020	3.00	1330	BZ, K, LB	DM	3	NW	good	7-8	12	none	1 light shower	none	none
3	24/06/2020	3.00	1300	BZ, K	DM	1	SW-NW-N	good	7-8	19	none	none	none	none
3	20/07/2020	3.00	1200	BZ	DM	2	NW	good	1-4	12-14	none	none	none	none
3	29/07/2020	3.00	1130	BZ	DM	2	SW-S	good	8	16	none	none	none	none
3	07/08/2020	3.00	1230	BZ	DM	3	SW	good	5-7	21	none	1 shower	none	none
3	14/08/2020	3.00	1200	BZ, H	DM	3	NE	good	8	20-22	none	none	none	none
3	21/08/2020	3.00	915	H, K	DM	5-6	SW	good	7-8	15-17	none	light showers	none	none

VP	Date	Duration (hr)	Start Time	Target Sp	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp. (C)	Ground Cond.	Rain	Disturbance factors	Factors affect vis
4	27/03/2020	3.00	1330	BZ, SH	JK	3	NE	good	5-6	13	Dry	None	None	None
4	21/04/2020	3.00	1315	BZ	DM	4	E	good	0-1	13-14	none	none	none	none
4	27/04/2020	3.00	1200	BZ, K, SH	DM	1	NE	good	3-5	12	none	none	none	none
4	05/05/2020	3.00	1145	BZ, LB	DM	4	E	good	2-3	12-14	none	none	none	none
4	21/05/2020	3.00	1145	BZ, K	DM	1-2	SW-S-SE	good	4-6	16-18	none	none	none	none
4	09/06/2020	3.00	1330	BZ, K	DM	2	SW	good	8	14-13	none	1 light shower	none	none
4	22/06/2020	3.00	815	BZ, LB	DM	4-5	S	good	7-8	13-17	none	light showers	none	none
4	17/07/2020	3.00	900	BZ, LB	DM	3-4	SW	good	8	16-18	none	light showers	none	none
4	28/07/2020	3.00	830	BZ, K	DM	3-4	NW	good	4-6	12-14	none	light showers	none	none
4	10/08/2020	3.00	1200	BZ, H, K	DM	2	NE	good	8	19-17	none	light showers	none	none
4	17/08/2020	3.00	1130	BZ, K	DM	2-3	NE	good-mod	8	17-16	none	rain for hour	none	rain
4	24/08/2020	3.00	1130	BZ, SH	DM	2	E-SE	good	6-7	16-17	none	none	none	none

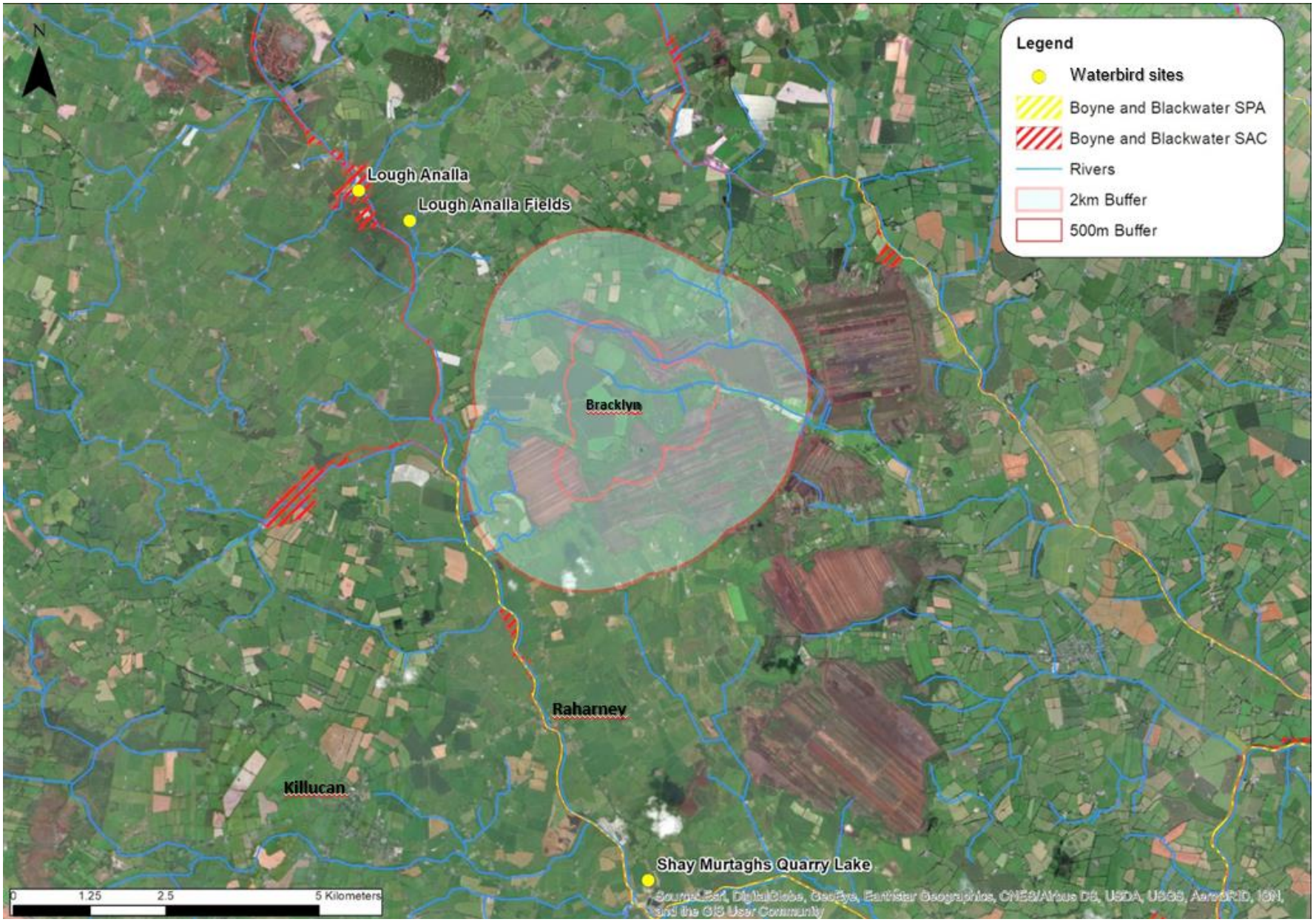

Figure A3.5: Wintering waterbird sites in the vicinity of Bracklyn Wind Farm

Table A3 6: Walkover survey effort

Season	Date	Duration	Start time	Surveyor	Wind Force	Wind Dir.	Cloud (oktas)	Temp. (C)	Rain
1	21/12/2018	4.00	1230	MT	2	W	2-6	6-9	light showers
1	21/12/2018	4.00	1230	HPD	2	W	2-6	6-9	light showers
1	07/01/2019	5.75	1130	KW	3	W	3-5	8-11	light shower
1	25/01/2019	2.00	1430	MT	3	W	7	10	none
1	25/01/2019	2.00	1430	HPD	3	W	7	10	none
1	08/03/2019	6.00	930	KW	3	W	5-6	8-10	shower
1	08/03/2019	6.00	930	HPD	3	W	5-6	8-10	shower
2	17/04/2019	6.00	1300	HD	2-3	E	7-8	8-13	none
2	17/04/2019	6.00	1300	HPD	2-3	E	7-8	8-13	none
3	18/02/2020	4.00	1000	DM	4	SW	6-7	5-6	showers
3	11/03/2020	6.00	900	DM	4	SW	6-8	7-8	light shower
4	08/05/2020	6.00	1230	DM	1-2	SW	4-7	18-19	none
4	26/06/2020	6.50	1015	DM	2-4	S	6-8	17-20	none
4	30/07/2020	6.00	1200	KW	3	S	7	17-20	none
5	22/12/2020	6.00	930	DM	1	SE	5-7	1-4	none
5	10/02/2021	6.00	1000	DM	3	E	3-7	2-3	light shower

Table A3.7: Breeding raptor survey effort

Season	Date	Duration	Start time	Surveyor	Wind Force	Wind Dir.	Cloud (oktas)	Temp. (C)	Rain
2	05/06/2019	6.50	745	KOC	2-3	W	8	11	light rain
2	09/06/2019	6.00	1000	KW	1-2	SW	5-8	13-16	none
2	24/06/2019	6.00	930	KW	1-2	E	1-2	16-20	none
2	08/07/2019	6.00	1215	KW	0	NA	8	20	none
4	20/03/2020	6.00	920	KW	3	NE	3	7	none
4	23/03/2020	6.00	1030	KW	2	SSE	5	9	none
4	27/04/2020	6.00	1020	KW	1	NE	3	10	none
4	24/05/2020	6.67	1010	KOC	3	W	1-7	17-23	none
4	27/05/2020	3.50	1630	DM	1-2	N	4-5	17-20	none
4	29/05/2020	2.00	1330	KOC	4	SE	4-5	25	none
4	16/07/2020	6.00	915	DM	3	W	5-8	16-20	none
4	31/07/2020	6.00	810	KW	2	SW	8	17-20	showers

Table A3.8: Winter waterbirds survey effort

Season	Date	Surveyor	Wind Force	Wind Dir.	Cloud (oktas)	Temp. (C)	Rain
1	28/11/2018	KW	4	S	7-8	10-13	showers
1	07/01/2019	KW	3	W	3-5	8-11	light shower
1	17/01/2019	KW	2	S	1-2	2-4	none
1	08/02/2019	KW	4-5	W	6-8	7-10	showers
1	08/02/2019	HPD	4-5	W	6-8	7-10	showers
1	15/03/2019	KW	3	W	7-8	8-11	showers
3	29/11/2019	DM	2	E	1	2-5	none
3	30/12/2019	DM	2	S-SW	8	10	light drizzle
3	29/01/2020	DM	3-4	SW	7-8	4-9	light showers
5	19/10/2020	DM	4	S	8	12	light rain
5	04/11/2020	DM	2	NW	6-8	9-10	none
5	11/12/2020	DM	2	SW-W	5-6	7-8	none
5	08/02/2021	DM	4	E	6	3	none
5	19/02/2021	DM	4-5	S	8	10-12	shower
5	15/03/2021	DM	3	W	6-7	12-13	none

Table A3.9: Hen harrier survey effort

Season	Date	Duration	Start time	Surveyor	Sunset	Wind Force	Wind Dir.	Temp. (C)	Rain
3	30/10/2019	2.25	1545	DM	1700	4-6	E	9	none
3	29/11/2019	2.00	1515	DM	1615	0-3	E	3-5	none
3	30/12/2019	2.00	1515	DM	1617	2	W	10	none
3	29/01/2020	2.75	1545	DM	1704	4	SW	9	none
5	19/10/2020	2.00	1720	DM	1822	3-4	S	11-12	drizzle
5	17/11/2020	2.00	1515	DM	1616	1	E	3-5	none
5	09/12/2020	2.00	1510	DM	1609	4	SE	7	none
5	08/02/2021	2.00	1625	DM	1725	3	E	2	none
5	27/02/2021	2.00	1702	CS	1802	0-3	S	8	none
5	15/03/2021	2.00	1730	DM	1832	2-3	W	11-12	none

APPENDIX 4: HABITAT MAPS & TABLES

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Table A4.1: Habitats associated with the proposed infrastructure and felling zones

Habitat types Fossitt (2000) code	Linear features (m)			Areas of habitats (ha)													Footprint Area (ha)
	FW4*	WL1*	WL2*	BC1	BL3	FL8	GA1	GS2*	PB4	WD1 - plantation	WD1 - older*	WD4	WN1*	WN7 – Non-Annex*	WN7 – Annex I*	WS5	
Total lengths/areas within redline boundary	3,057 10,703	1,065	7,772	82.98	4.33	0.19	68.89	1.65	0.48	21.78	4.72	57.68	6.99	5.21	0.199	3.45	258.52 **(269.43)**
Infrastructural elements – areas of habitat loss For FW4 lengths given reflect locations directly affected by proposed development For access tracks 5m allowance for track with 10m taken for WL1/2 intersections & 5m for watercourse crossing points For grid route & cabling not associated with other infrastructure a 5m work corridor was applied																	Area without linear habitat **(Overall area)**
Site compound				0.393													0.393 **(0.39)**
Spoil storage areas (x2)				3.391		0.192											3.583 **(3.58)**
Access track	190	31	124	0.533	0.921		0.676	0.160		0.174	0.066	0.893				0.029	3.425 **(3.60)**
Grid route (from T10)	10	5			2,153m on road		1.180	0.004	0.020				0.009	0.104		0.037	**4,660m**
Cabling (not associated with other infrastructure)	409				0.083		0.205					0.090					**755m**
Substation											0.380	1.175					1.555 **(1.56)**
T01 - hardstand							1.032										1.032 **(1.32)**
T02 - hardstand			21	0.720	0.013												0.733 **(0.74)**
T03 - hardstand	30	31		0.950	0.034					0.013							0.997 **(1.00)**
T04 - hardstand	78		69	0.302						0.403							0.705 **(0.77)**
T05 - hardstand	32		104				0.510					0.522					1.032 **(1.03)**
T06 - hardstand					0.035					0.249		0.744					1.029 **(1.03)**
T07 - hardstand	85		141		0.009					0.033		0.708					0.750 **(1.00)**
T10 - hardstand																0.699	0.775 **(0.78)**
T11 - hardstand							0.077					0.923					1.000 **(1.00)**
Met. mast				0.024													0.024 **(0.02)**
Met. mast hardstand				0.122	0.003												0.125 **(0.13)**
MV switchgear room							0.037										0.037 **(0.04)**
Total habitat affected by infrastructural elements	834m	67m	459m	6.435	2.078	0.192	3.717	0.164	0.020	0.872	0.446	5.055	0.009	0.114	0.000	0.765	19.652ha
% Habitat affected	6	6	6	8	48	100	5	10	4	4	9	9	0	2	0	22	7.5

Felling areas for substation, turbulence reduction buffers and bat feature buffers																	Area without linear habitat **(Overall area)**
Habitat types Fossitt (2000) code	**Linear features (m)**			**Areas of habitats (ha)**													**Footprint Area (ha)**
	FW4*	WL1*	WL2*	BC1	BL3	FL8	GA1	GS2*	PB4	WD1 - plantation	WD1 - older*	WD4	WN1*	WN7 – Non-Annex*	WN7 – Annex I*	WS5	
Site entrance	66		56									0.117					0.117 **(0.18)**
Turn to T1	138		73									0.129					0.129 **(0.17)**
Grid route from T10														0.089			0.089 **(0.09)**
Substation felling											0.700	2.106					2.806 **(2.81)**
T04	383		383							2.189		0.030					2.219 **(2.46)**
T05	273		512									2.875					2.875 **(3.55)**
T06										1.189		4.593					5.782 **(5.85)**
T07	529		347							1.03		3.972					5.002 **(5.33)**
T10														1.445		2.447	3.892 **(3.92)**
T11	143											2.492					2.492 **(2.49)**
Total habitat alteration for felling	1,532		1,371							4.408	0.700	16.314	0.000	1.534	0.000	2.447	25.401 **(26.87)** Turbine buffers = 23.62
% Habitat affect by alteration	11		17							20	15	28.3	**Avoided**	30	**Avoided**	71	10

Table A4.2: List of non-native species and occurrence in relation to proposed development

Species	Legal status of as Invasive Alien Species - IAS[1]	Risk of impact assessment NBDC[2] & Invasive Species Ireland[3]	Covered in NRA guidance[4]	Propagation pathway Sources of information **2**, **5**	Occurrence within the site † Indicates widespread species where distribution was not mapped fully, as the project was not considered as posing a risk of spreading the species during construction works
Rhododendron *Rhododendron ponticum*	Schedule III	2. Risk of high impact 3. Red listed	yes	Wind dispersed seed and vegetative - suckering	Two clumps of shrubs noted adjacent to grid connection route – considered beyond the zone of influence
Montbretia *Crocosmia* X *crocosmiiflora*	None	2. Not assessed 3. Amber listed	yes	Vegetative - spreading of corms. Risk of spreading during construction	Two small clumps identified along grid connection route
Sycamore *Acer pseudoplatanus*	None	2. Risk of medium impact 3. Amber listed	no	Winged seeds	† Throughout the site and along grid route, including older specimens in treelines and younger trees in plantations.
Beech *Fagus sylvatica*	None	2. Not accessed 3. Amber listed	no	Seed	† Throughout the site and along grid route. Well represented in older growth woodland and treelines, where large older specimens were recorded.
Sitka spruce *Picea sitchensis*	None	2. Risk of low impact 3. Amber listed	no	Seed – often 'escaping' from plantations into heath and bog land	† Commercial plantations dominated by this species
Larch *Larix* species	None	2. Not accessed 3. Not assessed	no	Seed – slow spreading	† Only a very small proportion planted within the commercial plantations
Leyand cypress X *Cuprocyparis leylandii*	None	2. Not accessed 3. Not assessed	no	Hybrid species – does not spread. Not considered to be invasive, however where introduced can have a negative impact locally – crowding out native species	Noted at two locations along the grid connection route, including a road side hedge and the other a bolted hedgerow around abandoned dwelling – considered beyond the zone of influence
Snowberry *Symphoricarpos albus*	None	2. Risk of medium impact 3. Amber listed - uncertain risk	no	Vegetative – suckering. Risk of spreading during construction	Identified within several hedges along grid connection route and has also been planted within wind farm site as cover for game birds
Variegated yellow archangel *Lamiastrum galeobdolon ssp. argentatum*	None	2. Not assessed 3. Not accessed	no	Seed & vegetative - requiring just one stolon with pair of leaves to propagate Risk of spreading during construction	Single patch located along grid connection route
Evergreen *Lonicera* shrubs *L. nitida*/*L. pileata*	None	2. Not assessed 3. Not assessed	no	Transplanting of roots, cuttings & seed. Not considered to be invasive, however where introduced can have a negative impact locally – crowding out native species. Risk of spreading during construction	Identified within several hedges along grid connection route and has also been planted within wind farm site as cover for game birds

1. Species listed under the Third Schedule of the European Communities (Birds and Habitats) Regulations 2011 as 'non-native species subject to restrictions under Regulations 49'.

2. Impact status based on risk assessments for invasive species in Ireland (Kelly *et al*. 2013 & O'Flynn *et al*. 2014).

Kelly, J., O'Flynn, C., and Maguire, C. (2013). *Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland*. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland. Available online at: https://invasivespeciesireland.com/wp-content/uploads/2013/03/Risk-analysis-and-prioritization-29032012-FINAL.pdf

O'Flynn, C., Kelly, J. & Lysaght, L. (2014). Ireland's invasive soecuies and non-native species – trends in introduction. *National Biodiversity Data Centre Series* No.2, Ireland. Available online at: http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Trends-Report-2013.pdf

3. Information from Invasive Species Ireland website: https://invasivespeciesireland.com/wp-content/uploads/wp-post-to-pdf-enhanced-cache/1/amber-list-recorded-species.pdf

4. National Roads Authority (2010). *The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads*. NRA. Dublin. Available online via: http://www.tii.ie/technical-services/environment/construction/

5. Stokes, K., O'Neill, K. & McDonald, R.A. (2004). *Invasive species in Ireland*. Unpublished report to Environment & Heritage Service and National Parks & Wildlife Service. Quercus, Queens University Belfast, Belfast.

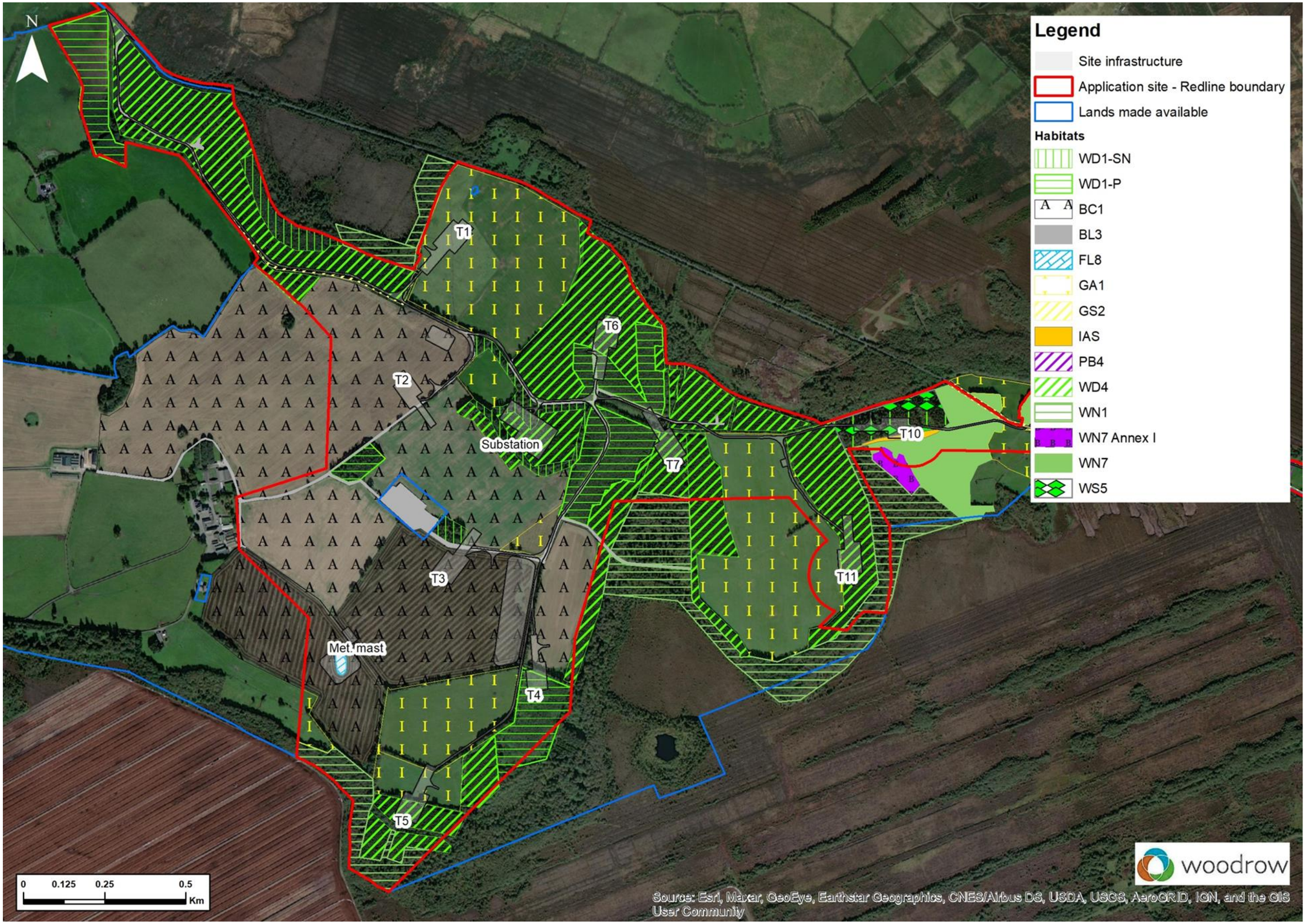

Figure A4.1: Habitat map (Fossitt, 2000) for proposed wind farm site

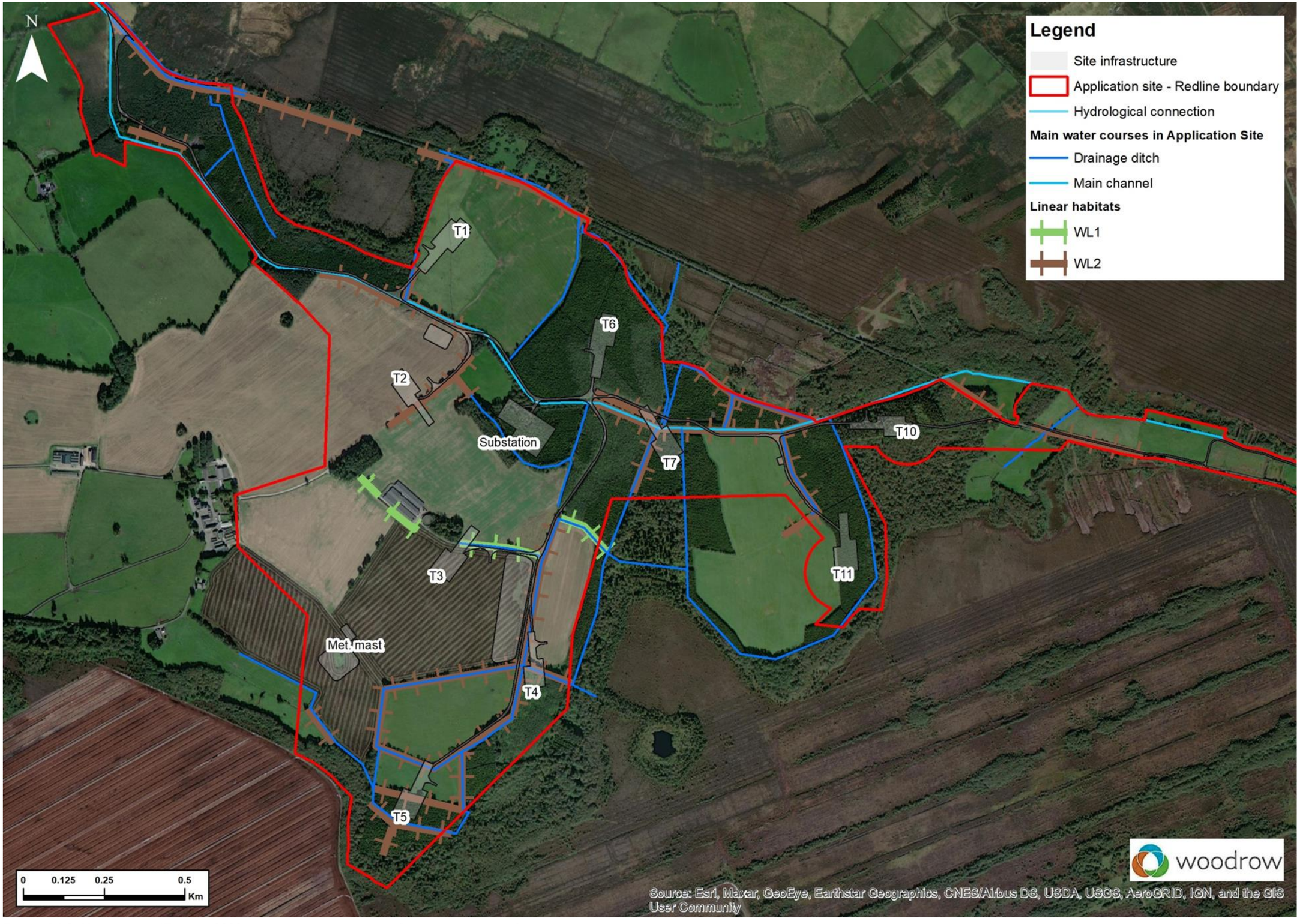

Figure A4.2: Habitat map (Fossitt, 2000) showing linear habitats for proposed wind farm site

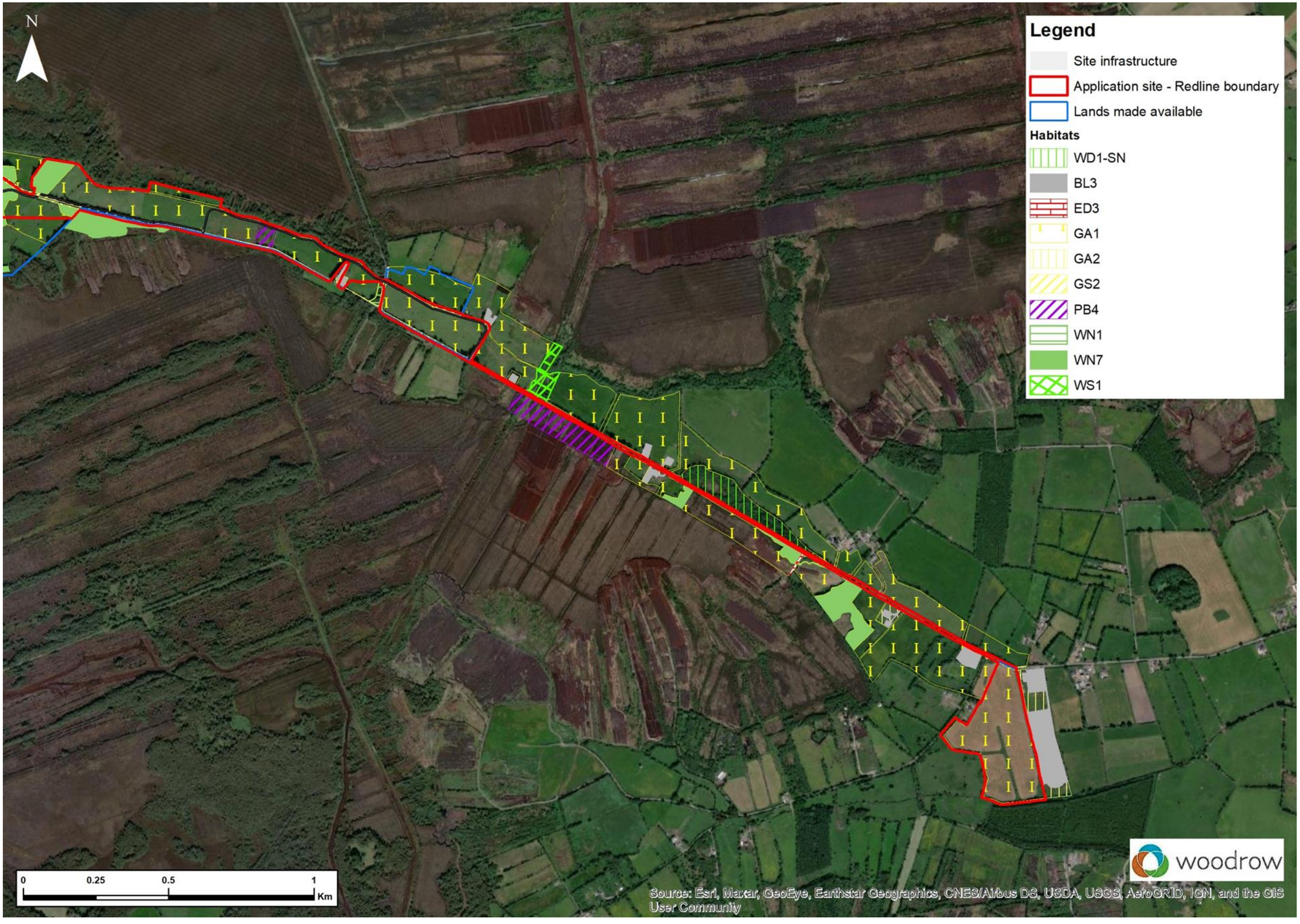

Figure A4.3: Habitat map (Fossitt, 2000) covering the grid connection route

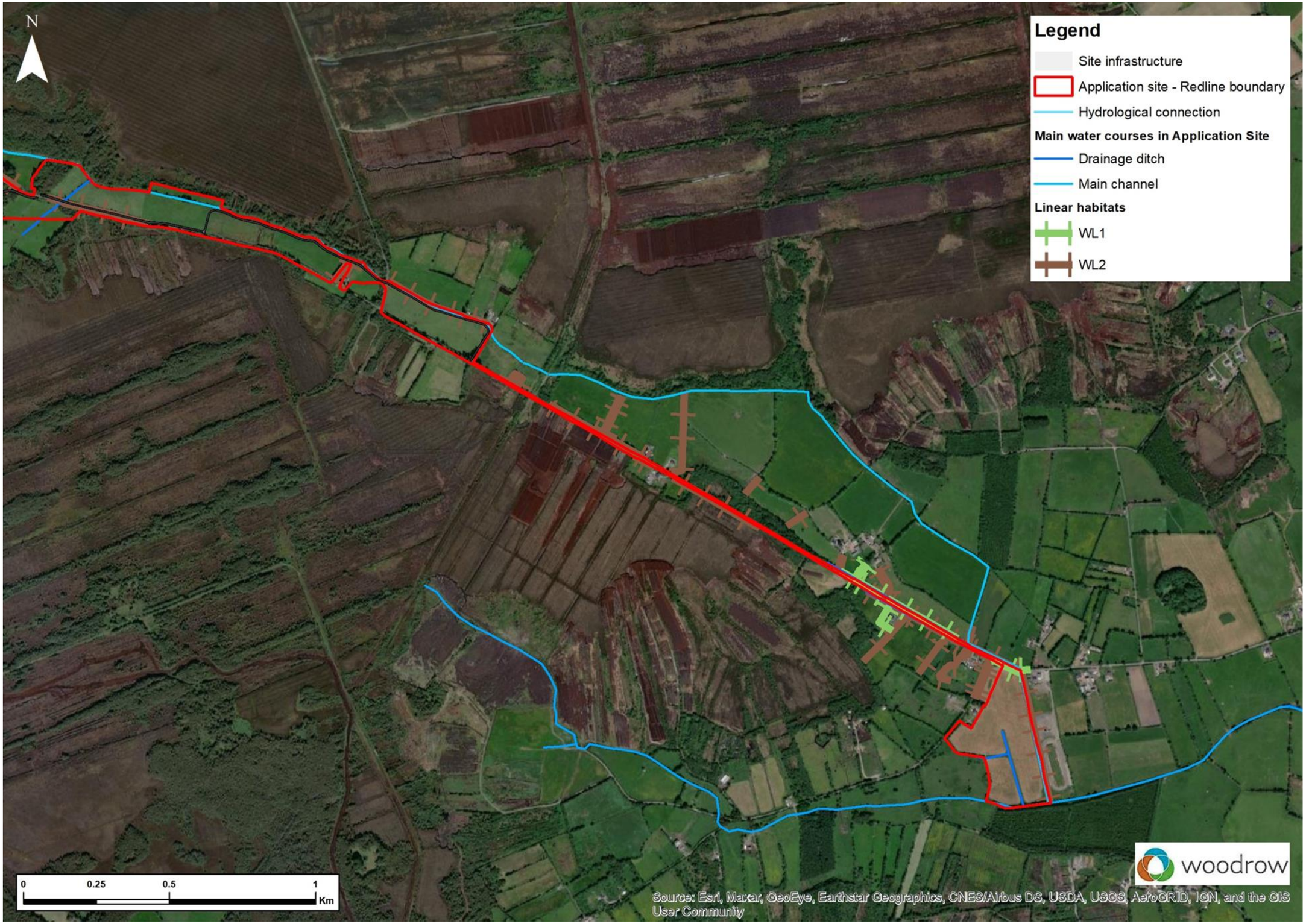

Figure A4.4: Habitat map (Fossitt, 2000) showing linear habitats along the grid connection route

Figure A4.5: Distribution of non-native species within the proposed wind farm site

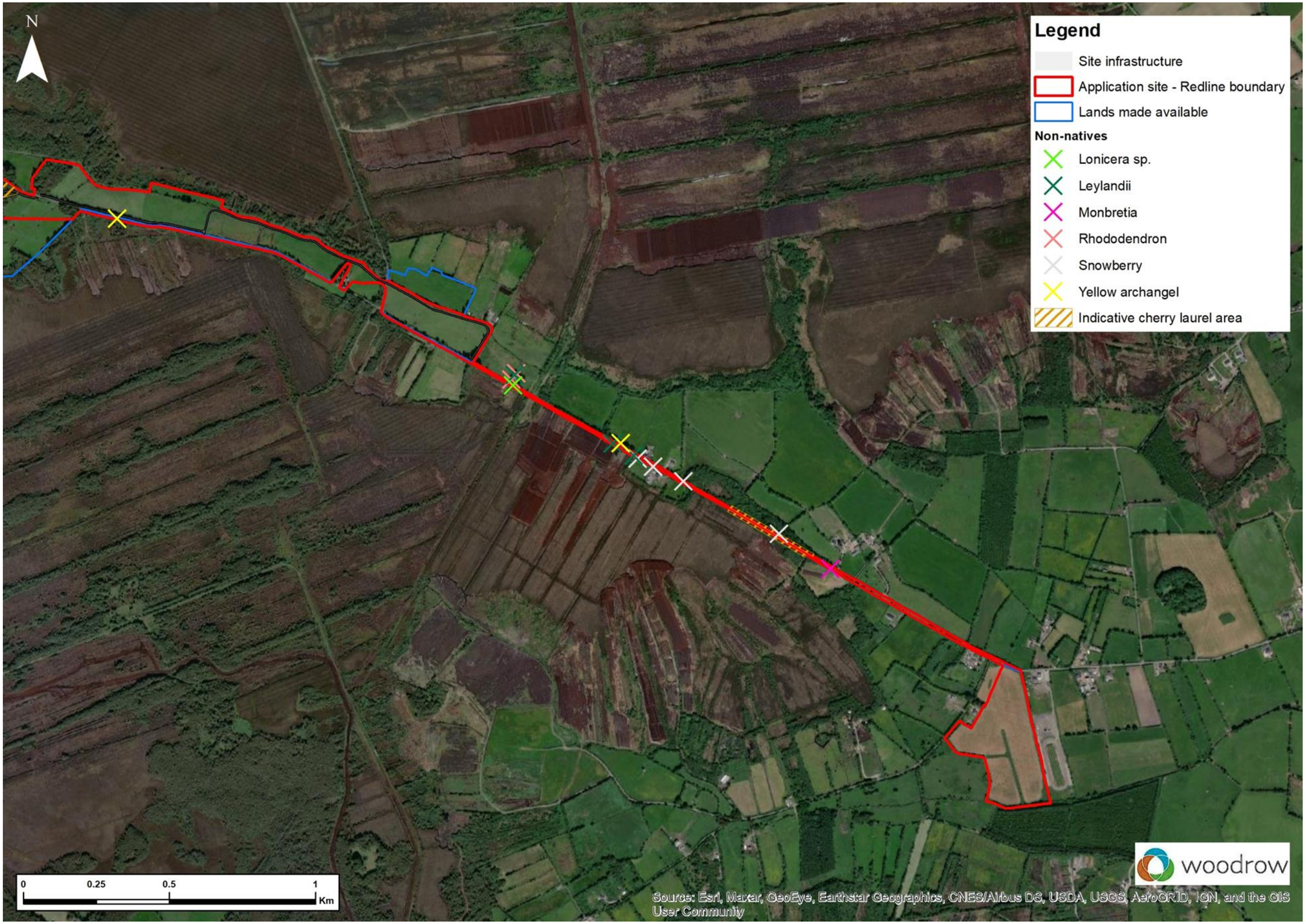

Figure A4.6: Distribution of non-native species along the grid connection route

APPENDIX 5: DISTRIBUTION OF OTTER SIGNS

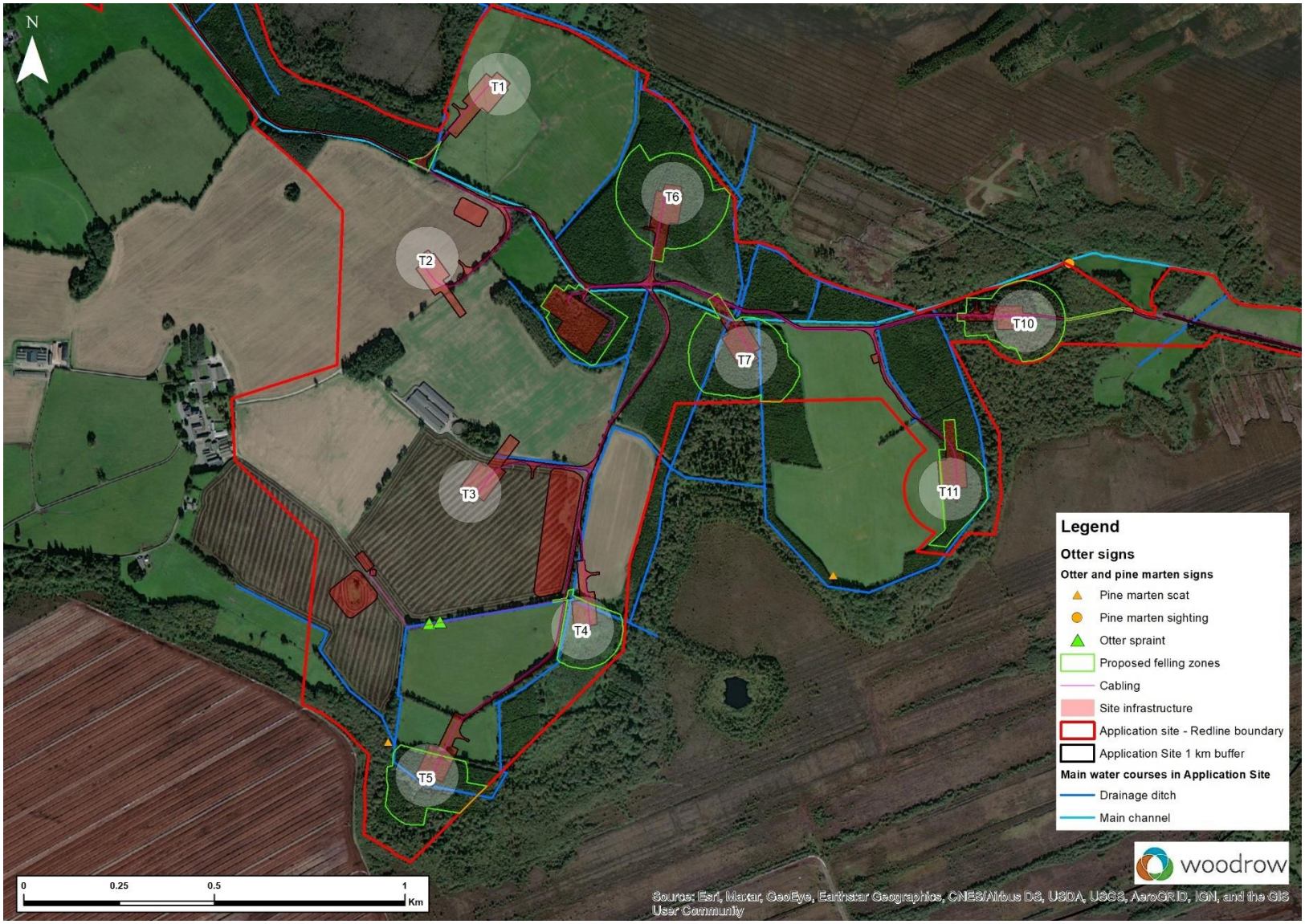

Table A5.1: Otter activity recorded at for proposed development

APPENDIX 6: MAPS FOR ANNEX I & WETLAND BIRD SPECIES

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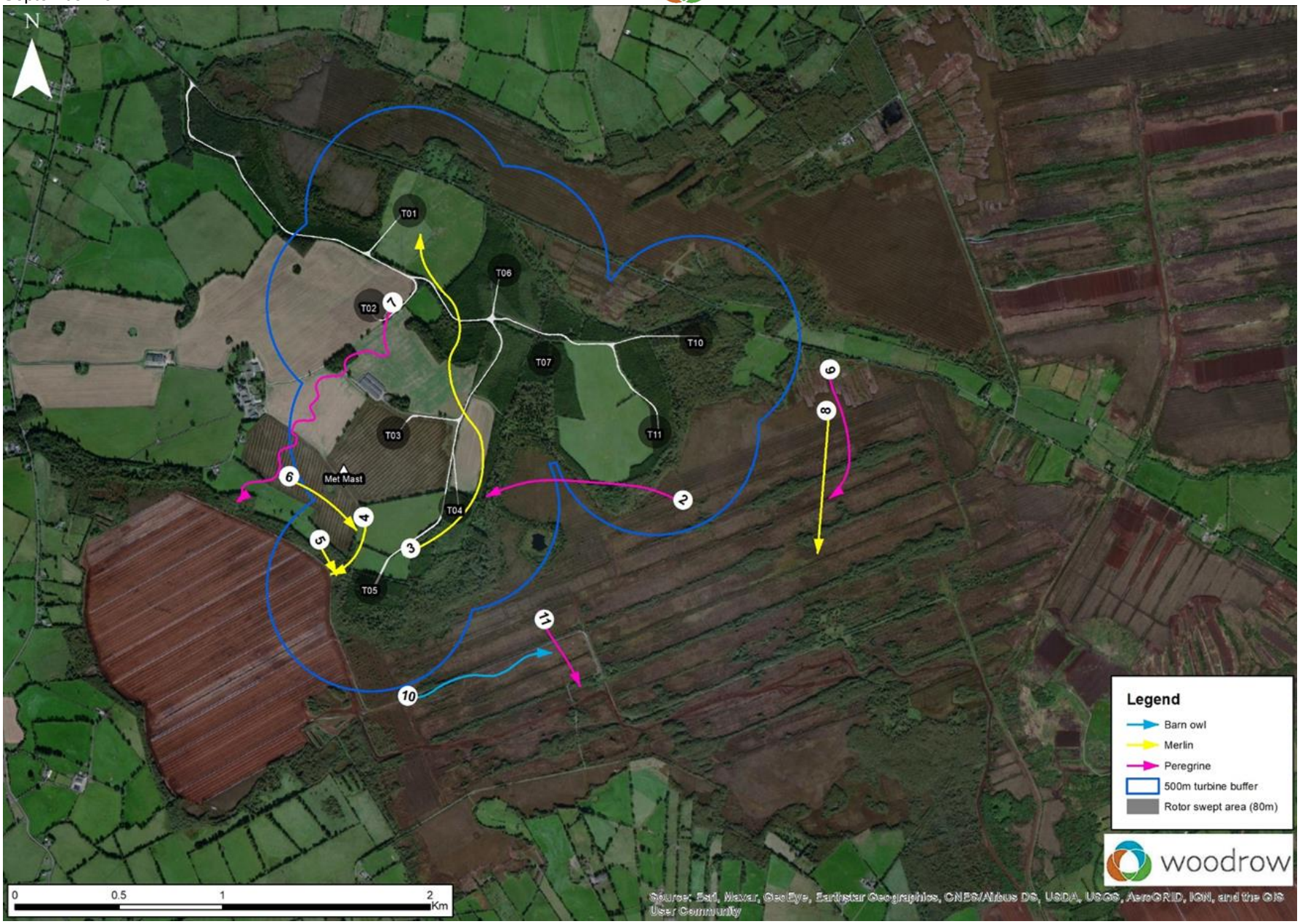

Figure A6.1: All flight lines for Annex I birds of prey & barn owl (Oct-2018 to Aug-2020)

Table A6.1: Birds of prey & barn owl

Map reference	Season	Date	Time	BTO Code	Label	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
2	Non-breeding 2018-19	08/01/2019	1059	PE	2	1	40				
3	Non-breeding 2018-19	03/01/2019	1336	ML	3	1	12				
4	Non-breeding 2018-19	03/01/2019	1438	ML	4	1	10				
5	Non-breeding 2018-19	23/01/2019	1515	ML	5	1	15	15			
6	Non-breeding 2018-19	04/02/2019	1255	ML	6	1	10				
7	Non-breeding 2018-19	21/02/2019	1559	PE	7	1	25				
8	Non-breeding 2019-20	16/10/2019	950	ML	8	1	15	10-15	F	Juv.	
9	Non-breeding 2019-20	30/10/2019	1000	PE	9	1	75	50-75			
10	Breeding 2020	20/03/2020	1824	BO	10	1	3	3-10	M	AD	Travelling
11	Breeding 2020	17/08/2020	940	PE	11	1	30	25-40			travelling

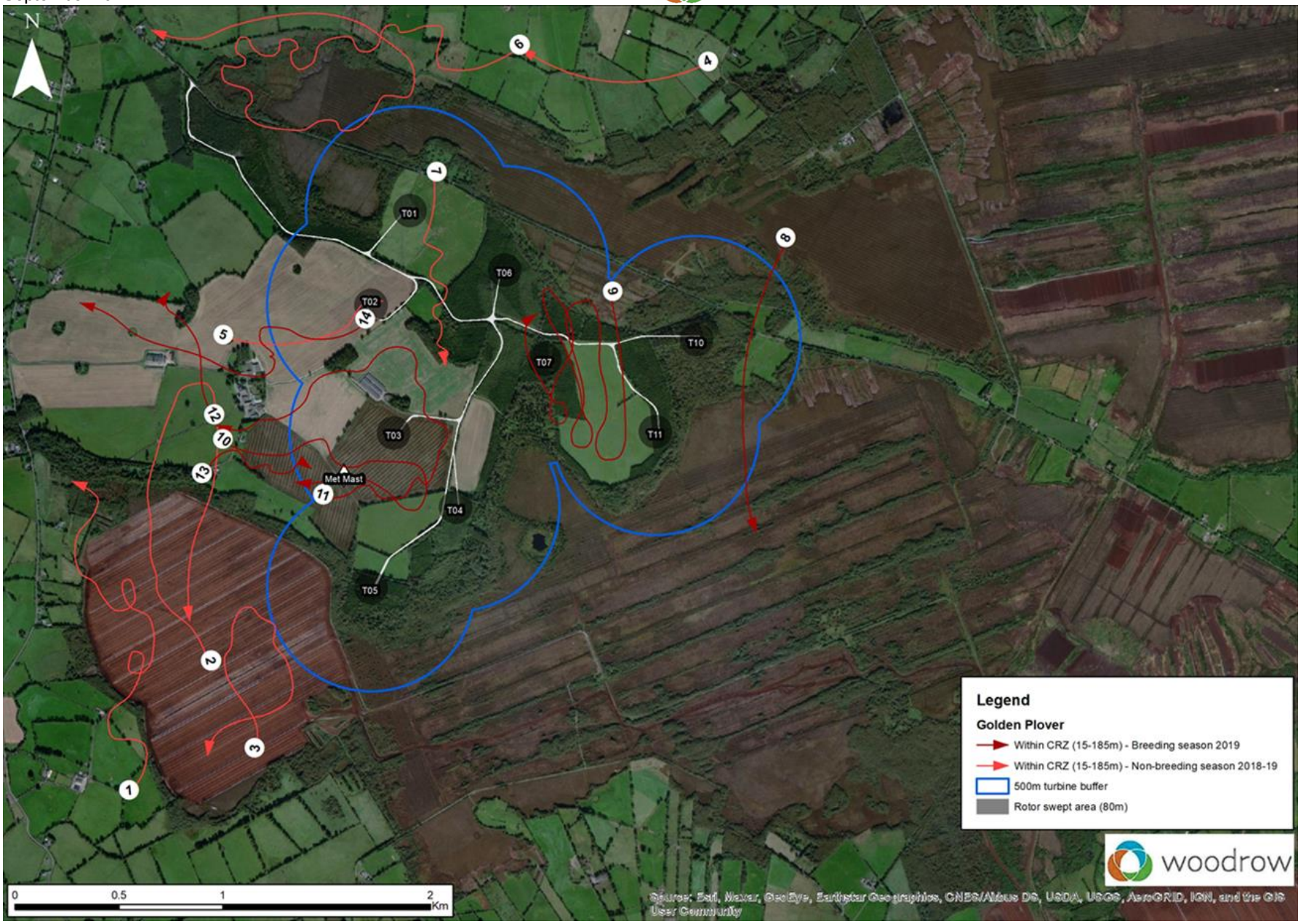

Figure A6.2: Golden plover flight lines Year 1 (Oct-2018 to Apr-2019)

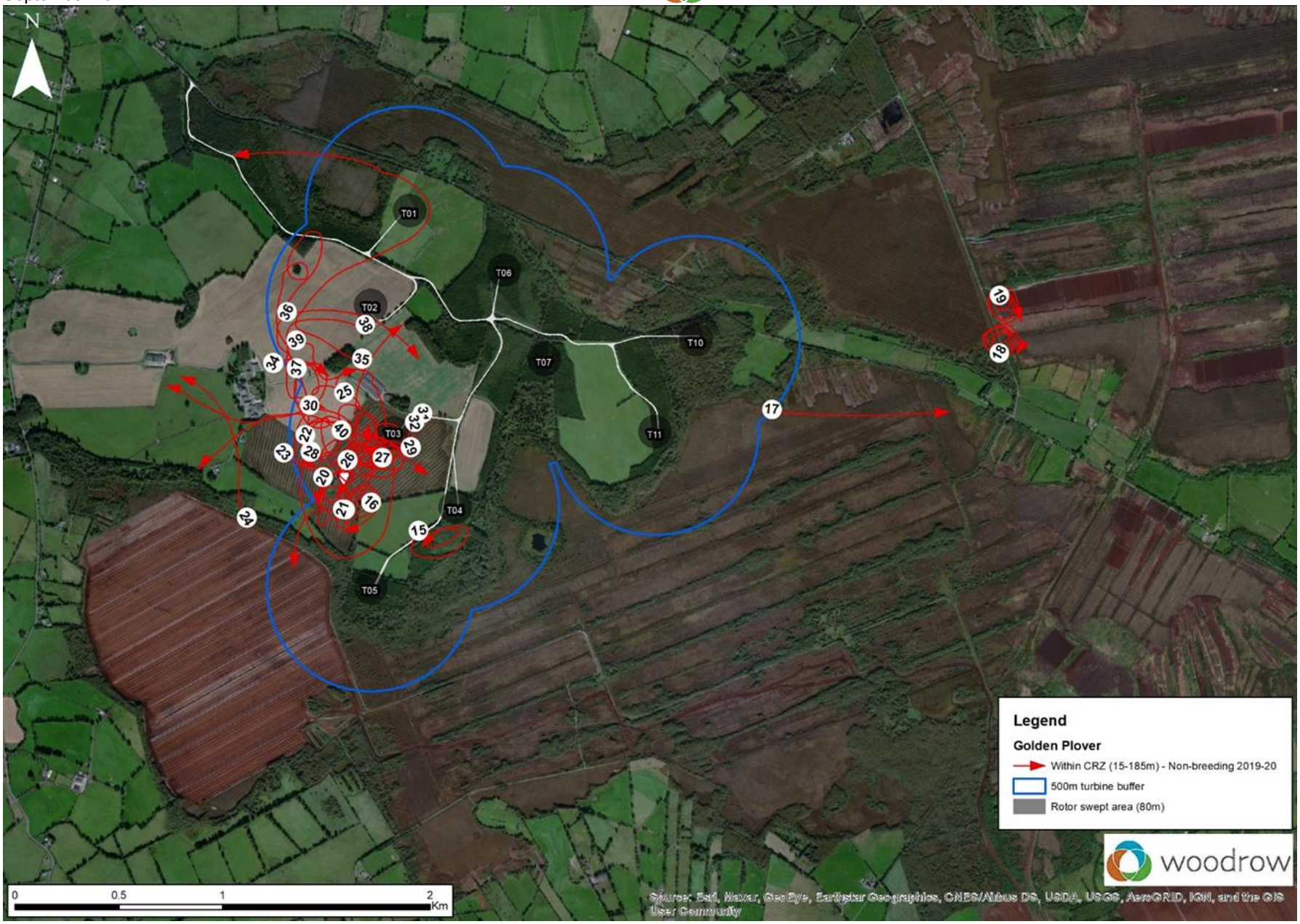

Figure A6.3: Golden plover flight lines Year 2 Oct-2019 to Mar-2020

Table A6.2: Golden plover flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	08/01/2019	1539	GP	140	100	80-100			
2	Non-breeding 2018-19	08/01/2019	1548	GP	140	100	40-100			
3	Non-breeding 2018-19	21/02/2019	1306	GP	400	150				
4	Non-breeding 2018-19	07/12/2018	1018	GP	100	180				
5	Non-breeding 2018-19	21/12/2018	1132	GP	1	60				
6	Non-breeding 2018-19	04/02/2019	1057	GP	29	100				
7	Non-breeding 2018-19	21/02/2019	1557	GP	7	80				
8	Breeding 2019	19/03/2019	1312	GP	5	80				
9	Breeding 2019	16/04/2019	1257	GP	200	70				
10	Breeding 2019	23/04/2019	1046	GP	16	30				
11	Breeding 2019	23/04/2019	1139	GP	24	40				
12	Breeding 2019	23/04/2019	1142	GP	24	80				
13	Breeding 2019	23/04/2019	1201	GP	22	30				
14	Breeding 2019	23/04/2019	1140	GP	22	50	30-60			
15	Non-breeding 2019-20	29/10/2019	1010	GP	55	150	150-175			
16	Non-breeding 2019-20	13/02/2020	1023	GP	65	100	100-150			circling
17	Non-breeding 2019-20	30/10/2019	950	GP	1	100	100			
18	Non-breeding 2019-20	14/02/2020	1520	GP	155	150	150-175			circling
19	Non-breeding 2019-20	14/02/2020	1555	GP	200	150	150-175			circling
20	Non-breeding 2019-20	10/10/2019	1320	GP	150	70	0-100			
21	Non-breeding 2019-20	10/10/2019	1400	GP	35	70	0-100			
22	Non-breeding 2019-20	10/10/2019	1410	GP	200	100	0-175			
23	Non-breeding 2019-20	15/11/2019	1015	GP	9	75	75			
24	Non-breeding 2019-20	23/12/2019	1225	GP	4	150	150-175			travelling
25	Non-breeding 2019-20	23/12/2019	1410	GP	11	50	0-100			circling
26	Non-breeding 2019-20	23/12/2019	1425	GP	26	90	0-175			circling
27	Non-breeding 2019-20	23/12/2019	1440	GP	12	90	0-175			circling
28	Non-breeding 2019-20	10/01/2020	1440	GP	2	75	0-75			travelling

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
29	Non-breeding 2019-20	10/01/2020	1455	GP	3	100	0-100			travelling
30	Non-breeding 2019-20	27/01/2020	1340	GP	130	100	0-175			circling
31	Non-breeding 2019-20	27/01/2020	1428	GP	31	100	10-200			circling
32	Non-breeding 2019-20	27/01/2020	1545	GP	5	100	0-100			circling
33	Non-breeding 2019-20	26/02/2020	1506	GP	5	100	0-100			circling
34	Non-breeding 2019-20	01/10/2019	1420	GP	1	170	>170			
35	Non-breeding 2019-20	01/10/2019	1525	GP	12	150	150-175			
36	Non-breeding 2019-20	29/10/2019	1230	GP	35	50	20-50			
37	Non-breeding 2019-20	29/10/2019	1340	GP	100	100	50-150			
38	Non-breeding 2019-20	14/11/2019	1245	GP	65	175	175			
39	Non-breeding 2019-20	09/01/2020	1225	GP	6	100	100			travelling
40	Non-breeding 2019-20	09/01/2020	1340	GP	7	100	0-100			circling

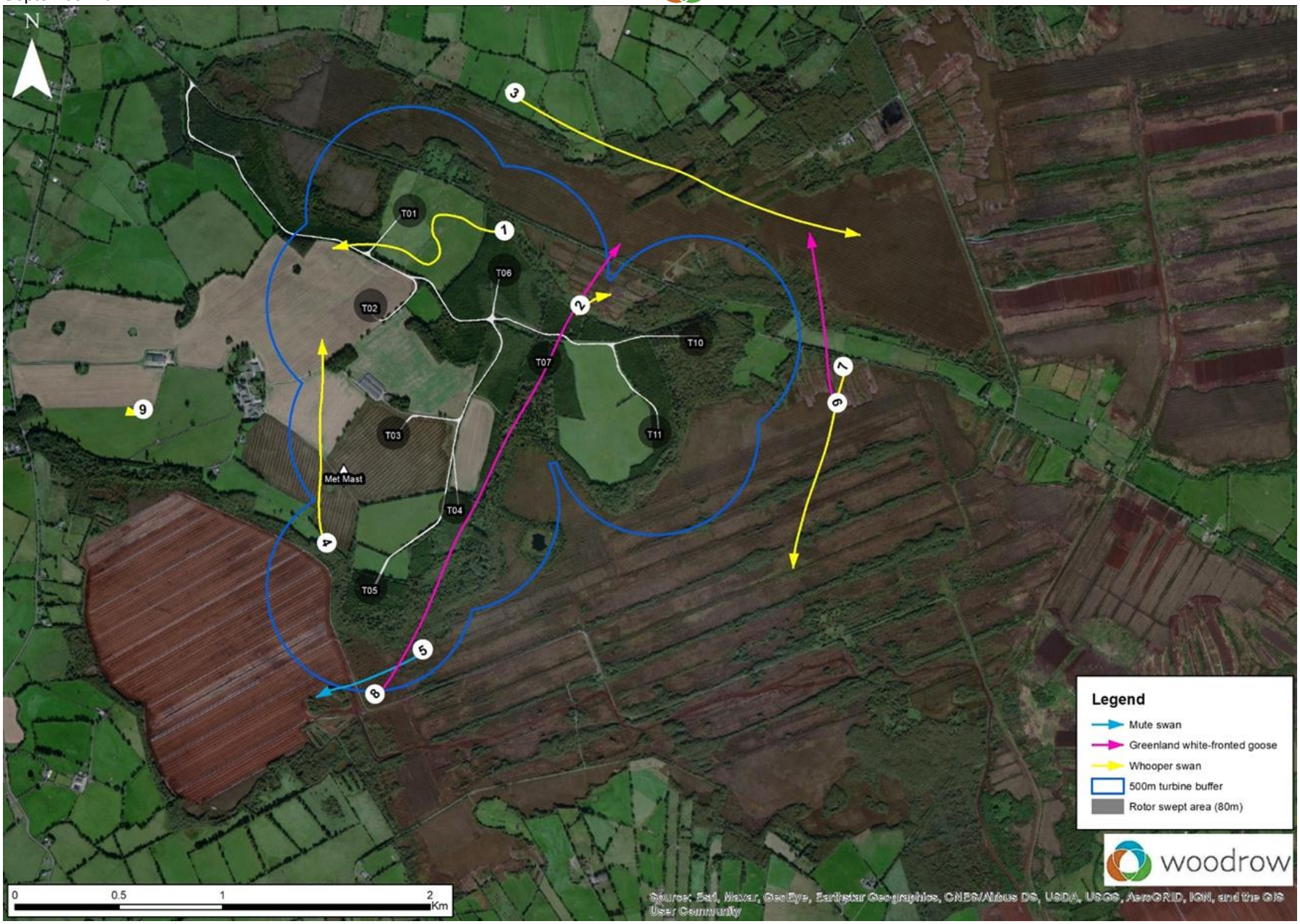

Figure A6.4: All geese & swan flights (Oct-2018 to Aug-2020)

Table A6.3: Geese & swan flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	25/10/2018	1031	WS	2	40				
2	Non-breeding 2018-19	25/10/2018	1031	WS	2	30				
3	Non-breeding 2018-19	07/12/2018	840	WS	2	100				
4	Breeding 2019	19/03/2019	1827	WS	7	10				
5	Non-breeding 2019-20	11/12/2019	950	MS	1	75	75			travelling
6	Non-breeding 2019-20	15/11/2019	1308	WG	1	100	100			
7	Non-breeding 2019-20	23/12/2019	850	WS	4	100	100			travelling
8	Non-breeding 2019-20	02/10/2019	1425	WG	42	175	>175			
9	Non-breeding 2019-20	10/03/2020	1310	WS	1	0				

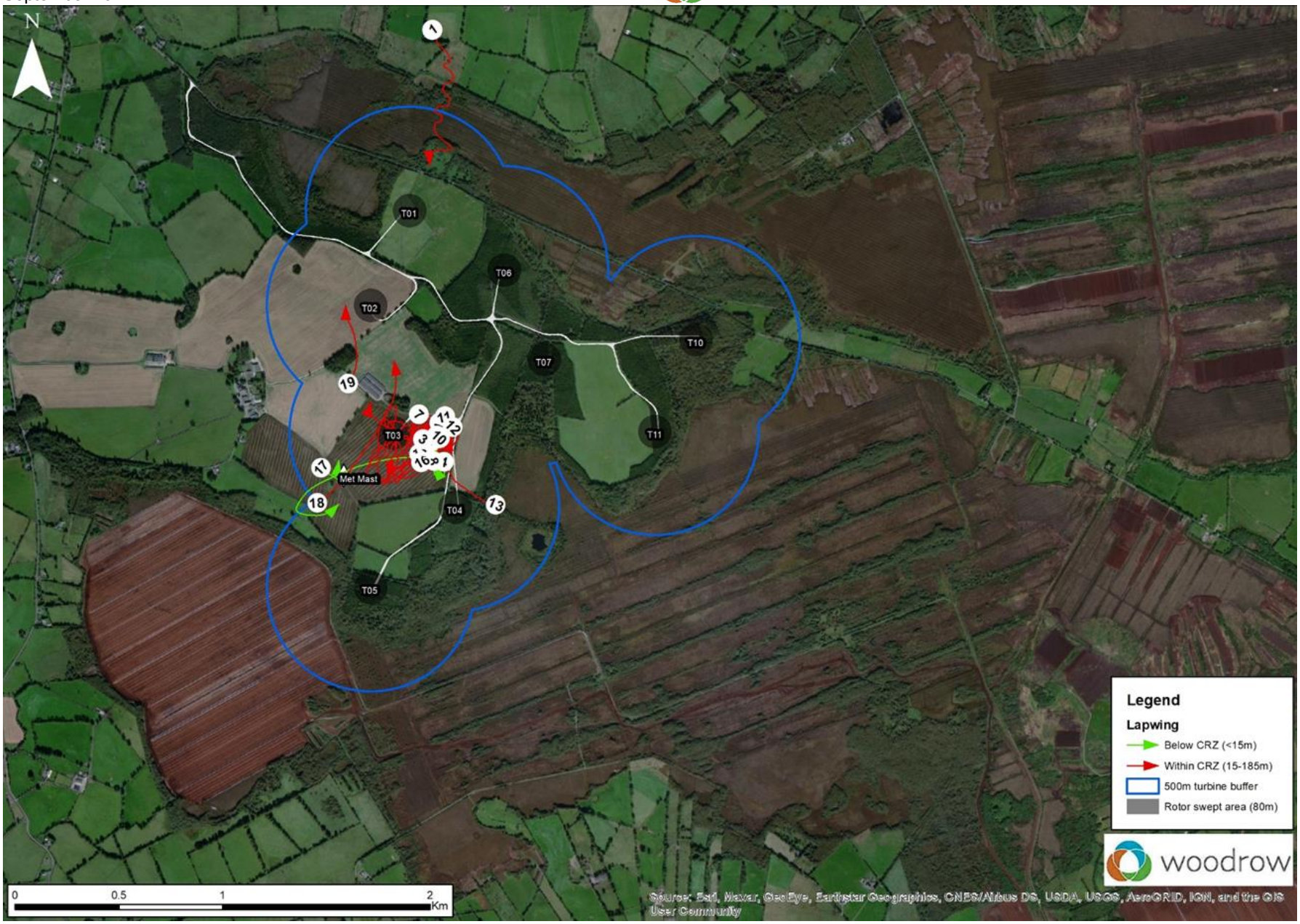

Figure A6.5: All lapwing flight lines (Oct-2018 to Aug-2020)

Table A6.4: Lapwing flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	21/02/2019	1554	L	16	80				
2	Breeding 2019	19/03/2019	1612	L	1	50				
3	Breeding 2019	19/03/2019	1613	L	1	50				
4	Breeding 2019	19/03/2019	1626	L	1	50				
6	Breeding 2019	19/03/2019	1636	L	1	30				
7	Breeding 2019	19/03/2019	1643	L	1	20				
8	Breeding 2019	19/03/2019	1650	L	2	10				
9	Breeding 2019	19/03/2019	1652	L	1	20				
10	Breeding 2019	19/03/2019	1655	L	1	50				
11	Breeding 2019	19/03/2019	1739	L	1	30				
12	Breeding 2019	19/03/2019	1739	L	1	30				
13	Breeding 2019	19/03/2019	1745	L	3	80				
14	Breeding 2019	25/03/2019	1501	L	1	20				
15	Breeding 2019	25/03/2019	1539	L	1	10				
16	Breeding 2019	25/03/2019	1615	L	1	30				
17	Breeding 2019	23/04/2019	1058	L	1	10				
18	Breeding 2019	23/04/2019	1139	L	1	30				
19	Breeding 2019	23/04/2019	1140	L	1	25	25			

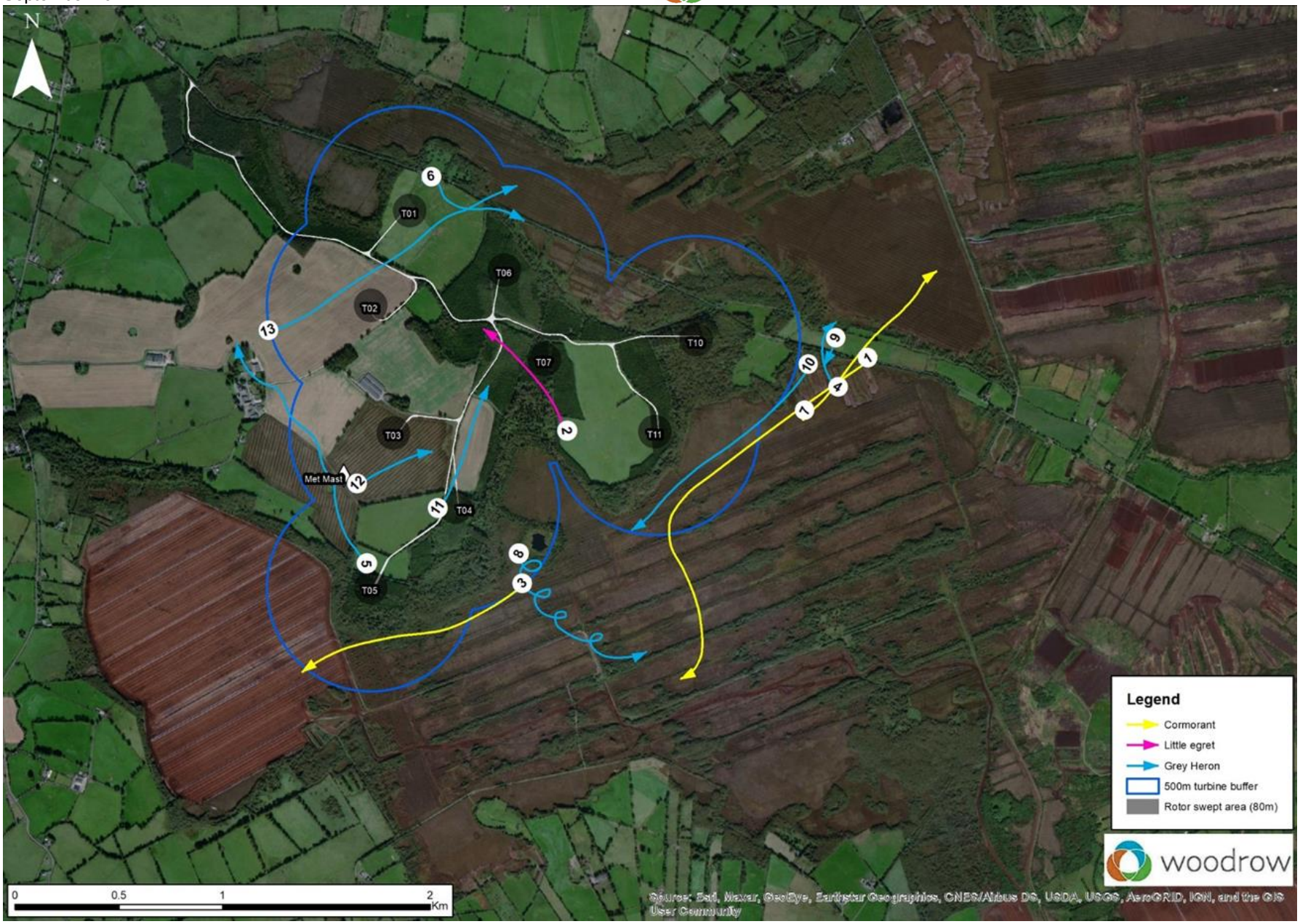

Figure A6.6: All little egret, grey heron & cormorant flight lines (Oct-2018 to Aug-2020)

Table A6.5: Little egret, grey heron & cormorant flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	13/12/2018	1519	CA	1	40				
2	Non-breeding 2018-19	07/12/2018	1357	ET	1	50				
3	Non-breeding 2018-19	03/01/2019	1324	CA	1	50				
4	Breeding 2019	27/06/2019	1915	H	1	100				
5	Breeding 2019	23/04/2019	1220	H	1	40				
6	Breeding 2019	19/03/2019	1730	H	1	50				
7	Non-breeding 2019-20	15/11/2019	1415	CA	2	75	75			
8	Breeding 2020	27/04/2020	1000	H	1	100	100-150			travelling
9	Breeding 2020	10/06/2020	1928	H	1	25	0-25			travelling
10	Breeding 2020	10/06/2020	1936	H	1	25	0-25			travelling
11	Breeding 2020	14/08/2020	1230	H	1	50	25-50			travelling
12	Breeding 2020	21/08/2020	1140	H	1	50	5-50			travelling
13	Breeding 2020	10/08/2020	1230	H	1	50	50-75			travelling

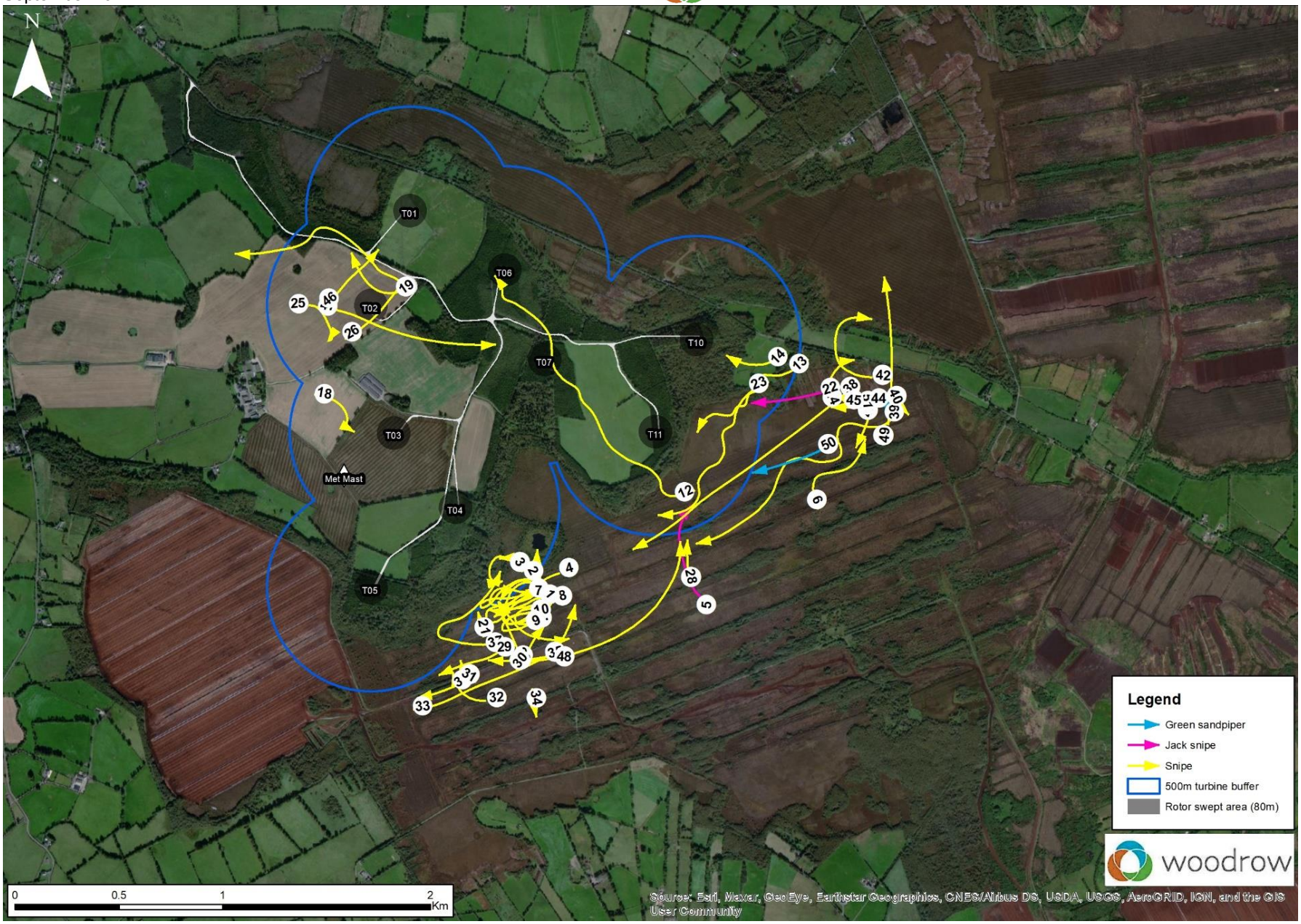

Figure A6.7: All snipe, jack snipe & green sandpiper flight lines (Oct-2018 to Aug-2020)

Table A6.6: Snipe, jack snipe & green sandpiper flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	01/12/2018	958	SN	2	20				
2	Non-breeding 2018-19	01/12/2018	959	SN	1	10				
3	Non-breeding 2018-19	01/12/2018	1000	SN	1	15				
4	Non-breeding 2018-19	25/01/2019	1125	SN	2	7				
5	Non-breeding 2018-19	25/01/2019	1125	JS	1	7				
6	Non-breeding 2018-19	25/01/2019	1130	SN	3	7				
7	Non-breeding 2018-19	19/02/2019	1148	SN	9	30				
8	Non-breeding 2018-19	19/02/2019	1149	SN	6	30				
9	Non-breeding 2018-19	19/02/2019	1151	SN	5	20				
10	Non-breeding 2018-19	19/02/2019	1151	SN	2	15				
11	Non-breeding 2018-19	19/02/2019	1153	SN	1	15				
12	Non-breeding 2018-19	25/10/2018	1701	SN	1	40				
13	Non-breeding 2018-19	01/12/2018	1345	SN	1	40				
14	Non-breeding 2018-19	01/12/2018	1345	SN	1	5				
18	Non-breeding 2018-19	25/10/2018	1648	SN	1	5				
19	Non-breeding 2018-19	04/02/2019	1144	SN	1	10				
20	Breeding 2019	25/03/2019	1105	SN	1	30				
21	Breeding 2019	25/03/2019	1202	SN	5	2				
22	Breeding 2019	19/03/2019	1230	JS	1	2				
23	Breeding 2019	19/03/2019	1530	SN	6	50				
24	Breeding 2019	25/03/2019	1309	SN	2	1				
25	Breeding 2019	25/03/2019	1512	SN	1	5				
26	Breeding 2019	25/03/2019	1537	SN	1	50				
27	Non-breeding 2019-20	01/10/2019	1210	SN	1	65	10-100			
28	Non-breeding 2019-20	01/10/2019	1212	SN	1	100	100			
29	Non-breeding 2019-20	14/10/2019	1900	SN	3	30	30			
30	Non-breeding 2019-20	14/11/2019	1115	SN	1	20	0-20			
31	Non-breeding 2019-20	14/11/2019	1120	SN	1	10	0-10			

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
32	Non-breeding 2019-20	27/11/2019	920	SN	2	20	5-20			
33	Non-breeding 2019-20	27/11/2019	1110	SN	35	75	75			
34	Non-breeding 2019-20	11/12/2019	935	SN	1	5	5			travelling
35	Non-breeding 2019-20	20/12/2019	830	SN	3	5	0-5			
36	Non-breeding 2019-20	09/01/2020	855	SN	1	5	5			flying
37	Non-breeding 2019-20	13/02/2020	946	SN	2	100	0-175			travelling
38	Non-breeding 2019-20	02/10/2019	910	SN	7	100	100			
39	Non-breeding 2019-20	02/10/2019	950	SN	2	100	100			
40	Non-breeding 2019-20	28/11/2019	1125	SN	1	10	5-10			
41	Non-breeding 2019-20	13/12/2019	1050	SN	1	5	0-5			flushed
42	Non-breeding 2019-20	23/12/2019	900	SN	2	25	0-50			flushed
43	Non-breeding 2019-20	10/01/2020	900	SN	1	5	0-5			travelling
44	Non-breeding 2019-20	26/02/2020	930	SN	1	5	0-5			travelling
45	Non-breeding 2019-20	10/03/2020	1007	SN	1	5	0-5			flying
46	Non-breeding 2019-20	20/12/2019	1345	SN	1	20	0-20			flushed
47	Non-breeding 2019-20	09/01/2020	1440	SN	1	75	0-75			travelling
48	Breeding 2020	22/06/2020	1400	SN	1					chipping
49	Breeding 2020	28/04/2020	903	SN	1	75	50-75			drumming
50	Breeding 2020	29/07/2020	937	GE	1	25	0-25			travelling
51	Breeding 2020	07/08/2020	1600	GE	1	10	0-10			flying

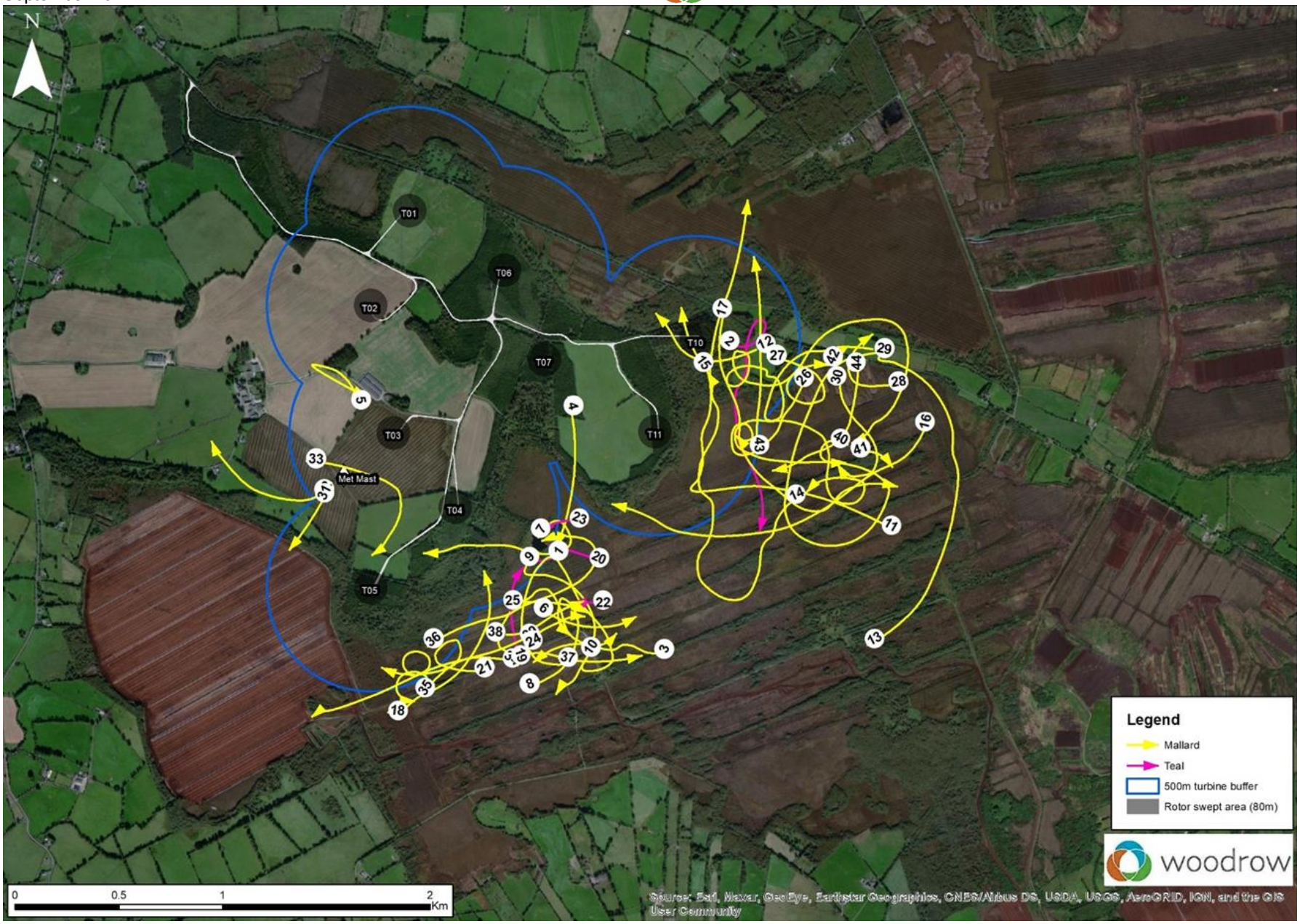

Figure A6.8: All mallard & teal flight lines (Oct-2018 to Aug-2020)

Table A6.7: Mallard & teal flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Non-breeding 2018-19	01/12/2018	1200	T	2	25				
2	Non-breeding 2018-19	01/12/2018	1448	T	2	30				
3	Non-breeding 2018-19	07/03/2019	1653	MA	1	30				
4	Non-breeding 2018-19	07/12/2018	1221	MA	2	30				
5	Non-breeding 2018-19	21/02/2019	1429	MA	2	25				
6	Breeding 2019	25/03/2019	1003	MA	1	10				
7	Breeding 2019	25/03/2019	1114	MA	1	30				
8	Breeding 2019	25/03/2019	1204	MA	2	2				
9	Breeding 2019	08/05/2019	1006	MA	1	20				
10	Breeding 2019	08/05/2019	1049	MA	2	10				
11	Breeding 2019	25/03/2019	1401	MA	1	15				
12	Breeding 2019	25/03/2019	1418	MA	3	30				
13	Breeding 2019	23/04/2019	803	MA	3	30				
14	Breeding 2019	23/04/2019	805	MA	3	40				
15	Breeding 2019	23/04/2019	807	MA	4	30				
16	Breeding 2019	23/04/2019	817	MA	1	15				
17	Breeding 2019	08/05/2019	1503	MA	1	15				
18	Non-breeding 2019-20	01/10/2019	950	MA	1	150	150-170			
19	Non-breeding 2019-20	09/01/2020	1115	T	4	25	10-25			travelling
20	Non-breeding 2019-20	24/01/2020	1025	T	15	25	20-25			travelling
21	Non-breeding 2019-20	13/02/2020	925	MA	2	100	0-100	M+F		circling
22	Non-breeding 2019-20	13/02/2020	1128	T	2	50	0-50			travelling
23	Non-breeding 2019-20	09/03/2020	1027	T	1	50	50-75			travelling
24	Non-breeding 2019-20	09/03/2020	1038	MA	1	50	0-50			travelling
25	Non-breeding 2019-20	09/03/2020	1121	MA	1	25	5-25	M		travelling
26	Non-breeding 2019-20	26/02/2020	1032	MA	2	75	0-75	M+F		travelling
27	Non-breeding 2019-20	10/03/2020	1024	MA	2	50	0-50	M+F		travelling
28	Non-breeding 2019-20	10/03/2020	1031	MA	3	75	50-75	2M+F		travelling

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
29	Non-breeding 2019-20	10/03/2020	1039	MA	1	75	0-75	M		circling
30	Non-breeding 2019-20	10/03/2020	1126	MA	2	50	0-50	M+F		travelling
31	Non-breeding 2019-20	16/10/2019	1140	MA	2	50	50			
32	Non-breeding 2019-20	10/03/2020	1411	MA	2	50	0-50	M+F		travelling
33	Non-breeding 2019-20	10/03/2020	1449	MA	2	50	50-75	M+F		travelling
34	Breeding 2020	27/04/2020	847	MA	2	15	0-15	M+F		travelling
35	Breeding 2020	27/04/2020	903	MA	1	10	0-10	M		travelling
36	Breeding 2020	27/04/2020	933	MA	3	50	0-50	2M+F		travelling
37	Breeding 2020	05/05/2020	817	MA	2	45	5-45	M+F		travelling
38	Breeding 2020	05/05/2020	910	MA	3	30	20-30	2M+F		travelling
39	Breeding 2020	05/05/2020	928	MA	2	60	20-60	M+F		travelling
40	Breeding 2020	22/04/2020	835	MA	5	25	20-25			circling
41	Breeding 2020	22/04/2020	923	MA	4	50	20-50			travelling
42	Breeding 2020	22/04/2020	940	MA	2	25	20-50	M		travelling
43	Breeding 2020	28/04/2020	847	MA	4	90	90-100	3M+F		travelling
44	Breeding 2020	28/04/2020	924	MA	1	50	30-50	M		travelling

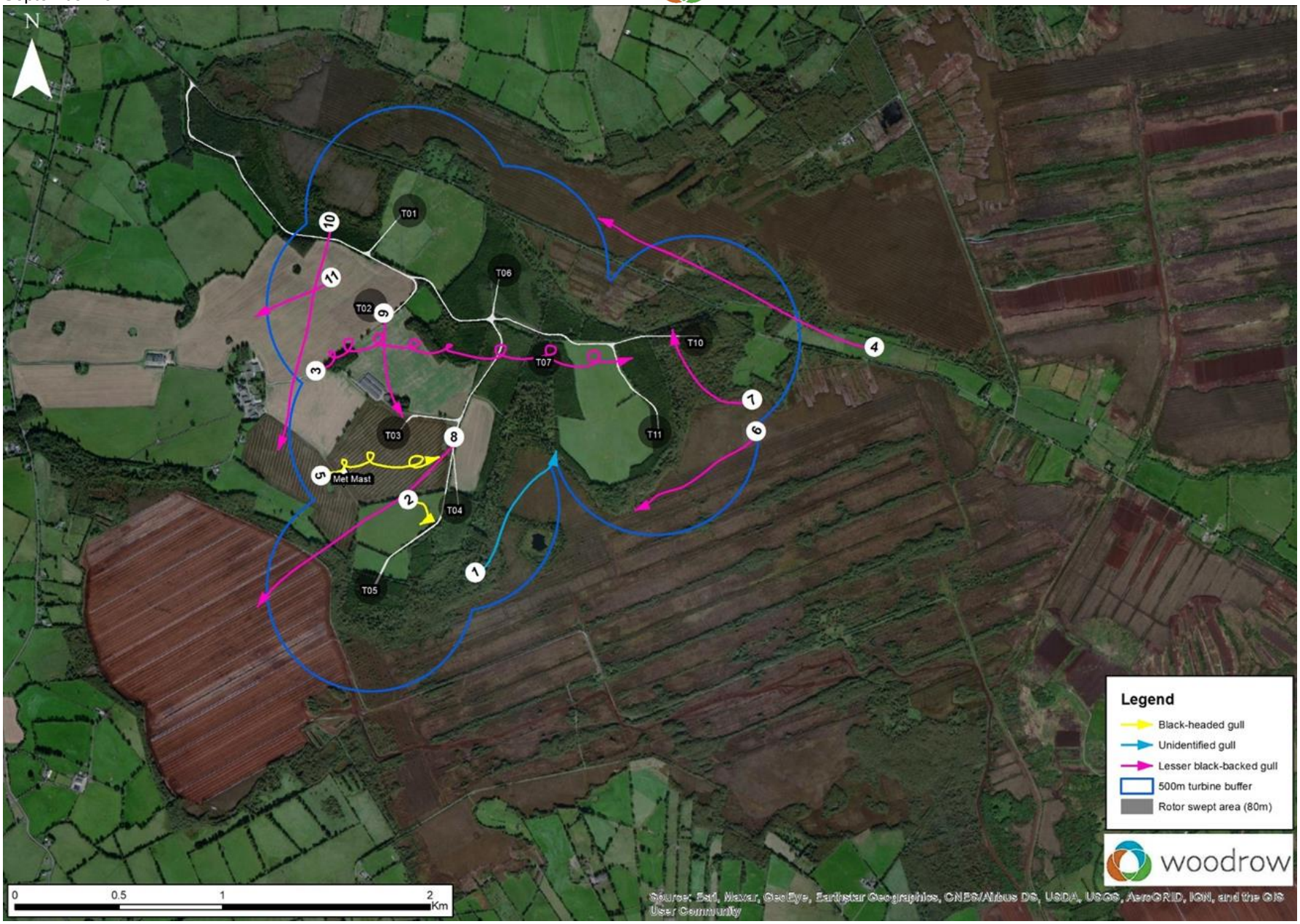

Figure A6.9: All gull flight lines (Oct-2018 to Aug-2020)

Table A6.8: Gull flights

Map reference	Season	Date	Time	BTO Code	No. of birds	Height (m)	Flight height range	Sex	Age	Behaviour
1	Breeding 2019	24/05/2019	1619	Gulls	3	60	50-70			
2	Breeding 2019	10/07/2019	1145	BH	1	10	0-10			
3	Breeding 2019	10/07/2019	1300	LB	2	175	>175			
4	Non-breeding 2019-20	10/01/2020	1027	LB	1	75	75		Juv.	travelling
5	Non-breeding 2019-20	13/12/2019	1405	BH	1	15	0-20		AD	circling
6	Breeding 2020	21/08/2020	1309	LB	15	50	50-100			travelling
7	Breeding 2020	21/08/2020	1314	LB	7	50	50-100			travelling
8	Breeding 2020	10/06/2020	1550	LB	2	175	175-200			travelling
9	Breeding 2020	05/05/2020	1328	LB	1	75	50-75		AD	travelling
10	Breeding 2020	22/06/2020	925	LB	1	100	25-100		AD	travelling
11	Breeding 2020	17/07/2020	1158	LB	1	50	50-75			travelling

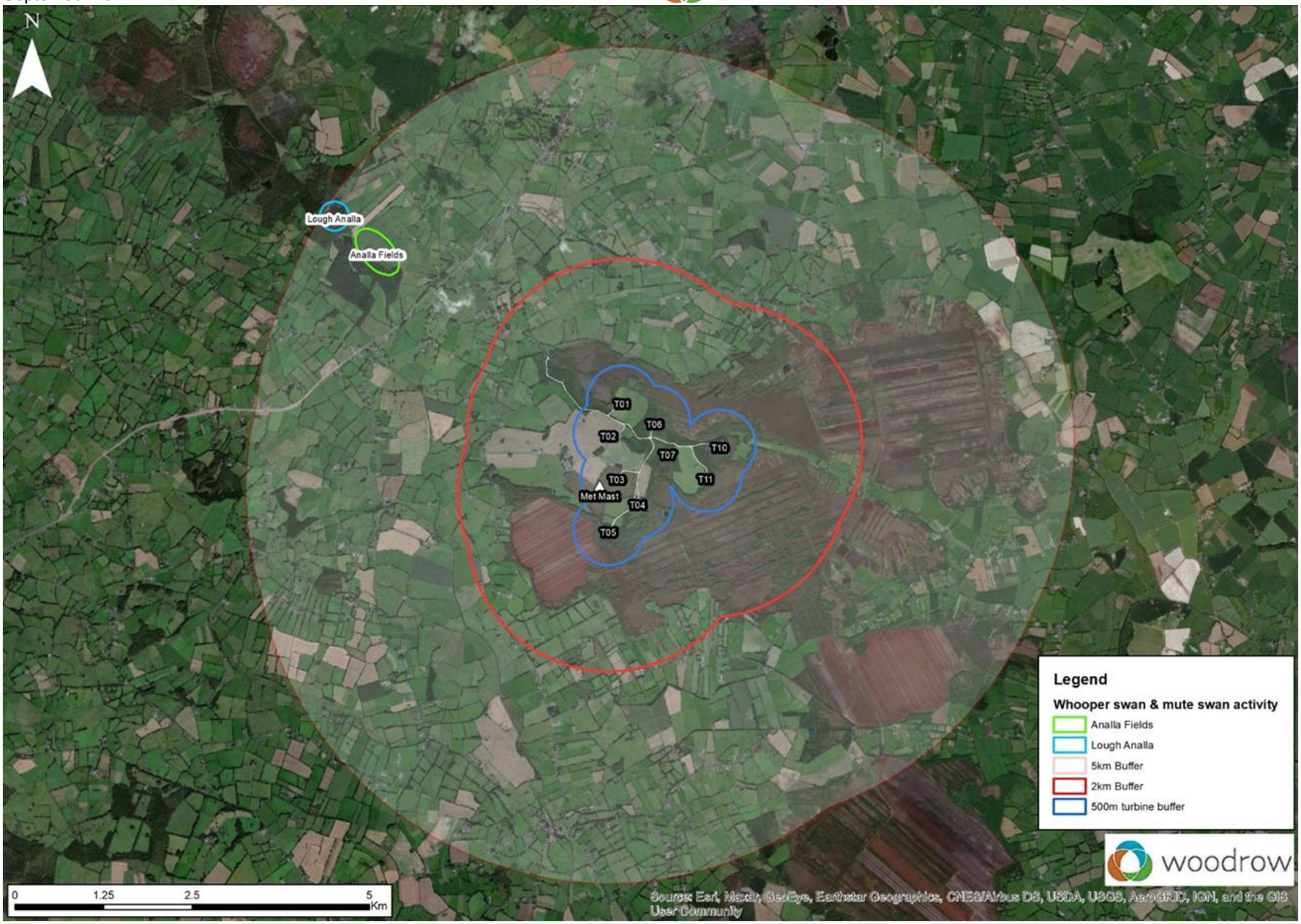

Figure A6.10: Lough Analla - closest whooper swan site to proposed development

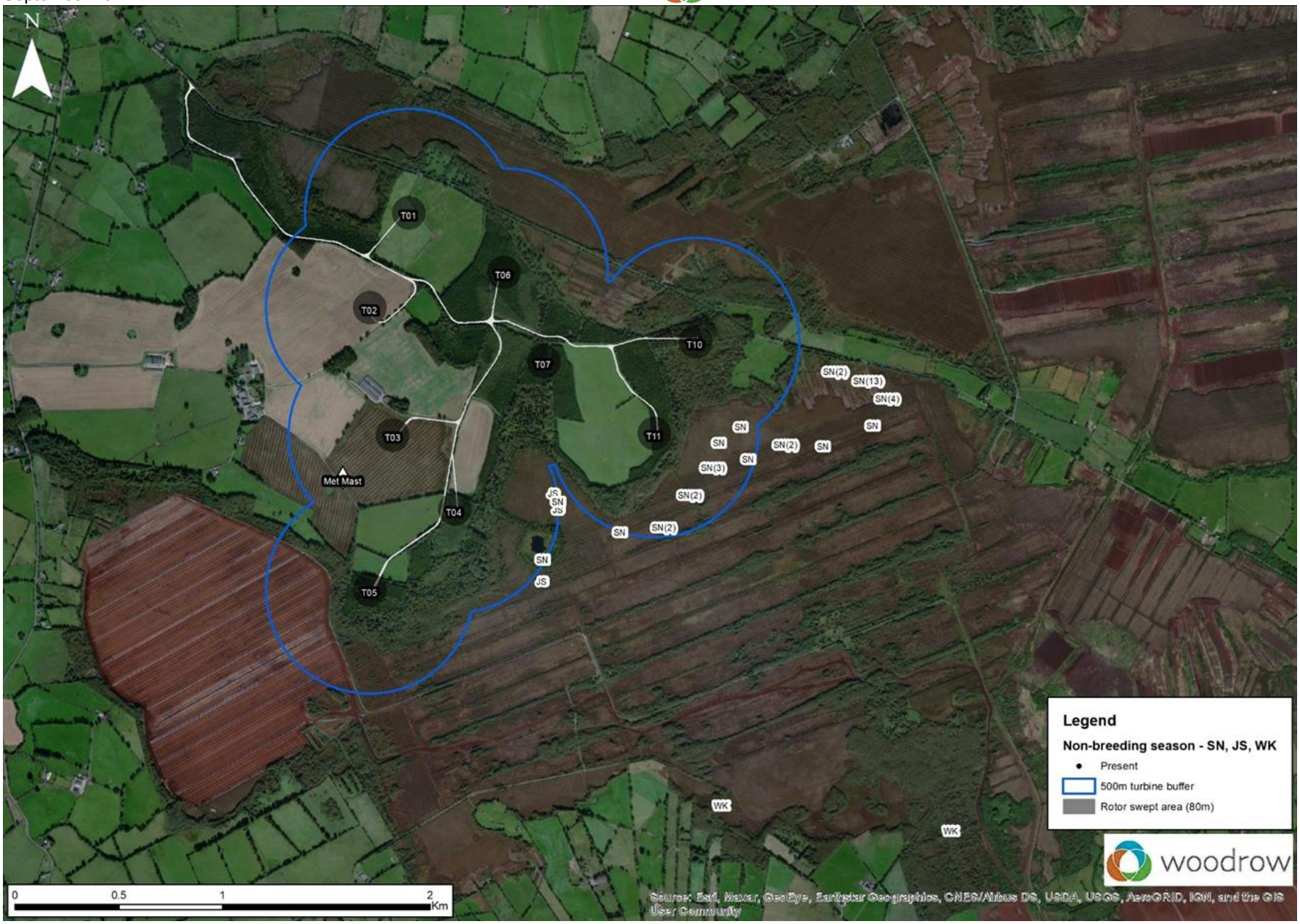

Figure A6.11: Wintering snipe, jack snipe & woodcock distribution based on walkover surveys

Figure A6.12: Winter distribution of ducks & herons base on walkover surveys

APPENDIX 7: AVIAN COLLISION RISK MODELLING REPORT

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STATEMENT OF AUTHORITY

This CRM report has been written by **Aoife Moroney** (BSc., MSc.) with guidance and input from **Will Woodrow** (MSc., MSc. (Arch), CIEEM, CEcol) throughout the analysis and assessment.

Will is a Director and Principal Ecologist at Woodrow Sustainable Solutions Ltd (Woodrow). He has been studying and working in ecology, including avian ecology, since 1985 and has worked as an ecological consultant since 2004. Will has worked on numerous wind farm projects, including over 20 impact assessments and has undertaken collision risk modelling on over nine wind farm proposals to date.

Aoife is a Graduate Ecologist with Woodrow. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She is currently undertaking a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford. Aoife is highly proficient in data analysis and management. She regularly assists in the compilation of environmental reports (including for Appropriate Assessment and Ecological Impact Assessment) as part of larger and smaller scale infrastructure projects.

OVERVIEW

The Application is for a nine-turbine wind farm development proposed for Bracklyn, Co. Westmeath.

As shown in **Appendix 3**, flight data for selected target species was collected from four vantage points (VPs) over two years. **Appendix 3** also provides details of timings for VP watches and demonstrates that the minimum requirement of 36 hours per VP per season was achieved across the two year, amounting to a total of 578.25 hours of VP watch data. As listed by the survey effort tables in **Appendix 3**, conducting of VP watches simultaneous by two surveyors was largely avoided over the two-year study. Simultaneous VP watches were only undertaken on nine out of 96 survey days. When simultaneous VP watches did occur, care was taken to ensure that the viewsheds of the VPs did not overlap, i.e. watches from VP1 and VP3 were not undertaken at the same time to avoid overlap. Therefore, no correction factor to account for simultaneous observer effort was required.

The flight risk volume applied in this analysis is based on a buffer extending 500 m from turbine towers (as shown on the flight line maps in **Appendix 6**), which equates to area of 450.43 ha. The Collision Risk Modelling (CRM) applies a worst-case scenario with a rotor swept area spanning from 20 to 185 m, which accounts for the proposed hub height of 104 m and a blade diameter of 162 m of the Vestas V162 specified.

CRM was undertaken for those target species with > 200 flight seconds occurring with the potential collision risk zone (CRZ) over the two years (i.e. at collision risk height and within the turbine envelope = 500 m turbine buffer). CRMs were run for nine species, including:

- Greenland white-fronted goose 18,900 flight seconds in CRZ
- Mallard 1,843 flight seconds in CRZ
- Sparrowhawk 2,480 flight seconds in CRZ
- Buzzard 53,033 flight seconds in CRZ
- Kestrel 15,751 flight seconds in CRZ
- Lapwing 9,642 flight seconds in CRZ
- Golden plover 1,341,077 flight seconds in CRZ
- Snipe 1,689 flight seconds in CRZ
- Lesser black-backed gull 6,100 flight seconds in CRZ

COLLISION RISK MODEL – APPROACH

The collision risk analysis was undertaken using the Scottish Natural Heritage (SNH) model and guidelines[147][148][149], based on Band *et al*. (2007)[150].. The SNH model uses two approaches for different situations. The first approach is for birds that take regular flights through a wind farm area and the second is for birds that may occupy an area, including a wind farm, as a regular territory. The model approach used in this case is the second approach, relating to birds occupying a given area.

Stage 1 - Number of birds flying through rotors

This stage involved a number of sequential steps:

1. Identify a 'flight risk volume' V_w which is the area of the windfarm multiplied by the height of the rotors, as shown in Equation 1.

$$V_w = Area_{windfarm} * rotor\ diameter \quad (1)$$

2. Calculate the combined volume swept out by the windfarm rotors using Equation 2:

$$V_r = X\pi R^2(d + l) \quad (2)$$

where X is the number of wind turbines, d is the depth of the rotor back to front, and l is the length of the bird.

3. Estimate the bird occupancy n within the flight risk volume. This is the number of birds present, multiplied by the time spent flying in the flight risk volume, within the period (usually one year) for which the collision estimate is being made.
4. The bird occupancy, in bird-seconds, of the volume swept by the rotors b is then calculated using Equation 3.

$$b = n\left(\frac{V_r}{V_w}\right) \quad (3)$$

5. Calculate the time taken for a bird to make a transit through the rotor and completely clear the rotors t, see Equation 4:

$$t = \frac{d + l}{v} \quad (4)$$

where v m/sec is the speed of the bird through the rotor.

6. To calculate the number of bird transits through the rotors N, divide the total occupancy of the volume swept by the rotors in bird-secs by the transit time t, as shown in Equation 5:

$$N = \frac{n\left(\frac{V_r}{V_w}\right)}{t} = \frac{b}{t} \quad (5)$$

Note in this calculation that the factor $(d + l)$ actually cancels itself out, so only assumed values need be used - it is used above to help visualise the calculation.

Within this stage, a weighting system is also applied to the value for bird occupancy n, which is intended to take account of the fact that the observations arise from different Vantage Points (VPs),

[147] SNH (2000). Windfarms and birds: Calculating a theoretical collision risk assuming no avoiding action. Guidance Note Series. Scottish Natural Heritage.

[148] SNH (2018). Avoidance Rates for the onshore SNH Wind Farm Collision Model v2. Scottish Natural Heritage

[149] SNH (2014) Flight Speeds and Biometrics for Collision Risk Modelling. Scottish Natural Heritage October 2014.

[150] Band, W., Madders, M., & Whitfield, DP., (2007). Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farm Sites. In: de Lucas, M., Janss, G. & Ferrer, M. (Eds) 2007. Birds and Wind Farms – Risk Assessment and Mitigation. Quercus Editions, Madrid, 259-279

that different vantage points cover varying area extents (in terms of total hectarage), and that the combination of the areas seen from all VPs may not always incorporate the entire site being assessed. The weighting factor for each VP is worked out by the percentage cover of the 20 m viewshed, as well as the combined percentage cover of all the VPs

Stage 2 - Probability of bird being hit when flying through the rotors

This stage uses data relating to bird and rotor characteristics in order to compute the likelihood of a bird being hit when flying through the rotor. The turbine and operational model inputs are shown in **Table A5.7.1** and **Table A5.7.2** provides the model input for dimensions/attributes of target species. This, together with the output from Stage 1, allows for a model output of the likely number of collisions per year.

Data relating to the likelihood of a bird being hit when flying through the rotor is derived from a spreadsheet available from NatureScot (formerly Scottish Natural Heritage)[151]. The outputs from this spreadsheet are provided for each target species in **Table A5.7.3**. Following the above steps, the number of bird transits per year through the rotors can be combined with the probability of a bird being hit when flying through the rotor to give a likely collision risk per year (assuming no avoidance). An avoidance figure is then applied in order to get a predicted likely collision rate, and thus a likely mortality rate. This stage also takes into account the proportion of time that turbines are likely to be operational.

Avoidance rate are given in SNH (2016, 2018)[152, 153] and Furness (2019)[154], which are used to provide estimates of the number of collisions per annum and for the life of the project (30 years).

Table A5.7.1: Turbine and operational inputs – worst case scenario

*Based on turbine specifications of Vestas V162 with a hub height of 104 m rotor diameter of 162 m

Turbine parameter*	Input data used in CRM
No. of turbines proposed	9
No. of blades per rotor	3 blades
Hub height	104 m
Rotor diameter	162 m
Max. chord of blade	4.5 m
Circumference of rotor swept area	508.9 m
Rotor swept area	20,612 m^2
Extent of rotor swept area	23 to 185 m
Pitch of blade[155]	25°
Rotational period	6.5[156]
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Restart wind speed	24 m/s
Turbine operational time	85%

[151] Available at - https://www.nature.scot/wind-farm-impacts-birds-calculating-probability-collision (Accessed March 2021)

[152] Scottish Natural Heritage (2016). Avoidance rates for the onshore SNH wind farm collision risk model. SNH.

[153] Scottish Natural Heritage (2018). Avoidance rates for the onshore SNH wind farm collision risk model. SNH.

[154] Furness, R.W. (2019). Avoidance rates of herring gull, great black-backed gull and common gull for use in the assessment of terrestrial wind farms in Scotland. Scottish Natural Heritage Research Report No. 1019.

[155] This estimate is based on Band (2012) where it is stated that 25-30 degrees is reasonable for typical large turbines. It should be noted, however, that this is in relation to large off-shore turbines which will experience larger pitch angles than onshore due to higher wind speeds. It is therefore considered that this is a conservative estimate.

[156] This is a precautionary value chosen based on turbines of a similar dimension.

Table A5.7.2: Avian biometrics[157] and flight speeds[158] [159] [160] model inputs

Species	Length (cm)	Average (cm)	Wing-span (cm)	Average (cm)	Mean equivalent airspeed (m/s)
Greenland white-fronted goose[161]	64-78	**71**	-	**1.45**	**16**
Mallard	-	**58**	-	**90**	**18.5**
Sparrowhawk	28-38	**33**	55-70	**63**	**10.0**
Buzzard	51-57	**54**	113-128	**121**	**11.6**
Kestrel	32-35	**34**	71-80	**76**	**10.1**
Golden plover	-	**28**	-	**72**	**17.9**
Lapwing	-	**30**	-	**84**	**12.8**
Snipe	25-27	**26**	44-47	**46**	**17.1**
Lesser black-backed gull	52-64	**58**	135-150	**143**	**11.9**

Table A5.7.3: Average collision probability as calculated by Band (2007)

Species	Average	Upwind	Downwind	Avoidance rate
Buzzard	**6.1%**	8.3%	3.9%	98.0%[162]
Golden plover	**4.3%**	6.0%	2.6%	98.0%[16]
Greenland white-fronted goose	**6.0%**	7.9%	4.2%	99.8%[163]
Kestrel	**5.8%**	8.2%	3.4%	95.0%[17]
Lesser black-backed gull	**6.2%**	8.3%	4.0%	99.5%[164]
Mallard	**5.1%**	6.8%	3.5%	98.0%[16]
Snipe	**4.2%**	6.0%	2.4%	98.0%[16]
Sparrowhawk	**5.4%**	7.6%	3.1%	98.0%[16]
Lapwing	**5.0%**	7.1%	2.8%	98.0%[16]

[157] Snow, D. & Perrins, C.M. 1998. The Birds of the Western Palearctic: 2 Volume Set: Volume 1, Non-passerines; Volume 2, Passerines.

[158] Alerstam, T., Rosen M., Backman J., G P., Ericson P & Hellgren O. 2007. Flight Speeds among Bird Species: Allometric and Phylogenetic Effects. *PLoS Biol*, 5, 1656-1662.

[159] Bruderer, B & Boldt, A. (2001). Flight characteristics of birds: I. radar measurements of speeds. *Ibis* 143, pp 178-204.

[160] Provan, S. & Whitfield, D. P. (2006). *Avian flight speeds and biometrics for use in collision risk modelling*. Report from Natural Research to Scottish Natural Heritage. Natural Research Ltd, Banchory

[161] Sugimoto, H. & Matsuda, H. (2011). Collision risk of White-fronted Geese with wind turbines. *Ornithological Science* 10(1), pp 61-71.

[162] For species where there is no avoidance rate SNH (2018) recommend applying a rate of 98%

[163] SNH (2018) Avoidance Rates for the onshore SNH Wind Farm Collision Model v2. Scottish Natural Heritage

[164] Furness, R.W. (2019). Avoidance rates of herring gull, great black-backed gull and common gull for use in the assessment of terrestrial wind farms in Scotland. Scottish Natural Heritage Research Report No. 1019.

Viewshed spatial coverage

Vantage point (VP) locations used were the same during all survey periods. Viewshed spatial coverages for each VP were calculated using ArcGIS Pro. Spatial coverage of these VPs, both in relation to the spatial area of the viewshed (at 20 m) within the study area and proportion of the study area, is given in **Table A5.7.4**. The locations of these vantage points in relation to the site and study area (500m buffer from the turbines) and the spatial coverage of each viewshed are mapped in **Figure A7.1** to **Figure A7.4**.

Table A5.7.4: Spatial visual coverage of 500 m buffer and collision risk zone (CRZ)

Total area = 450.43 ha

Vantage Point (VP)	Area of CRZ visible within 500m turbine buffer	% Coverage	VP survey effort		
			Breeding season (hours)	**Non-breeding season** (hours)	**Total effort** (hours)
VP1	204.18 ha	45%	72.00	72.00	144.00
VP2	206.44 ha	46%	72.00	72.00	144.00
VP3	289.43 ha	64%	72.25	72.00	144.25
VP4	270.75 ha	60%	73.00	72.00	145.00

Figure A7.1: Viewshed analysis at Vantage Point 1

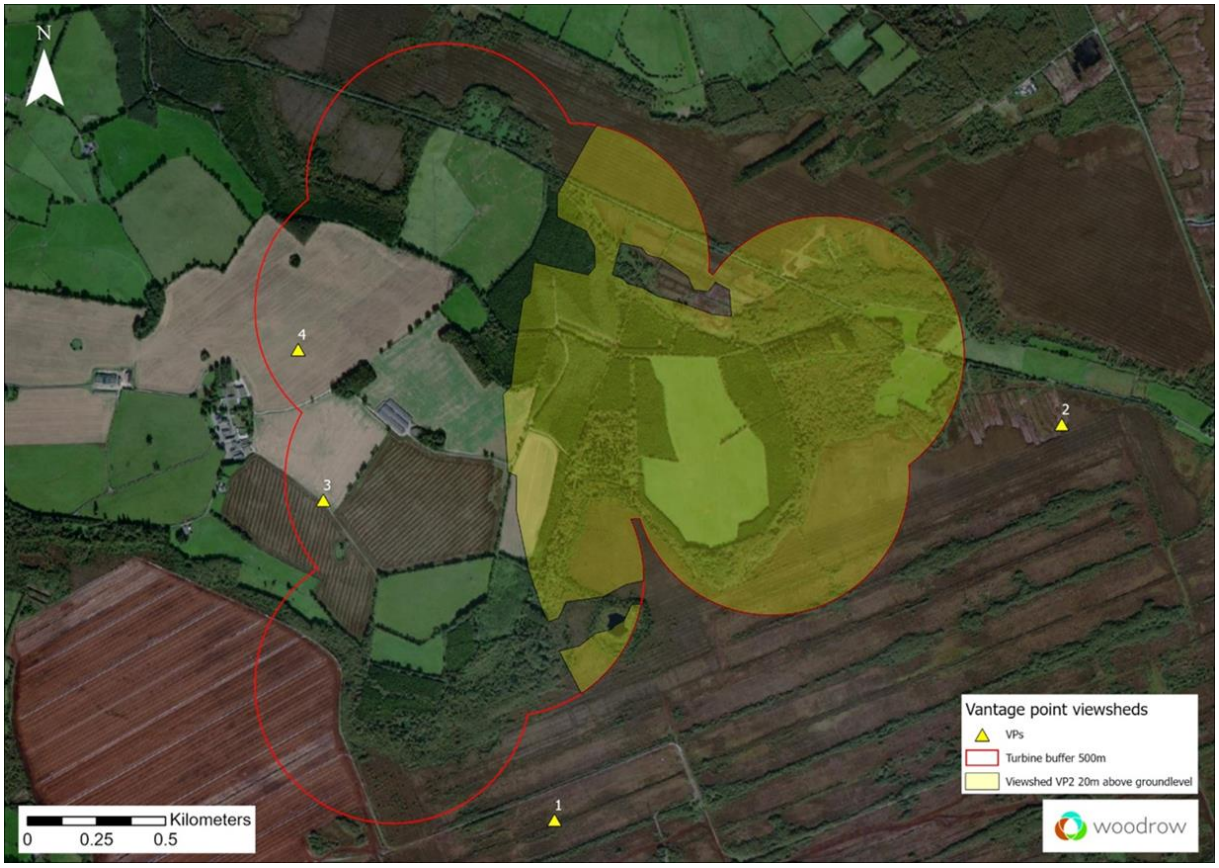

Figure A7.2: Viewshed analysis at Vantage Point 2

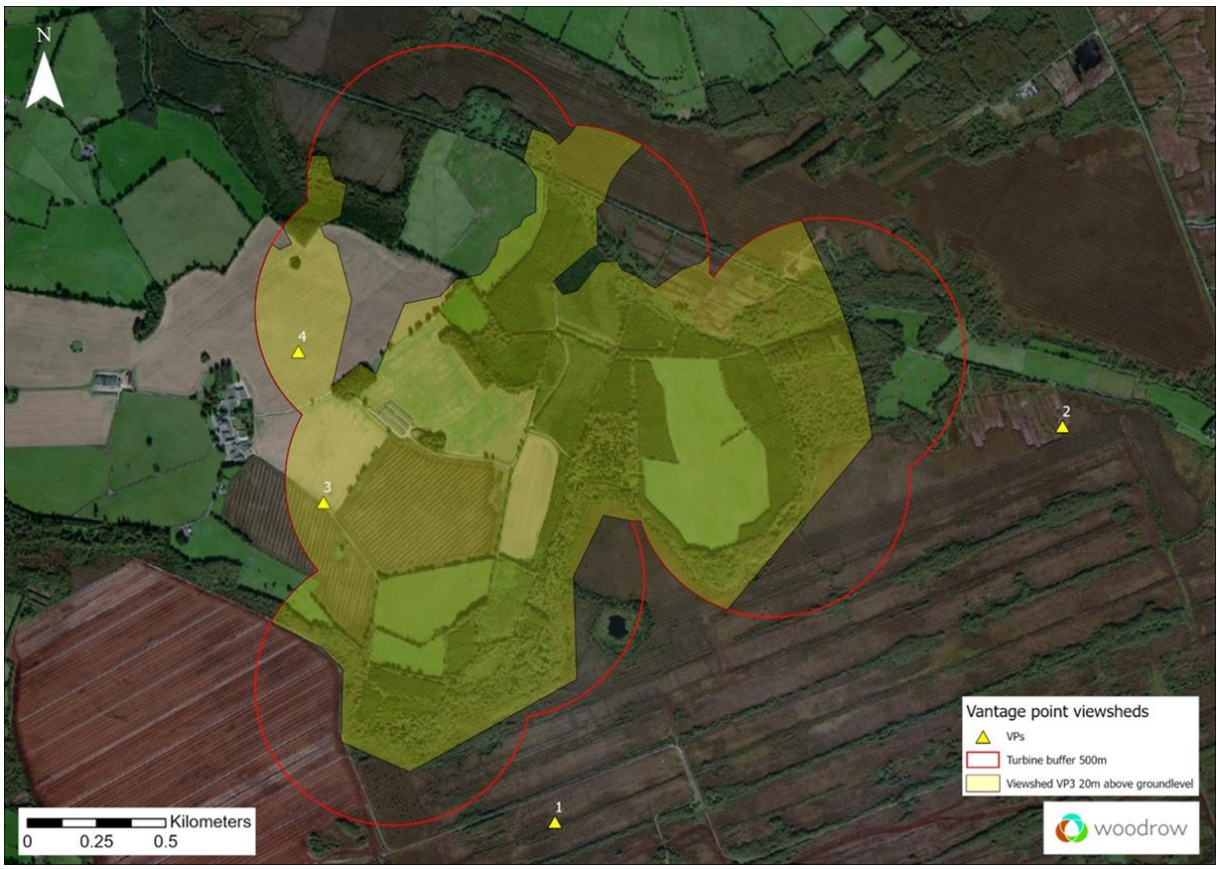

Figure A7.3: Viewshed analysis at Vantage Point 3

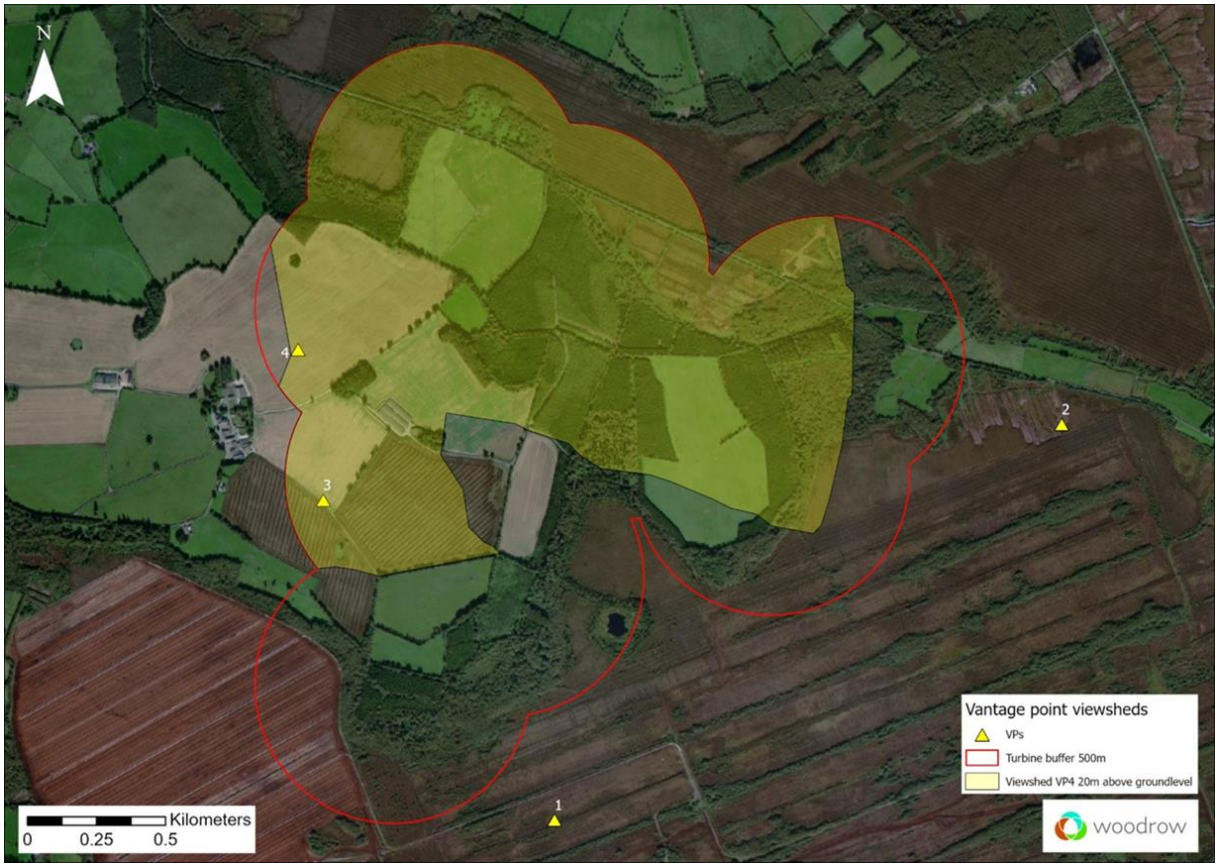

Figure A7.4: Viewshed analysis at Vantage Point 4

Recorded Flight Activity

Surveys were undertaken for four seasons between October 2018 and August 2020. Flight times within the study area and at risk height are provided in **Table A5.7.5** for the 9 target species included in the model**.**

Table A5.7.5: Flight seconds in CRZ for target species from each VP

Oct-2018 to Aug-2020

Species		VP1	VP2	VP3	VP4	Total (flight seconds)
Greenland white-fronted goose				18,900		18,900
Mallard		329	1,028	486		1,843
Sparrowhawk		265	449	658	1,108	2,480
Buzzard		6,372	4,761	21,619	20,281	53,033
Kestrel		2,280	2,923	7,625	2,923	15,751
Golden plover		34,950	62,530	1,131,637	111,960	1,341,077
Snipe		794	685		210	1,689
Lesser black-backed gull			4,470	1,280	230	6,100
Lapwing	Year-round			3,200	6,442	9,642
	Breeding			3200	10	3210
	Wintering				6432	6432

COLLISION RISK ASSESSMENT

As detailed above, the collision risk assessment is undertaken in two stages, with stage 1 being to ascertain the number of bird flights through the rotors and stage 2 being to ascertain the probability of a bird being hit by the rotors as it passes through.

The model inputs for both turbine and bird parameters, as well as the basis of weighting for observational effort are provided in **Table A5.7.1** to **Table A5.7.5**.

Stage 1 - Number of birds flying through rotors

As detailed in the preceding section, the first part of Stage 1 is defining the 'flight risk volume' V_w. This is derived from the wind farm area (4,504,300 m^2) multiplied by the rotor diameter (rotor swept area). This is shown below as 729,696,600 m^3, and calculated using Equation 1. The 'rotor swept volume' V_r is then worked out on the basis of the rotor swept area multiplied by the number of turbines, the depth of the rotor and the length of the bird. This is shown for each bird in **Table A5.7.6** and calculated using Equation 2.

$$V_w = Area_{windfarm} * rotor\ diameter = 4504300 * 162 = 729696600m^3$$

$$V_r = X\pi R^2(d + l) = 9\pi\left(\frac{162}{2}\right)^2 (4.5 + l)$$

Table A5.7.6: Risk Volume V_r and rotor transit time t for each species

Species	V_r (m^3)	t (s)
Buzzard	934959.839	0.40482
Golden plover	886727.784	0.26704
Greenland white-fronted goose	966496.183	0.32563
Kestrel	897858.258	0.47921
Lesser black-backed gull	942380.155	0.38779
Mallard	942380.155	0.27459
Snipe	883017.626	0.27836
Sparrowhawk	896003.179	0.42743
Lapwing	890437.942	0.37500

The next stage of the calculations is to determine the bird occupancy n within the flight risk volume. This is worked out individually for each VP and then averaged to find the mean occupancy across the site. The observation effort (see Equation 6) of each VP (in hectare hours) is first calculated by multiplying the area viewed from the VP (see **Table A5.7.4Error! Reference source not found.**) by t he number of VP hours undertaken (see **Table A5.7.4**). Occupancy n is then calculated, using Equation 7, by dividing the flight time at risk height (in hours) by the observation effort and then multiplying that value by the study area (500m turbine buffer) and the total hours the birds are active across the site. The time the birds are active is defined as the product of the number of days in the season/year and the mean day length. The figures calculated for occupancy, in bird-seconds, are shown in **Table A5.7.7**.

$$Observation\ effort = Area_{viewshed} * Survey\ effort \quad (6)$$

$$n = \frac{Flight\ time\ at\ risk\ height\ (hrs)}{Observation\ effort} * Area_{500m\ turbine\ buffer} * Daylight\ hours \quad (7)$$

Table A5.7.7: Occupancy n (bird-secs) values calculated for each Vantage Point

Species		VP1	VP2	VP3	VP4
Buzzard		29.5764	21.8569	70.7906	70.9911
Golden plover		78.6679	139.2061	1796.914	190.0457
Greenland white-fronted goose		0.0000	0.0000	24.0767	0.0000
Kestrel		10.5829	13.4189	24.9678	10.2316
Lesser black-backed gull		0.0000	11.2443	2.5119	0.4411
Mallard		1.5271	4.7194	1.5914	0.0000
Snipe		4.6068	3.9309	0.0000	0.9188
Sparrowhawk		1.2300	2.0613	2.1546	3.8784
Lapwing	Year-round	0.0000	0.0000	10.4783	22.5494
	Breeding	0.0000	0.0000	11.5279	0.0385
	Wintering	0.0000	0.0000	0.0000	17.4502

As previously described, a weighting factor was used to account for the varying extents of cover of each VP as well as the combined cover of each VP not accounting for the entire site. Weighted values for n were calculated using the values for percentage cover described in **Table A5.7.4**. In this case, the combined VPs cover the entirety of the site and therefore the total cover is 1.

$$n_{weighted} = \frac{n_{VP1}(0.45) + n_{VP2}(0.46) + n_{VP3}(0.64) + n_{VP4}(0.60)}{1}$$

Once a value for n has been calculated for each VP, this is then used to generate the mean activity for the site as a percentage of time (i.e. a percentage occupancy) within the risk zone, n_{avg}. This is calculated by adding the values for n and dividing by the number of VPs, in this case, four. The value for $n_{weighted}$ is also averaged. Both weighted and unweighted values for n_{avg} are shown in **Table A5.7.8**.

Table A5.7.8: Values obtained for n_{avg} and $n_{weightedavg}$ (bird-secs)

Species		n_{avg}	$n_{weightedavg}$
Buzzard		48.3037	27.8960
Golden plover		551.2084	342.0819
Greenland white-fronted goose		6.0192	3.8677
Kestrel		14.8003	8.2852
Lesser black-backed gull		3.5494	1.7582
Mallard		1.9595	0.9694
Snipe		2.3641	1.1105
Sparrowhawk		2.3311	1.3045
Lapwing	Year-round	8.2569	5.0718
	Breeding	2.8916	1.8576
	Wintering	4.3625	2.6223

The bird occupancy of the rotor swept volume b is then worked out using Equation 3 by multiplying n_{avg} by $\frac{V_r}{V_w}$.

The bird occupancy of the swept volume b is used to ascertain the number of bird transits through the rotors N by dividing b by the rotor transit time t, see Equation 4-5.Table A5.7.6 The number of transits through the rotors N is then adjusted by a factor of 0.85[165] to obtain Tn, which takes into account likely wind turbine down time. Calculations for the number of transits through the rotors are shown in **Table A5.7.9**.

[165] This operational period of 85% is referenced from a report by the British Wind Energy Association (BWEA) (2007) which identifies the standard operational period of the wind turbines in the UK to be roughly 85%.

Table A5.7.9: Values obtained for number of transits through the rotors T_n

Species		*Unweighted*				*Weighted*			
		n_{avg}	b	N	T_n	n_{avg}	b	N	T_n
Buzzard		48.3037	222.8096	550.3928	467.8339	27.8960	128.6753	317.8587	270.1799
Golden plover		551.2084	2411.384	9030.077	7675.566	342.0819	1496.513	5604.098	4763.483
Greenland white-fronted goose		6.0192	28.7010	88.1413	74.9201	3.8677	18.4422	56.6364	48.1410
Kestrel		14.8003	65.5599	136.8090	116.2876	8.2852	36.7005	76.5858	65.0979
Lesser black-backed gull		3.5494	16.5019	42.5542	36.1711	1.7582	8.1743	21.0793	17.9174
Mallard		1.9595	9.1101	33.1765	28.2000	0.9694	4.5072	16.4140	13.9519
Snipe		2.3641	10.2992	36.9991	31.4492	1.1105	4.8380	17.3802	14.7732
Sparrowhawk		2.3311	10.3045	24.1078	20.4917	1.3045	5.7666	13.4911	11.4675
Lapwing	Year-round	8.2569	36.2729	96.7277	82.2186	5.0718	22.2806	59.4149	50.5027
	Breeding	2.8916	12.7029	33.8743	28.7932	1.8576	8.1607	21.7618	18.4975
	Wintering	4.3625	19.1648	51.1061	43.4401	2.6223	11.5198	30.7195	26.1115

Stage 2 - Probability of bird being hit when flying through the rotors

The output figures from stage 1 (bird transits through the rotors per year) and stage 2 (probability of a bird being hit while passing through the rotors) are multiplied to get an estimated collision/mortality rate per year in the absence of any avoidance. An avoidance rate is then applied to this value. These results are detailed in **Table A5.7.10**

Table A5.7.3 provides the collision probability of the selected target species passing through the rotors. The average collision probability is applied within the CRM and is based the collision probability of a bird travelling upwind and travelling downwind. All collision probability calculations were undertaken using the setting for birds flapping, as opposed to the setting for gliding birds. This is appropriate for birds, like golden plover and snipe that predominately employ a flapping mode of flight. The flapping setting generates higher values for collision probability in species that incorporate gliding in their flight behaviour, in particular larger raptors, like buzzards. The higher (flapping) value has been retained for these species and will generate a more precautionary estimate for collision risk.

The model was also run for different rotation periods and pitch angles to examine the relationship between these variables and collision risk, see **Table A5.7.11** and **Table A5.7.12**Table A5.7.11. In terms of rotation period, a range of 5-12s was examined, based on turbines of a similar dimension. A high pitch angle of 30 degrees along with a lower pitch angle of 13 degrees was also compared.

Table A5.7.10: Collision risk model results

Species		*Unweighted*					*Weighted*				
		Collisions/year		Stats			Collisions/year		Stats		
		No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years	No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years
Buzzard		31.221	0.624	6.244	18.733	1.601	18.030	0.361	3.606	10.818	2.773
Golden plover		346.447	6.929	69.289	207.868	0.144	215.006	4.300	43.001	129.004	0.233
Greenland white-fronted goose		4.603	0.009	0.092	0.276	108.618	2.958	0.006	0.059	0.177	169.039
Kestrel		8.018	0.401	4.009	12.028	2.494	4.489	0.224	2.244	6.733	4.456
Lesser black-backed gull		2.403	0.012	0.120	0.360	83.230	1.190	0.006	0.060	0.179	168.021
Mallard		1.444	0.029	0.289	0.867	0.000	0.715	0.014	0.143	0.429	69.963
Snipe		1.395	0.028	0.279	0.837	35.831	0.656	0.013	0.131	0.393	76.278
Sparrowhawk		1.274	0.025	0.255	0.765	39.237	0.713	0.014	0.143	0.428	70.114
Lapwing	Year-round	4.647	0.093	0.929	2.788	10.761	2.854	0.057	0.571	1.713	17.51
	Breeding	1.627	0.033	0.325	0.976	30.727	1.045	0.021	0.209	0.627	47.829
	Wintering	2.455	0.049	0.491	1.473	20.366	1.476	0.030	0.295	0.885	33.882

Table A5.7.11: Weighted collision risk values for low and high rotation periods

Species		*High rotation period (5s)*					*Low rotation period (12s)*				
		Collisions/year		Stats			Collisions/year		Stats		
		No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years	No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years
Buzzard		22.247	0.445	4.449	13.348	2.247	12.808	0.256	2.562	7.685	3.904
Golden plover		250.558	5.011	50.112	150.335	0.200	184.154	3.683	36.831	110.492	0.272
Greenland white-fronted goose		3.555	0.007	0.071	0.213	140.638	2.306	0.005	0.046	0.138	216.808
Kestrel		5.642	0.282	2.821	8.463	3.545	2.963	0.148	1.482	4.445	6.749
Lesser black-backed gull		1.456	0.007	0.073	0.218	137.398	0.875	0.004	0.044	0.131	228.560
Mallard		0.847	0.017	0.169	0.508	59.066	0.579	0.012	0.116	0.347	86.351
Snipe		0.777	0.016	0.155	0.466	64.318	0.532	0.011	0.106	0.319	93.949
Sparrowhawk		0.890	0.018	0.178	0.534	56.200	0.485	0.010	0.097	0.291	103.123
Lapwing	Year-round	3.486	0.070	0.697	2.092	14.342	2.112	0.042	0.422	1.267	23.678
	Breeding	1.277	0.026	0.255	0.766	39.156	0.773	0.015	0.155	0.464	64.647
	Wintering	1.803	0.036	0.361	1.082	27.738	1.092	0.022	0.218	0.655	45.796

Table A5.7.12: Weighted collision risk values for low and high pitch angles

Species		*High pitch angle (30°)*					*Low pitch angle (13°)*				
		Collisions/year		Stats			Collisions/year		Stats		
		No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years	No avoid	Avoid	Per 10 years	Per 30 years	1 bird every x years
Buzzard		19.557	0.391	3.911	11.734	2.557	15.147	0.303	3.029	9.088	3.301
Golden plover		228.384	4.568	45.677	137.030	0.219	200.506	4.010	40.101	120.304	0.249
Greenland white-fronted goose		3.133	0.006	0.063	0.188	159.613	2.711	0.005	0.054	0.163	184.425
Kestrel		4.991	0.250	2.496	7.487	4.007	3.435	0.172	1.717	5.152	5.823
Lesser black-backed gull		1.284	0.006	0.064	0.193	155.740	1.021	0.005	0.051	0.153	195.918
Mallard		0.751	0.015	0.150	0.450	66.615	0.680	0.014	0.136	0.408	73.533
Snipe		0.702	0.014	0.140	0.421	71.267	0.599	0.012	0.120	0.359	83.528
Sparrowhawk		0.789	0.016	0.158	0.473	63.385	0.562	0.011	0.112	0.337	88.916
Lapwing	Year-round	3.128	0.063	0.626	1.877	15.984	2.349	0.047	0.470	1.409	21.286
	Breeding	1.146	0.023	0.229	0.687	43.641	0.860	0.017	0.172	0.516	58.116
	Wintering	1.617	0.032	0.323	0.970	30.916	1.214	0.024	0.243	0.729	41.170

RESULTS & OBSERVATIONS

The results generated by running this version of the CRM are considered to represent relatively high levels of theoretical collision risk posed to the target species recorded within the turbine envelope based on the flight data collected from October 2018 to August 2020, due to the parameters entered into the model being notably precautionary, including turbine dimensions (especially the maxchord for the blades and pitch), relatively high rotational period and selecting flapping flight behaviour for each species. It is also important to note that, as is always the case with a modelled approach, the collision risk model outputs are only considered to be indicative of the level of risk of fatalities resulting from the proposed wind farm site, and should be considered in conjunction with other discussions within the Avi-fauna section in the Biodiversity Chapter of the EIS. For instance, the outputs from the model do not take account of potential displacement of birds from the wind farm envelope, which for species breeding within or directly adjacent to the site may be more of a cause for concern, e.g. lapwing. It is also acknowledged that the application of CRMs to smaller, evasive species like sparrowhawk and snipe may not provide an accurate estimate of collision risk, as these species can be difficult to detect over the full extent of the viewsheds for VPs, due diminutive size, cryptic nature and/or flight behaviour.

The CRMs generated notably low levels of theoretical collision risk for eight of the target species recorded and less than 1 collisions (weighted) were predicted over the 30-year life span of the project for Greenland white-fronted goose, lesser black-backed gull, mallard, snipe and sparrowhawk.

- Buzzard 10.818 collisions per 30 years (weighted)
- Golden plover 129.004 collisions per 30 years (weighted)
- Greenland white-fronted goose 0.177 collisions per 30 years (weighted)
- Kestrel 6.733 collisions per 30 years (weighted)
- Lapwing (year-round) 1.713 collisions per 30 years (weighted)
- Lesser black-backed gull 0.179 collisions per 30 years (weighted)
- Mallard 0.429 collisions per 30 years (weighted)
- Snipe 0.393 collisions per 30 years (weighted)
- Sparrowhawk 0.428 collisions per 30 years (weighted)

The highest calculated collision risk was for golden plover, at approximately 4 collisions per annum. It is important to note, however, that robust studies on avoidance rates for golden plover have not been carried out and the generic avoidance rate of 98% as per SNH guidance was therefore applied. It should be acknowledged that avoidance rates for this species are likely considerably higher.

Weighted collision risk values for low and high dynamic operation speeds and pitch angles were also calculated to examine the impact of these variables on collision risk. These results emphasise how collision risk will vary with wind speed over time at Bracklyn Wind Farm.

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APPENDIX 8: OUTLINE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Bracklyn Wind Farm Limited

Bracklyn Wind Farm

Co. Westmeath & Co. Meath

OUTLINE CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

September 2021

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DOCUMENT APPROVAL

PROJECT	Bracklyn Wind Farm, Co. Westmeath & Co. Meath	
CLIENT / JOB NO	Bracklyn Wind Farm Limited	6175
DOCUMENT TITLE	Outline Construction Environmental Management Plan (CEMP)	

	Prepared by	**Reviewed**	**Approved by**
Document **Draft**	Name Jody Gormley	Name Sarah Moore	Name John McElvaney
Date 14th May 2021	Signature	Signature	Signature

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Date 9th September 2021	Signature	Signature	Signature

BRACKLYN WIND FARM, CO. WESTMEATH

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

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TECHNICAL SCHEDULES

1 INTRODUCTION

1.1 Background to Report

Jennings O'Donovan & Partners Limited (JOD), on behalf of Bracklyn Wind Farm Limited has prepared this outline Construction Environmental Management Plan (CEMP) for the proposed Bracklyn Wind Farm (the Development). This document has been prepared on a preliminary basis and will be further developed and expanded following the appointment of the Contractor for the main construction works. Some items of this outline CEMP can only be finalised with appropriate input from the Contractor who will actually carry out the construction works. This outline CEMP identifies for the incoming Contractor, the key environmental requirements that must be adhered to in order to deliver optimum environmental reassurance for the site.

1.2 Planning History

Retention permission was granted by Westmeath County Council on 14th October 2020 for an existing 80m meteorological mast at the site. There have been three other planning applications made in the site within the last 15 years, pertaining to the existing farm enterprise. These are as follows:

- A planning application for a pig rearing unit which was lodged on 14th August 2008, that was subsequently withdrawn.
- Retention permission granted by Westmeath County Council on 8th April 2009 for a 4550m^3 slurry storage tank and external sump at the site.
- Planning permission granted by Westmeath County Council on 22nd April 2009 for a pig rearing unit to accommodate 744 sows, facilities to rear weaners to 30kgs, staff facilities, installation of a proprietary wastewater treatment system, percolation area and the carrying out of all ancillary site development works.

1.3 Construction Environmental Management Plan (CEMP): Aims & Objectives

This outline Construction Environmental Management Plan (CEMP) has been developed in accordance with the Institute of Environmental Management and Assessment (IEMA) Practitioner "*Environmental Management Plans*", Best Practice Series, Volume 12, December 2008.

The principal objective of this outline CEMP is to avoid, minimise and control adverse environmental impacts associated with the development of Bracklyn windfarm. As such, the Contractors commit to safeguarding the environment through the identification, avoidance and mitigation of the potential negative environmental impacts associated with the development, construction, operation and decommissioning of Bracklyn Wind Farm.

This outline CEMP aims to define good practice as well as specific actions required to implement mitigation requirements as identified in the Environmental Impact Assessment Report (EIAR), the planning process and/or other licensing or consenting processes.

The outline CEMP will be developed further and / or amended where necessary, subsequent to planning consent, to take account of planning condition requirements and any information which may be made available from additional consultations, site surveys etc.

The CEMP will form part of the contract documents for the main Civil Construction works. The Civil Works Contractor will take account of the structure, content, methods and requirements contained within the various sections of this outline CEMP when further developing this document (to include environmental plans) as required by the Contract.

While this outline CEMP provides a benchmark for good practice, where avoidance or further minimisation of risks to the environment can be demonstrated through use of alternative methods or improvements to current practices, the Contractor will implement these wherever possible, subject to approval from environmental monitoring personnel.

1.4 CEMP Development & Implementation

The outline CEMP has been prepared to accompany a planning application for the proposed Bracklyn Windfarm. It is a live document on site and will be further amended where necessary, subsequent to planning consent. This outline CEMP may also be updated by the Contractor with site specific method statements and plans as required prior to each phase of the works. It is also effectively a document management system for recording information and data relating to environmental checks, reports, surveys, monitoring data and auditing. Upon completion of the construction works, the Contractor will submit a complete electronic copy of the final CEMP to the client for their records. This final CEMP will include electronic scans of all hard copy reports, data, field records and correspondence which are gathered over the course of the construction works.

While version numbers will remain fixed depending on the stage of the project, it is acknowledged that the CEMP is a continually evolving document which can be updated in part or whole, at any stage of the project. Hence, revision and document distribution records are included at the front of each CEMP document to enable individual documents to be updated at any time. A summary of the CEMP development process and the required input from the main parties involved in the planning and construction of the wind farm are indicated in Figure 1.1.

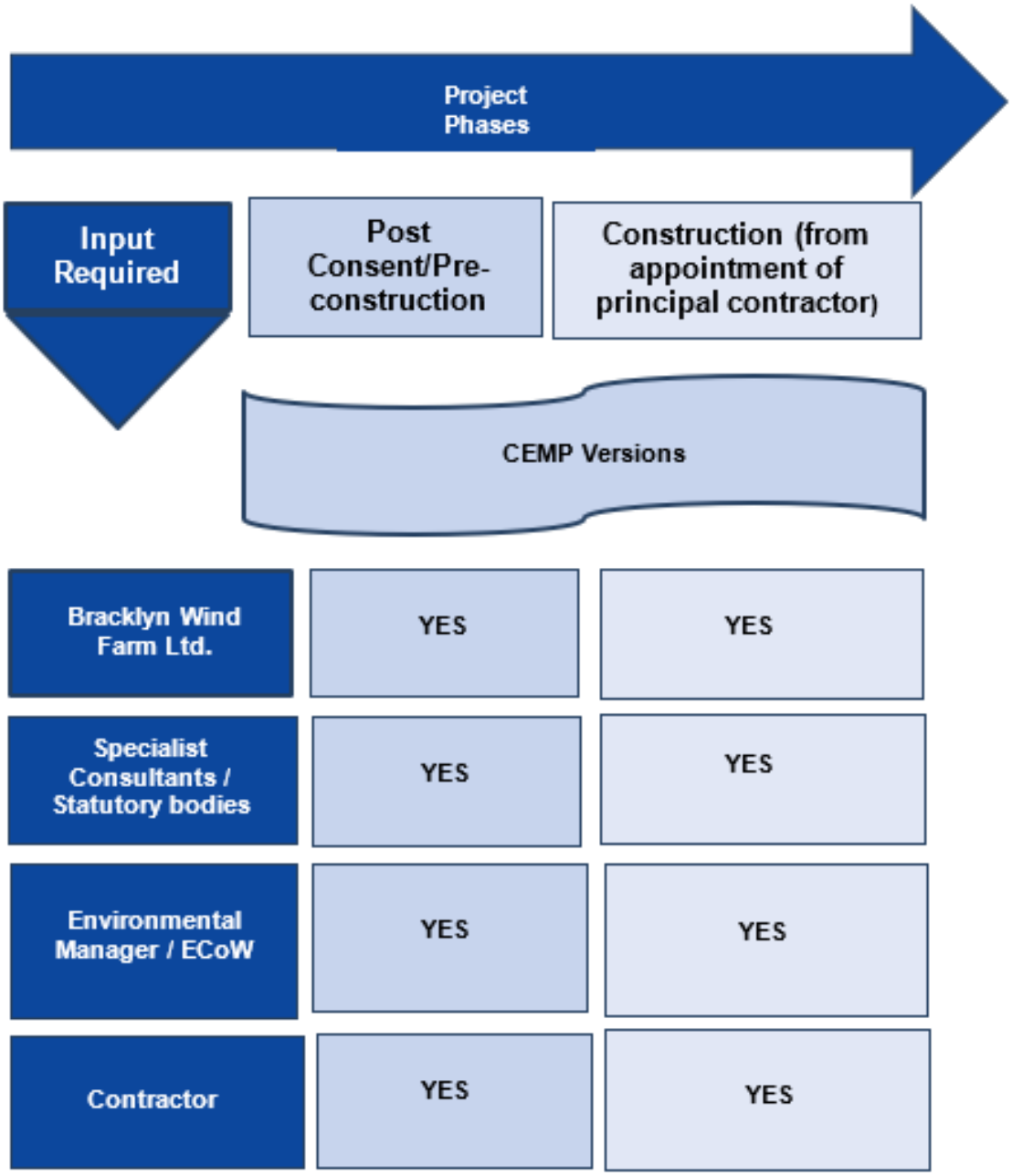

Figure 1.1 Summary of CEMP development process (CEMP Roles & Responsibilities)

This outline CEMP has been prepared by JOD on behalf of Bracklyn Wind Farm Limited for use by the appointed Contractor. The Contractor will be responsible for further development of the CEMP in line with planning condition requirements and other relevant licenses and consents. This may involve liaison with statutory bodies where appropriate.

Prior to commencement of construction works, the Contractor will identify a core Environmental Management Group, comprising of specific project personnel and an independent Ecological Clerk of Works (ECoW) and Environmental Manager. The Environmental Management Group will meet monthly to discuss the monthly environmental report and will advise site personnel on areas where improvements may be made on site. The group will draw on technical expertise from relevant specialists where required, including the Resident Engineer (R.E.), and will liaise with other relevant external bodies as required.

The Contractor will appoint an Environmental Manager (EM) who will be responsible for coordination and continued development of the CEMP and any other surveys, reports or method statements required. In conjunction with the ECoW, the EM will also review the Contractors method statements and environmental plans as required by the CEMP, carry out compliance auditing during the construction phase and coordinate the Environmental Management Group and required liaisons between Bracklyn Wind Farm Limited., the Contractor, the Planning Authority and other statutory authorities.

The Contractor will appoint an ECoW. The main roles and responsibilities of the ECoW relate to compliance monitoring with the CEMP and planning conditions and advice provision in relation to ecological matters. The ECoW will also assist the EM.

1.5 CEMP Structure

The CEMP is divided into discreet Sections which are designed to be filed as separate documents / folders if required. A copy of the CEMP documents / folder(s) will be kept in the site offices for the duration of the site works and will be made available for review at any time. The Contractor's EM will be responsible for the CEMP and will keep all sections updated throughout the construction phase.

Where the Contractor has standard documents within his own company / corporate Environmental Management Plans which cover a particular requirement of this CEMP, these will either be inserted or cross referenced within the relevant Section of this CEMP.

The CEMP Sections are listed in Table 1.2 as follows:

TABLE 1.2: CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP): Document Structure

Section	Title & Brief Description	Contractor Development Required
1	Introduction	No (Information purposes only)
2	Project Information Provides details on site location, scheme description and a summary of the environmental sensitivities at the site in Table 2.1 (as derived from the Appropriate Assessment Screenings and other information where available). Any documents prepared by or on behalf of Bracklyn Wind Farm Limited will be recorded in Table 2.3. which contains a record of all Scheme Amendments and a Register of Variations.	Yes Any documents prepared by the Contractor will be recorded in Table 2.3 and inserted in the CEMP where necessary. Any Scheme Amendments and / or Variations to the CEMP required during the works will be recorded by the Contractor in Tables 2.4 and 2.5.
3	Environmental Communications Plan Contains details on specific requirements relating to: • Contact details for Bracklyn Wind Farm Limited personnel, technical specialists, Contractor personnel, regulators, landowners, other stakeholders etc; • Meetings, reports and consultations; • Roles and responsibilities; and • General reporting procedures and tasks.	Yes The Contractor will: i) Insert contact information for regulatory authorities and other stakeholders (where not already provided) into Table 3.1 ii) Refer to Table 3.2 for details on requirements for meetings, reports and consultations iii) Insert information on Contractor appointments and responsibilities relating to environmental management and implementation of this CEMP into Table 3.3. iv) Refer to Figure 3.1 for a summary of the main communication lines.
4	Correspondence, Records, Reports This Section relates to document control and retention of records. The information at the start of Section 4 provides: • A list of all documents to be retained / filed within the CEMP. Table 4.1 provides a record of all Environmental Consents, Licenses and Permits issued for the project.	Yes The Contractor will complete Table 4.1. Throughout the duration of the Contract, the Contractor will insert / file all communication records, data, field records and reports associated with Environmental Management and implementation of this CEMP into this Section 4. This Section may be sub-divided into sub-folders for specific information relating to discrete areas of Environmental Management (such as waste management, pollution prevention, water quality monitoring, ecology etc). Alternatively, this information may be filed within the individual Technical Schedules in Section 5. The filing method selected by the Contractor will be made explicit at the start of Section 4.
5	Appendices	No.

TABLE 1.2: CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP): Document Structure		
Section	**Title & Brief Description**	**Contractor Development Required**
	Appendix A - Drawings	The Contractor is not required to develop the Appendices to this document. The Appendices are reference documents provided for information purposes.
6	Technical Schedules & Available Information Technical Schedules include the following: TS1 Environmental (Incident and Emergency) Response Plan (ERP) TS2 Surface Water Management Plan (SWMP) TS3 Water Quality Monitoring Plan (WQMP) TS4 Spoil Management Plan (SMP) TS5 Waste Management Plan (WMP)	Yes The Contractor is required to develop the Technical Schedules and/or include additional information or method statements as appropriate and where required by the Contract. The development of the Technical Schedules will generate more site specific documents which address particular environmental management procedures applicable for works in specified areas of the site. These Technical Schedules form the Contractor's Environmental Plans (for example, Waste Management Plan). Table 5.1 lists all Technical Schedules and provides information on Contractor responsibilities.

2 PROJECT INFORMATION

2.1 Site Location and Scheme Description

The Wind Farm and Grid Connection project is located within the townlands of Bracklin, Co. Westmeath and Coolronan, Co. Meath. The site is approximately 5.3 km north of Raharney village and approximately 4.7 km south of Delvin village, Co. Westmeath.

The proposed wind farm and electricity substation is located entirely within a single landholding; while ancillary elements of the overall development, including grid connection infrastructure and haul route upgrade works, are located on both private lands and within the public road network.

Current land use within the proposed wind farm site is predominately agricultural grassland, with small pockets of deciduous woodland and conifer tree plantations. The wind farm site is bordered by intact raised bog to the north, east and south, and with grassland to the west. Much of the grassland along the periphery of the proposed wind farm site is reclaimed cutover raised bog.

The proposed development comprises of 9 no. wind turbines (T1-T11, excluding T8 & T9) and all associated development works to accommodate their installation, operation, maintenance and the export of electrical power to the national grid. This will include a permanent meteorological mast 104m in height, site access tracks, foundations, hardstanding areas, underground cabling, single storey substation, accompanying equipment and compound area. Elevations for the turbine locations within the site range from 79m AOD at T6 and T7 to 93m AOD at T3. The Overall Site Layout Drawing No. BRK_PAS_LOC_002, Rev 0 is attached in Appendix A.

TABLE 2.1 Turbine Coordinates (Irish Transverse Mercator [ITM])

Turbine Base	Easting ITM	Northing ITM
T1	660970	759136
T2	660780	758679
T3	660893	758066
T4	661188	757707
T5	660780	757320
T6	661425	758849
T7	661617	758418
T10	662349	758514
T11	662153	758072

3 ENVIRONMENTAL CONTROLS

3.1 Use of CEMP

Prior to the commencement of construction works the contractor will draw up a detailed Construction Management Plan which will incorporate this outline CEMP. This outline CEMP is informed by mitigation measures set out in EIAR and associated documents and by the guidance documents and best practice measures listed below. This outline CEMP will be adhered to and further developed by the Contactor and will be overseen by the project representative/foreman.

The contractor will be required to supply a detailed Construction Management Plan for proposed activities on site which demonstrate how the environmental controls outlined in the following sections are to be achieved on site. This Construction Management Plan will be subject to review and will be agreed in advance of any works taking place on site. In some instance, with reference to works which may present a risk of sediment release, Inland Fisheries Ireland (IFI) will be consulted with respect to the development of the Construction Management Plan.

The following documents should contribute to the Construction Management Plan supplemented by specific additional measures proposed below:

- Forestry and Water Quality Guidelines-Forest Service (DMNR, 2000)
- Forestry and Freshwater Pearl Mussel Requirements- Site Assessment and Mitigation Measures (Forest Service, 2009);
- Forest Operations & Water Quality Guidelines (Coillte, 2009)
- Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water (IFI, 2016).

3.2 Human Beings and Community

3.2.1 Employment and Local Investment

During the 15-18 month construction phase of the proposed development, there would be economic effects resulting from expenditure on items such as site preparation, access roads, purchase and delivery of materials, plant, equipment and components.

Procurement of goods and services are likely to have a significant positive effect on the local economy.

3.2.2 Land Use

The proposed development site forms part of operational farm holdings and is owned by a number of private land owners.

The legal agreements include a suite of measures designed to minimise any likely land use effects including the clear identification of lands which may be subject to development, measures to ensure that disturbed lands are reinstated appropriately and returned to agricultural use insofar as possible, and provision for the use of proposed access tracks by landowners during the operational phase of the proposed development. Measures to facilitate the safe continuation of agricultural operations during the construction phase have been developed. This will include fencing and signage to be provided by the Contractor.

3.2.3 *Tourism and Recreation Assets*

The site shall be available for use as a recreational facility. Existing access tracks are, on occasion, used by local residents for walking/cycling and the upgrade of existing access tracks and construction of new tracks will improve the amenity value of the site. The Contractor shall manage public access during the construction period. This may involve fencing off areas of the site where mobile plant are active or where large components are being lifted or where other potential safety risks have been identified.

The Contractor will develop measures to ensure that local residents are informed of the construction work including the location and duration of temporary road closures and the identification of alternative routes during the construction works.

3.2.4 *Accidents or Natural Disasters*

As set out within **Chapter 6** and **Chapter 7** of the EIAR, the proposed development is not recognised to be a likely source of pollution during either the construction or operational phases, predominately due to the limited volume of hydrocarbons stored on site and the bunding arrangements to ensure that spillages do not occur. In the event of an accident on-site, mitigation measures set out in the above chapters will ensure that significant environmental effects do not occur.

There is limited likelihood for significant natural disasters to occur at the proposed development site. The potential natural disasters that may occur are therefore limited to flooding and fire. The risk of flooding is addressed in **Chapter 7** of the EIAR. Fluvial flooding of any significance is not anticipated for the wind farm site. However, there is potential for increased fluvial flood risk at the end mast locations on the grid connection. Within **Chapter 4** of the EIAR, it is considered that the risk of significant fire occurring, affecting the proposed development and causing it to have significant environmental effects is limited. One of the core mitigation by design features of the proposed development, maximising the distance to residential dwellings, further limits any likelihood of significant human health effects as a result of accidents or natural disasters.

The proposed development site is not regulated by, connected or proximate to any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations (i.e. sites regulated in accordance with the SEVESO Directives) and so there is no likelihood for cumulative effects or interactions with any such site.

3.2.5 *Community Benefit Funds and Community Investment*

The operation of the proposed wind farm will bring about a number of financial benefits to the community. These include investment opportunities, community benefit funds, contributions to local resident energy costs, payment of business rates to Westmeath County Council and rental income accrued by involved landowners.

3.2.6 *Noise*

During the construction and operational phases of the proposed development, noise levels sufficient to cause noise induced hearing damage or sleep disturbance are not likely to occur. The full results of this assessment are presented in **Chapter 11** of the EIAR, Noise and Vibration. Controls on construction noise are outlined in Section 3.8 of this CEMP.

3.2.7 *Lighting protection*

Appropriate lightning protection measures are incorporated in modern wind turbines to ensure that lightning is conducted harmlessly past the sensitive parts of the nacelle and down into the earth.

Lightning protection is also incorporated into the design of the proposed electricity substation.

3.2.8 *Ice Fall*

In extremely cold climates or at high altitude, ice can potentially build up on blades or other parts of the turbines. Ice can potential fall off and cause injury although there is no experience of any such incident in Ireland. Most modern turbines are fitted with anti-vibration sensors, which will detect any imbalance caused by the icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation. All occupied/habitable properties in the vicinity of the proposed wind farm are located well in excess of 500m from a proposed turbine and therefore there is no likely impact in respect of ice throw.

The Contractor(s) shall manage employees and the public so as to avoid a defined zone around turbines during weather when ice could potentially form on blades.

3.2.9 *Electromagnetic (EMF) Interference*

The proposed grid connection electricity lines will comply with international guidelines for EMF. The cables will also comply with EU guidelines for human exposure to EMF. The proposed substation is located well away from any residence with no possible EMF impact. The substation when operational will also comply with EU guidelines relating to exposure to EMF.

3.2.10 *Shadow Flicker*

Shadow Flicker is assessed in detail in **Chapter 12** of the EIAR. There will be no significant residual shadow flicker impacts arising from the proposed development. Mitigation measures will ensure that any residual effects are within the acceptable limits.

3.3 Ecology

3.3.1 *Approach*

All mitigation measures have been developed in the context of national and international legislative guidance for the protection and management of flora, habitats of conservation importance, fauna and aquatic ecological interest. The description of mitigation measures is provided in terms of mitigation by avoidance, reduction and remediation.

An Operational Phase Environmental Management Plan will also be drawn up and implemented and will be agreed with the relevant statutory bodies. Monitoring of wildlife and efficacy of the mitigation measures will be undertaken during and post construction.

3.3.2 *Statutory Protected Sites*

Proposed mitigation measures, required to prevent adverse effects on downstream Natura 2000 sites during construction, are outlined in the Natura Impact Statement (NIS) for the proposed development. The mitigation measures included in the NIS relate to protection of water quality flowing into the River Boyne and River Blackwater SAC and SPA. Figure 3.1 (taken from Figure 5.2 of the EIAR) shows the location of Natura 2000 Sites within 15km of the proposed development.

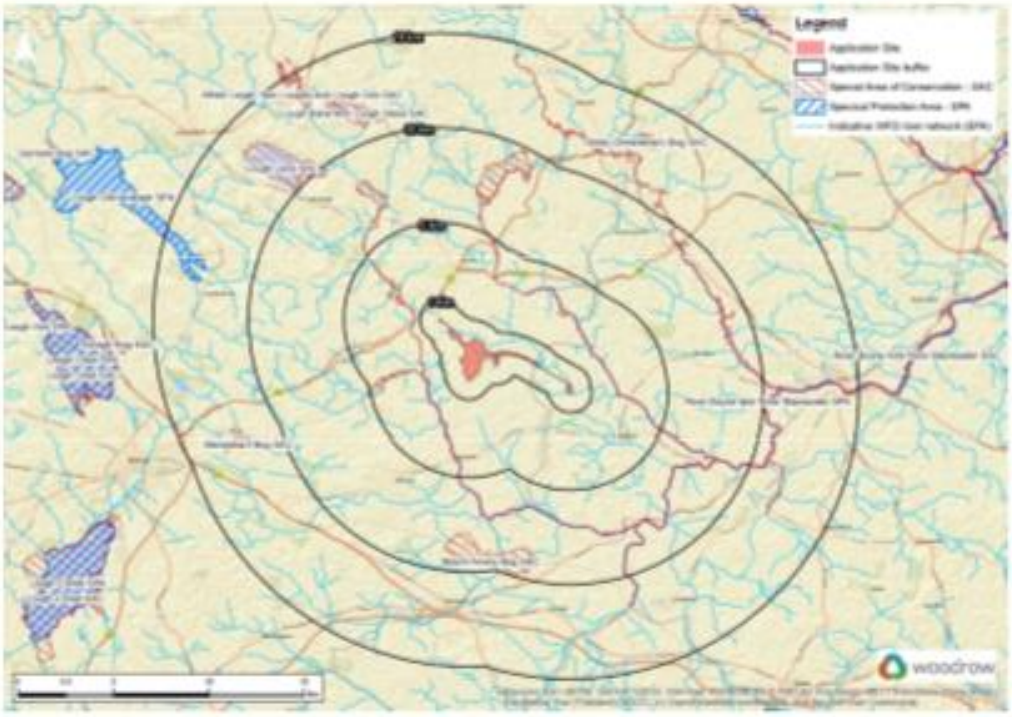

Figure 3.1 – Location of Natura 2000 Sites Within 15km of Proposed Development (Reproduced from Figure 5.2 of the EIAR)

The mitigation measures proposed are taken from **Chapter 7 of the EIAR** and are designed to avoid adverse effects on local watercourses and groundwater. If these measures are implemented in full, they will ensure avoidance of impacts on the Natura 2000 sites, and the Qualifying Interests (QIs), including river lamprey, Atlantic salmon, otter and kingfisher. Mitigation measures provided in the NIS include:-

- Avoidance of sensitive aquatic areas where possible by implementing a 50m construction buffer zone. Note: The majority of the proposed development (including all turbine locations) are located outside of areas that have been assessed to be hydrologically sensitive, apart from some sections of access track, the T7 hardstand, a section of the construction compound along, the north-western corner of the substation, sections of the grid connection route and locations of watercourse crossing.
- As described in **Chapter 3 of the EIAR**, specific mitigation measures, incorporated into the design of the development and through implementation of best practice methodologies will be employed where work inside buffer zones is proposed.
- Works for stream crossings will be carried out during the working window for instream works. This working window is defined by Inland Fisheries Ireland (IFI) as July to September to avoid vulnerable spawning salmonids/lamprey that may be present in downstream environments outside

of this window. Any works outside of this period would require a derogation under the Local Authorities (Works) Act, 1949;

- There will be no crossing of rivers or streams by machinery during the construction phase, other than by constructed access routes, and all machinery must remain within the works corridor and utilise designated access routes;
- There will be no direct dewatering to watercourses during the construction phase. All outflows from drainage associated with construction will be by diffuse overland drainage at appropriate locations and through settlement ponds;
- For locations where works will be undertaken within water protection buffer zones (i.e. within 50m of watercourses), double silt fences will be installed around the watercourse to prevent sediment/silt infiltration into the watercourse;
- Cement leachate, hydrocarbon oils and other toxic poisonous materials will require full containment and will not be permitted to discharge to any waters, and control measures to be place will include:-
  - Appropriate bunded storage area for storage of fuels/oils, with onsite storage of hydrocarbons to be kept to a minimum;
  - Mobile double skinned fuel bowser will be used for re-fuelling on-site;
  - No refuelling will be permitted at works locations within the 50m hydrological buffer;
  - Spill kits will be readily available to deal with any accidental spillage;
  - There is an outline emergency plan for the construction phase to deal with accidental spillages;
  - Ready-mixed concrete will be brought to site, with no batching of wet-cement products occurring on site;
  - Where possible pre-cast products will be installed, including all watercourse crossings;
  - Use of wet-cement products within the hydrological buffer will be avoided, insofar as possible;
  - Lined cement washout ponds will be used for chute cleaning, with minimal volumes of water being imported onto the site;
  - No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be permitted; and
- Wastewater emanating on-site (sewage, waste-water from site office) will be taken off-site for disposal/treatment at controlled facilities. To this effect, welfare facilities for construction site workers will include self-contained port-a-loos with an integrated waste holding tank. No water will be sourced on the site, nor will any wastewater be discharged to the site.

Chapter 7 of the EIAR also provide details of the Sustainable Drainage Systems (SuDS) that will be implemented to manage surface water taking account of water quantity (flooding), water quality (pollution) and biodiversity (wildlife and plants). This SuDS will adopt the following elements:-

- Open constructed drains for development run-off collection and treatment;
- Infiltration interception drains for upslope 'clean' water collection and dispersion;
- Flow attenuation and filtration check dams to reduce velocities, with consideration given to gradient with drains to determine spacing requirements; and
- Settlements ponds and buffered outfalls to control and store development runoff to allow settlement prior to discharge at Greenfield runoff rates. No outflow will be permitted directly into natural watercourses.

The site drainage and attenuation system will be installed prior to the main construction activities, and includes excavation of drainage ditches and installation of settlement ponds and soakaways. The site-specific drainage scheme is required to attenuate, hydraulically (flow) and hydrochemically (pollutants), the projected increase in runoff of *c*. 20.4 m^3/day (worst-case scenario) that will arise from the creation of additional areas of hardstanding.

Chapter 7 of the EIAR also provides details of management of soil/peat deposition areas to avoid impacting on water quality including:-

- Both proposed spoil deposition areas are located outside the 50m stream buffer zone;
- Silt fences, straw bales and biodegradable matting will be used to control surface water runoff for deposition areas; and
- Deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff

Other measures include:-

- In order to avoid run-off of silt-laden water impacting upon water quality within surface water features adjacent to the works corridor, reinstatement works including measures to re-vegetate disturbed areas through re-seeding and/or placement of saved turves will be undertaken immediately after construction works;
- During construction, turves will be stored separately from spoil (soil/rock). Separate storage of turves will ensure vegetation is not significantly damaged and that turves can be replaced as a top-mat to facilitate rapid re-instatement of the surface vegetation, thereby significantly reducing the likelihood of soil erosion and the likelihood of silt laden surface waters affecting water quality;
- To ensure control measures are implemented appropriately, an Ecological Clerk of Works (ECoW) and Environmental Manager will be employed for the duration of the construction works; and
- Monitoring of water quality during construction will be undertaken as outlined in Technical Schedule 3 – Water Quality Monitoring Plan.

3.3.3 *Important Habitats*

As described in Section 5.3.4 of the EIAR Semi-natural woodland habitats assessed as Local Importance (Higher Value) to Regional (County) Importance were identified during site surveys and the initial site layout was re-designed to avoid these areas. This iterative design process, described further at **Chapter 2 of the EIAR**, included the omission of 2 no. turbines and revising the configuration of ancillary infrastructure to avoid areas of bog and natural/semi-natural woodland. These design iterations also assessed the requirement for felling to implement bat feature buffers around several turbines, which have been designed to avoid impinging on natural/semi-natural woodland. There are 2 no. locations where the proposed bat feature buffers would extend into important woodland habitats, including Annex I bog woodland at T10 and oak-birch-holly woodland at T11. However, these areas of woodland will be retained and additional post-construction monitoring for bats will be undertaken at these locations to determine if the residual habitat feature draws bats towards the rotor swept area (see **Section 5.6.1.6 of the EIAR**).

Figure 3.2 (taken from Figure 5.1 of the EIAR) shows the location of wind farm infrastructure relative to Bracklin Wood and Lisclogher Bog.

Figure 3.2 – Location of Wind Farm Infrastructure Relative to Bracklin Wood and Lisclogher Bog (Reproduced from Figure 5.1 of EIAR)

The proposed development was designed to utilise existing agricultural/forestry access tracks and the infrastructural footprint largely targets lower value habitats including tillage, improved grassland and commercial monocrop plantations. Likewise, areas where felling is required to implement bat feature buffers generally comprise commercial forestry and the lengths of treelines and hedgerows to be removed has been kept to a minimum. Similarly, the number of locations where access tracks are required to intersect hedgerows/treelines has been limited thus minimising the extent of hedgerow/treeline removal.

Habitat types are assessed in Section 5.3.4 of the EIAR. Table 3.1 below presents a summary of the habitat types within the proposed development site and which have potential EU Annex 1 Affiliations.

TABLE 3.1 – SUMMARY OF HABITAT TYPES (REPRODUCED FROM TABLE 5.17 OF THE EIAR)

Code	Fossitt (2000) habitat type	Potential EU Annex I Affiliations	Areas (ha) or Length (m)			Occurrence within construction corridor/operational footprint
			Grid route	Wind farm site	Total	
BC1	Arable crops	No		82.98ha	82.98ha	T2 and T3 including access tracks, met mast, large deposition area, temporary site compound.
BL3	Buildings & artificial surfaces	No	0.25ha	4.08ha	4.33ha	Concrete and gravel roads through site (including the area of piggery). Houses and tracks along grid connection route (excluding the local metaled road along the grid route).
ED3	Recolonising bare ground	No	0.001ha		0.001ha	Adjacent to grid connection route
FW4	1st to 3rd order steams As shown by EPA mapping – indicative flow network classified as FW4 as most sections are highly channelised and therefore does not strictly fit criteria for FW2-Depositing/lowland river Drainage ditches	No	1,143m 471m	2,127m 10,232m	3,270m 10,703m	Main channel through the Site is the Bolandstown (1st/2nd order stream), which joins Carranstown (3rd order) stream where the grid connection route crosses into Co. Meath. Access tracks run adjacent to this channel, as do sections of grid connection route. There are 4 no. of cross points and the T7 hardstand extends across the channel. Site drained by extensive network of ditches all flowing into the main channel – access tracks and grid connection route cross or run next to drains, with felling areas around turbines and substation occurring areas with or next to drains.
FL8	Other artificial lakes & ponds	No		0.19ha	0.19ha	Ecologically poor, ephemeral scrape that will be used as a location for spoil deposition. Area of depression reported, with the maximum extent of the wet area much smaller at 0.06ha.
GA1	Improved grassland	No	25.658ha	45.236ha	70.89ha	T1, sections of access tracks to T5 and T11, grid connection route.
GA2/WS3	Amenity grassland & Ornamental-non-native shrubs	No	0.15ha		0.15ha	Gardens along grid connection route (not in proposed development site)
GS2	Dry meadow & grassy verges	No	0.87ha	0.78ha	1.65ha	Along roadside stretches grid of connection route and existing farm/forestry tracks

TABLE 3.1 – SUMMARY OF HABITAT TYPES (REPRODUCED FROM TABLE 5.17 OF THE EIAR)						
Code	**Fossitt (2000) habitat type**	**Potential EU Annex I Affiliations**	**Areas (ha) or Length (m)**			**Occurrence within construction corridor/operational footprint**
			Grid route	**Wind farm site**	**Total**	
PB4	Cutover bog	Possibly	0.48ha		0.48ha	Adjacent to grid of connection route
		[7150] Depression on peat substrate of the Rhynchosporion				
WD1	Mixed broadleaved woodland – older *growth/semi-natural*	No		4.72ha	4.72ha	Substation and ring fort at T3, also adjacent to access tracks in places and adjacent to grid connection route
WD1	Mixed broadleaved woodland - *plantation*	No		21.78ha	21.78ha	T4, turbine felling areas for T4, with small areas at T6, T7
WD4	Conifer plantation	No		57.68ha	57.68ha	T5, T6, T7, T11, access tracks to T1, T5, T6, T7, T10, T11, substation, turbine felling areas for T5, T6, T7, T10, T11
WN1	Oak-birch-holly woodland	Unlikely [91A0] Old sessile oak woods with Ilex & Blechnum in the British Isles	0.03ha	6.95ha	6.99ha	Felling area for T11 (unless avoided) and small area in felling area for T10, small sections on grid connection route
WN7	Bog woodland - *Non-Annex I*	No	1.32ha	3.89ha	5.21ha	Felling area at T10, start of grid connection route exiting wind farm site east of T10, with some areas adjacent along other sections of grid route.
WN7 – Annex 1	Bog woodland – *Annex I*	Yes [91D0] *Bog woodland - small area south of T10		0.199ha	0.199ha	Small area within turbine felling area for T10, unless avoided
WS1	Scrub	No	0.05ha		0.05ha	Adjacent to grid of connection route (not in proposed development site)
WS5	Recently felled woodland	No		3.45ha	3.45	T10, within felling area for T10
WL2	Hedgerow	No	464m	601m	1,065m	Adjacent to T3 access track, grid connection route
WL2	Treeline	No	1,092m	6,810m	7,902m	Felling areas for T4, T5, T7, access tracks, adjacent to grid connection route.

Potential damage to sensitive habitats adjacent to proposed site infrastructure, has largely been avoided; as construction for the majority of the proposed site access tracks will involve upgrading existing forestry and farm tracks. Likewise, the majority of internal site cabling will be buried directly adjacent to or within the existing tracks. For sections of newly proposed access track, a 5m buffer from woodland and treelines has been implemented within which there will be no excavation work, tracking of heavy plant or storage of materials. Measures required to protect watercourses (e.g. erection of silt fence) will be permitted. If for unforeseen circumstances during the course of construction works any of these activities are required to occur within the buffer an appropriately qualified arboriculturist will undertake a pre-construction assessment to ensure impacts to vegetation are avoided. This 5m treeline/woodland buffer will be implemented along sections of access track running in improved grassland to T10/T11 and from T4 to T5.

To avoid widespread disturbance to habitats, access within the proposed development site will be restricted to the footprint of the proposed works corridor and no access between different parts of the proposed development will be permitted, except via the proposed works corridor. An ECoW will be employed throughout the construction phase to ensure that construction activities do not encroach, unnecessarily, into any important habitats.

3.3.4 Non-native and Invasive Species

The presence and distribution of non-native species within the proposed development site were identified and mapped during walkover surveys (see **Section 5.3.4.1 of the EIAR**). No Third Schedule invasive species were identified; however, best practice guidelines will be employed during construction to ensure that non-native species are not spread and, where feasible, are controlled. In particular, it is proposed to implement measures to control the presence of cherry laurel between turbines T10 and T11. Details of proposed measures to control cherry laurel are provided within the Habitat Management Plan at **Annex 5.6 to the EIAR**.

To avoid non-native species being introduced to the site, quarry material will be sourced from licensed quarries, and certification that materials do not contain invasive species will be required. A pre-construction walkover survey of the works corridor will confirm the presence of any invasive non-native species that may have escaped into the area since the baseline surveys were conducted.

3.3.5 *Birds*

From vantage point surveys, it was observed that the site had low densities of use by waterbird species.

Usage of the wind farm site by raptor species of higher conservation concern, including hen harrier, goshawk, merlin and peregrine was found to be very low, with no breeding or roosting sites located within the 2 km turbine buffer. A barn owl breeding site was located within 1.4km of the closest proposed turbine, with another possible site c. 3.5km to the north.

Apart from snipe, woodcock and a failed lapwing breeding attempt, no other notably sensitive breeding species, were recorded within or directly adjacent to the proposed works corridor. All snipe breeding activity was found to be beyond the zone of influence for construction activity and operational displacement effects.

A detailed list of species observed over a two-year period is presented in **Table 5.2.2 of the EIAR**.

As part of the iterative design process (embedded mitigation), areas of old growth woodland have been avoided and will be retained. These areas were identified as important for woodland birds, especially breeding woodcock as well as a range of Amber listed breeding passerines.

To avoid widespread disturbance to birds, access within the proposed development site will be restricted to the footprint of the proposed works corridor and no access between different parts of the site will be permitted except via the proposed works corridor. Measures proposed at **Section 5.5.1.1 of the EIAR** to protect water quality will avoid adverse effects on birds that rely on downstream aquatic habitats, such as grey wagtail and kingfisher.

To avoid direct and indirect disturbance to breeding birds, the following restrictions on timings of construction works will, where feasible, be applied:-

- Construction will be timed to commence outside the bird breeding season (March to August inclusive). This does not preclude construction continuing during the breeding season, but would allow sensitive bird species to choose nesting sites away from sources of potential disturbance;
- Where removal of suitable nesting habitat is required to facilitate the works, habitat clearance works will be undertaken prior to the 1st March in the construction year;
- Vegetation removal required for creation of bat feature buffers around turbines will be undertaken outside the bird breeding season;

- Once vegetation has been removed within the works corridor, these areas will be retained in a condition that limits suitability for nesting birds for the remainder of the construction phase. Any areas of potential cover, particularly cover for ground nesting species, will be rendered unsuitable by cutting vegetation or tracking over with an excavator;
- Should the clearance of vegetation suitable for nesting birds be required during the bird breeding season, the relevant vegetation will be surveyed in advance by the ECoW (with ornithological survey experience);
- Any construction works proposed during the breeding bird season will be preceded by a survey and will ensure the implementation of buffer zones (if nests/territories are identified) and measures required in order to avoid disturbance. Particular attention will be given to sensitive bird species (including breeding raptors and waders); and
- If works are scheduled to commence in February, a pre-construction visit will be required to monitor potential lapwing breeding sites in the tillage fields surrounding T2 and T3, as this species can be present on territories early in the season (late-February/early March).

3.3.6 *Mammals (excluding bats)*

The likelihood of effects on aquatic mammals, specifically otter foraging habitats, will be avoided through water quality protection measures as described at **Section 5.5.1.1 of the EIAR**.

The proposed development has been designed to minimise the impact on features which are important for mammals such as hedgerows and drains. Old growth woodland and treelines have been avoided insofar as possible. While commercial forestry will be removed, care has been taken to ensure that overall connectivity between existing woodland and linear features is retained throughout the construction and operational phases of the proposed development.

During the design phase of the proposed development, a badger main sett was located within the footprint of the proposed substation. The dimensions of the substation compound were altered to avoid directly affecting the sett and a set-back distance of 30m was imposed. Likewise, an outlier sett in an earth bank southwest of the T2 hardstand (see **Figure A5.8.1 at Annex 5.8 to the EIAR**) was avoided by re-aligning the access track to ensure a standoff of in excess of 30m was retained. There was also badger activity recorded at the southern end of the field, adjacent to the southern-most part of the spoil deposition area. An appropriate 30m standoff will be maintained from the spoil storage and the felling area for T4. Proposed excavation for cabling running along this tree line to the meteorological mast will be buffered by 30m from sett entrances.

It is acknowledged that the distribution of mammal resting places can change over time. Therefore, in order to avoid accidental disturbance during the construction phase, a pre-construction walkover survey of the proposed development site will be undertaken. If any mammal resting places are identified, then appropriate exclusion zone(s) will be implemented and construction activities will be timed to avoid sensitive periods for the species affected, i.e. the breeding season.

Likewise, inappropriately timed vegetation removal, required to implement bat feature buffers has the potential to directly affect the resting sites of borrowing and arboreal mammals. Although during baseline surveys, no mammal resting places were identified within the footprint of the proposed development or proposed felling areas, a pre-construction walkover survey will be undertaken prior to commencement of construction.

Pre-construction/felling surveys will cover all suitable habitat for protected mammals including within 50m of the works corridor for badgers and red squirrel, 100m for pine martin and 150m for otter. The aim of the surveys is to identify the resting sites of protect mammals and implement appropriate exclusion zone buffers, if required.

The following mitigation measures will be applied to avoid disturbance to badgers:-

During the breeding season (December to June inclusive), no construction works should be undertaken within 50m of active setts, nor blasting or pile driving within 150m of active setts.

Out of the breeding season (July to November, inclusive), the following restrictions will apply:

- No heavy machinery should be used within 30m of badger setts (unless carried out under licence);
- Lighter machinery (generally wheeled vehicles) should not be used within 20m of a sett entrance; and
- Light work, such as digging by hand or scrub clearance should not take place within 10m of sett entrances.

Disturbance to foraging mammals will be avoided by:-

- Construction works being largely limited to daylight hours thus allowing nocturnal animals like badgers and otters to forage through the night; and

- Minimising the risk of mammals becoming trapped if falling into excavations through the provision of egress points, e.g. placing escape planks or spoil runs.

3.3.7 *Bats*

The removal of vegetation is likely to impact on habitats utilised by roosting, foraging and commuting bats. **Annex 5.5 to the EIAR** provides a detailed discussion on, and assessment of, the likely effects on bats and proposed mitigation measures to avoid likely significant effects.

During the construction phase of the proposed development, mitigation largely focuses on avoidance of direct effects to roosting bats, with further consideration given to likely indirect effects on foraging/commuting habitats.

The iterative design process has, insofar as possible, avoided the removal of older growth treelines and woodland habitats likely to be utilised by roosting bats, as described at **Chapter 2 of the EIAR**.

While several trees/treelines were noted as supporting Potential Roost Features (PRFs) within the works corridor, no active roosts were identified during surveys. However, given that a period of time is likely to elapse prior to the commencement of construction, it is acknowledged that roosting bats could occupy PRFs, such as ivy clad trees with occasional holes/fissures. Therefore, pre-construction roost surveys will be undertaken to identify and protect any bats occupying roosts in vegetation earmarked for removal.

Any trees identified as supporting moderate to high PRFs within the works corridor will be targeted with further surveys, including emergence/re-entry surveys and/or roost inspections (using endoscopes and thermal imaging cameras). Surveys will determine occupancy, the type of roost (e.g. maternity, hibernation, mating, transitional), species using the roost and the level of occupancy. Surveys will be conducted by appropriately experienced ecologists.

For any occupied roost sites, where vegetation removal is proposed, these surveys will inform a derogation license application process (from the NPWS) to undertake appropriate mitigation actions, as required, to ensure the conservation of bats. Such actions could include measures to exclude bats from potential roost holes prior to vegetation removal and provision of alternative roost sites.

Trees requiring felling, and identified as having moderate-to-high PRF, where surveying proves inconclusive will be 'soft felled', as outlined in the NRA (2005) guidelines[1]. This procedure must be carried out in suitable weather conditions, at an appropriate time of year, and involves:-

- Removing the tree in sections, starting with the top branches and then working down the trunk trying to avoid cutting through cavities;
- Any sections with PRFs must be lowered with care and laid on the ground with potential entrances to roosts orientated upwards to allow bat to vacate the roost; and
- Sections must be left in situ for at least 24 hours in suitable weather conditions to allow any bats to disperse.

For any occupied roost sites where vegetation removal is not proposed, an exclusion zone will be implemented to prevent disturbance during times of occupancy as may be determined from **Table 5.28 of the EIAR**. The extent of the exclusion zone can be up to 30m for any notably disruptive works such as piling/rock breaking; however, this measure should be proportional to the disturbance levels emanating from the construction activity.

3.3.8 *Marsh Fritillary*

In Ireland the occurrence of this species is largely restricted to locations where the larval foodplant devil's-bit scabious (Succisa pratensis) occurs. The extent of devil's-bit scabious within the lands-made-available for the project was limited to a few very small patches and it was totally non- existent from areas occupied by the proposed development footprint based on lack of suitable habitat within the potential Zone of Influence, required and the proposed development site was assessed as unsuitable for this species.

3.3.9 *Fisheries*

The main drainage channel (modified stream) flowing through the proposed development site was found to be unsuitable for spawning salmon and lamprey. The proposed development site is at the

[1] NRA (2005). Guidelines for the Treatment of Bats prior to the Construction of National Road Schemes. Environmental Series on Construction Impacts, Transport Infrastructure Ireland - TII (formerly NRA), Dublin. Available at: https://www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Bats-during-the-Construction-of-National-Road-Schemes.pdf

upper reaches of a tributary of the Stonyford River that is subject to periodic drainage maintenance works. Drainage has a negative effect on the occurrence of white-clawed crayfish; and therefore, it is considered unlikely that species occurs in this watercourse.

Salmon and lamprey spawning habitat and white-clawed crayfish are noted as occurring downstream of the proposed development. White-clawed crayfish have been recorded from the catchment of the Stonyford River. Salmon and river lamprey are listed as Qualifying Interests (QIs) of the River Boyne and River Blackwater SAC. The healthiest population of river lamprey are reported as occurring in the lower reaches of the Boyne River main channel downstream of Navan and the Stonyford tributary was considered to only support brook lamprey. Salmon run the River Boyne almost every month of the year and the Boyne is considered important for this species. In-stream improvement works on the Stonyford River have created spawning habitat for salmon.

Other native fish species recorded from the Stonyford River include brown trout and eels, and non-native species including stoneloach and minnow.

The mitigation measures required for protection of fisheries are there as included in **Section 3.3.2 of this CEMP** for the protection of the River Boyne and River Blackwater SAC and SPA.

3.3.10 Monitoring Measures

3.3.10.1 Pre-Construction Ecological Monitoring

In order to avoid accidental disturbance to the resting places of protected mammals including badgers, otters, red squirrels and pine martens; construction activities will be preceded by an ecological walkover survey of the proposed works corridor, including the grid connection route and bat feature buffers..

Likewise, as outlined in Section **5.5.1.6 of the EIAR**, in order to limit accidental disturbance to bat roosts during construction; prior to works commencing trees within the works corridor previously assessed as supporting moderate to high PRFs will be re-assessed. Initially this will involve a ground level visual assessment, which will be followed up by inspections under licence and re-entry/emergence surveys, as required.

As detailed in Section **5.5.1.4 of the EIAR**, construction works conducted during the bird breeding season will require pre-construction nesting bird surveys to avoid disturbance breeding birds. If nests are identified ongoing monitoring will be implemented to ensure protection measures (exclusion zone

buffers) are implemented and to determine when works can processed, once the breeding attempted is completed.

3.3.10.2 Water Quality Monitoring

In order to verify the efficacy of pollution prevention and mitigation measures during construction, water quality monitoring will be undertaken in accordance with the proposals enclosed in **Technical Schedule 3 – Water Quality Monitoring Plan**.

3.3.10.3 Monitoring of Annex I Bog Woodland

Given the presence of Annex 1 habitats within the vicinity of the proposed development, it is deemed to be prudent to undertake monitoring to ensure that construction activities do not adversely impact on the quantity or quality of this habitat.

Prior to construction, eight permanent quadrats (10x10m squares) will be set up within the area of Annex I bog woodland between T10 and T11 for long-term vegetation monitoring.

During the construction phase, surveys will be repeated to ensure that the habitat is not impacted by construction works, especially by any drainage in the vicinity of T10 and the access track leading to T11.

Post-construction surveys will be undertaken in Years 1, 2, 3, 5 and 10.

Surveys will be undertaken by a suitably qualified botanist and at the optimal time of year for surveying bog woodland.

3.3.10.4 Monitoring of Bat Feature Buffers

The aim for bat feature buffers around turbines is to ensure that habitats are as featureless as possible to discourage foraging bats, as well as potential prey species for kestrels. Initially this will require regular monitoring in Years 1, 2 & 3 to ensure vegetation clearance measures and ongoing management result in the desired habitat conditions. Once the optimal conditions have been created (after Year 3) the habitat will continue to be maintained in this manner.

3.3.10.5 Bird Monitoring

Ornithological monitoring surveys will commence at the commencement of construction and will continue, post-construction, in Years 1, 2, 3, 4, 5, 10 &15.

Surveys will be conducted, in accordance with SNH guidance2, by a suitably experienced ornithologist and will include the following:-

- Vantage point surveys;
- Wider area breeding raptors surveys;
- Breeding season surveys of 500m turbine buffer; and
- Fatality monitoring (to be conducted conjunction with bat fatality monitoring.

3.3.10.6 Bat Monitoring

A three-year post-construction monitoring programme is proposed for bats (SNH et al. 2019), with monitoring in Years 1, 2 & 3. Monitoring is designed to evaluate the success bat feature buffers at reducing bat activity levels in the vicinity of turbines.

Bat activity surveys will be undertaken in Years 1, 2 & 3.

Fatality monitoring will be undertaken in Years 1, 2 & 3.

3.4 Soils and Geology

3.4.1 Description

Based on the GSI bedrock mapping (www.gsi.ie), the majority of the proposed development is mapped to be underlain by Dinantian Pure Unbedded Limestones; while the far eastern portion of the proposed wind farm site and section of the proposed grid connection are mapped to be underlain by Dinantian Upper Impure Limestones.

The southwestern corner of the WF site is mapped to be underlain by Dinantian Lower Impure Limestones.

Based on the GSI/Teagasc soils mapping (www.gsi.ie); the central, southern and western areas of the proposed wind farm site are mainly underlain by deep, well- drained mineral soils (BminDW) with cutover bog mapped on the northern and eastern portion of the site. The proposed electricity substation is mapped as being underlain by cutover peat.

[2] Scottish Natural Heritage (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms.

The soil type mapped along the proposed grid connection route is mainly cut peat with some peaty gleys towards the eastern side at the end mast location.

GSI subsoils mapping (www.gsi.ie) show that limestone tills are present in the central, southern and western areas of the proposed wind farm site and cutover bog mapped on the northern and eastern portion of the proposed wind farm site, including the location of the proposed electricity substation. Cutover bog is also mapped along the majority of the proposed grid connection route as well as the end mast locations. The subsoils at the haul route works areas are mapped as limestone tills.

Peat depths recorded (refer to **Annex 6.2** to the EIAR) from over 50 probes ranged from 0-2.5m with an average peat depth of 0.6m. 86% of the probes recorded peat depths of less than 1.0m with 95% of peat depth probes recorded peat depths of less than 2.0m. A number of localised readings recorded peat depths from 2.0 to 2.5m.

Probing undertaken along the access roads in agricultural areas demonstrate that peaty topsoil is typically present with some shallow pockets of peat between approximately 0.3 and 0.5m in depth. The peat is typically dry and very firm.

Trial pit and peat probe locations are illustrated on **Table 3.2** below.

TABLE 3.2 TRIAL PIT AND PEAT LOCATIONS		
Location	**Average Peat Depth (m)**	**Summary of Subsoil Lithology**
T1	0	Slightly sandy SILT over sandy, gravelly SILT
T2	0	Slightly sandy SILT over SILT/CLAY
T3	0	SILT/CLAY with cobbles
T4	0.25	Slightly gravelly SILT/CLAY over sandy, gravelly SILT/CLAY
T5	0.7	Gravelly, sandy SILT
T6	0.7	Sandy, gravelly SILT
T7	0.75	Sandy, gravelly SILT
T10	1.8	Lacustrine CLAY over sandy GRAVEL (fine)
T11	0	SILT/CLAY with cobbles and boulders
Meteorological Mast	0	SILT/CLAY with cobbles and boulders
Temporary Compound	0	Slightly sandy SILT over SILT/CLAY
Site Control Building	0	Slightly gravelly SILT/CLAY
Substation	1	Sandy gravelly SILT

A peat stability risk assessment was carried out for the main infrastructural elements at the proposed development site (refer to **Annex 6.2** to the EIAR). The findings of the peat stability risk assessment showed that the proposed development site has an acceptable margin of safety, is suitable for the proposed development and is considered to be at low risk of peat failure.

There are no known areas of soil contamination within the proposed development site or in its immediate environs. During the site walkovers and site investigations, no areas of contamination concern were identified.

3.4.2 Construction Phase Mitigation Measures

3.4.2.1 Peat, soil, subsoil and bedrock excavation

The excavation of peat, soil and subsoil will have a direct effect on the geological environment and no specific mitigation measures are proposed. The excavation of materials will be completed in accordance with best practice for the management and treatment of such materials.

3.4.2.2 Erosion of Exposed Peat, Soil and Subsoil at Excavation and Storage Areas

The following avoidance and design measures are proposed to reduce erosion effects at excavation and spoil storage areas:-

- Bog mats will be used, as necessary, to support construction plant and machinery on soft ground, thus reducing the likelihood of peat, soil and subsoil erosion and avoiding the formation of rutted areas. This will substantially reduce the likelihood for surface water ponding to occur;

- Excavated soil will be side cast and stored temporarily adjacent to excavation areas for use during reinstatement and landscaping. Where material is not required for reinstatement or landscaping, it shall be immediately transported to the spoil deposition areas;

- Silt fences, and all necessary surface water management measures (including upslope interceptor drains), will be installed around all temporary stockpiles to limit movement of entrained sediment in surface water runoff. All slopes will be sealed with the bucket of an excavator;

- In order to minimise runoff during the construction phase, works will not take place during periods of intense or prolonged rainfall (to prevent increased silt laden runoff). Drainage systems, as outlined in **Chapter 7** of the EIAR, will be implemented to limit runoff effects during the construction phase;

- At the designated spoil deposition areas, material will be placed in layers to ensure stability is maintained and works will be undertaken in accordance with best practice construction methodologies. Works at the spoil deposition areas will be monitored, on a weekly basis during the construction phase and monthly for a six-month period thereafter, by an appropriately qualified Geotechnical Engineer. In the event that any ground stability issues arise, the Engineer will have the power to cease works until such time as remedial works have been completed to his/her satisfaction;

- Permanently mounded soils and subsoils; for example, berms surrounding turbines and hardstands, berms located along access tracks and at the spoil deposition areas; will be seeded and grassed over at the earliest opportunity to prevent erosion;

- The electricity line (grid connection) trench will be reinstated to the required specification and in accordance with landowner requirements and will be reseeded or allowed to vegetate naturally

(on agricultural land) or topped with tarmacadam (or similar along public roads) at the earliest opportunity to prevent erosion; and

- Following the installation of the proposed end masts, excavated material will be reinstated, graded to match the surrounding ground profile and reseeded or allowed to vegetate naturally.

3.4.2.3 Contamination of Peat, Soils and Subsoils by leakages, spillages of hydrocarbons or other chemicals

The following measures are proposed to specifically prevent contamination of peat, soils and subsoils:-

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;

- All bunded areas will have 110% capacity of the volume to be stored;

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;

- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;

- Spill kits will be available to deal with any minor accidental spillages within the temporary construction compound and during re-fuelling;

- All waste tar material arising from road cuttings (from trenching in public roads and haul route upgrade works) will be removed off-site and disposed of at a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and

- An emergency plan for the construction phase to deal with accidental spillages is contained in **Technical Schedule 1 – Environmental Incident and Emergency Response Plan**. This emergency plan will be further developed by the contractor prior to the commencement of construction.

3.4.3 Monitoring Measures

There is no proposed monitoring programme for land and soils. However, during and post-construction, all excavated or raised areas (i.e. cut and fill) and reinstated/landscaped ground, including the spoil deposition areas, will be inspected for signs of erosion and instability. These inspections will be undertaken on a weekly basis during the construction phase and monthly, for a six-month period, post construction.

3.5 Water

3.5.1 Description

On a regional scale, the proposed development is located in the Boyne River surface water catchment within the Eastern River Basin District (ERBD) in Hydrometric Area 07.

On a more local scale, the majority of the wind farm site (including all of the proposed 9 no. turbine locations) and the grid connection (including end masts) is located in the Stonyford River (Boyne_SC050) surface water catchment.

The Stonyford River flows into the Boyne River approximately 17km downstream of the proposed site.

A small area on the far west of the proposed site is located in the River Deel surface water catchment (Deel[Raharney]_SC_010). The River Deel flows into the Boyne River approximately 18km downstream of the proposed site. There is no proposed infrastructure located in the River Deel surface water catchment.

In addition to numerous land drains, the majority of the wind farm and 110kV substation site is drained by 3 no. main streams which are headwater streams of the Stonyford River and River Deel.

Along the grid connection, there will be a requirement for 4 no. watercourse crossings. Of these 4 no. mapped crossings, 3 no. will be required within the wind farm site itself and the other 1 no. is an existing crossing along the public road.

3.5.2 *Flood Risk*

There are no areas on the historical 6" or 25" mapping in the area of the wind farm site or grid connection route that are identified as an area that is "Liable to Floods". No recurring flood incidents were identified near the proposed wind farm site from OPW's Flood Hazard Mapping. The closest mapped flood event is along the Stonyford River near Delvin village, ~3km to the north of the site.

Each of the watercourses that emerge in the area of the proposed wind farm site are small headwater streams and therefore fluvial flood of any significance is not anticipated.

No elements of the proposed wind farm infrastructure are located in a mapped PFRA flood zone.

The proposed 110kv substation is located centrally within the wind farms site and it is also located outside of a mapped PFRA flood zone.

The end masts at the Mullingar-Corduff 110kV overhead electrical transmission line are located in a PFRA mapped 100-year fluvial flood zone. Due to the overhead nature of the end mast and the small footprint area of the foundations, there will be no potential for increased fluvial risk at the end mast locations.

3.5.3 *Surface Water Quality*

Most recent data shows that the Stonyford River has a Moderate (Q3-4) to Good (Q4) Q-rating both upstream and downstream of the wind farm site and grid connection. The Deel River is reported to have a High Status (Q5) upstream of the WF site and reduces to Moderate (Q3-4) to Good (Q4) downstream of the WF site.

Surface Water Quality Monitoring was carried out at three locations (within and downstream of the wind farm site). Results were either "Good Status" or "High Status".

3.5.4 *Hydrogeology*

The limestones which underlie the proposed development are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer (Bedrock which is Moderately Productive only in Local Zones) and a Poor Aquifer.

In terms of local Groundwater Bodies (GWBs), the proposed development is located in the Athboy GWB (IE_EA_G_001).

The bedrock aquifer at the proposed development site have a Low Importance.

Based on the trial pit investigation, the groundwater table in the areas of limestone tills are more than 2.5 – 3m below ground level. However, in areas of cutover bog, the underlying silts/clays were generally found to be saturated. Groundwater levels in areas of cutover bog will be between 1 and 1.5m below ground level.

The vulnerability rating of the aquifer beneath the proposed wind farm and substation site is mapped as "Low" to "High". The low vulnerability reflects the peat covered areas and the high vulnerability areas are typically mineral subsoils. The moderate vulnerability areas are in the transition zone between the peat and the mineral subsoils.

There are no mapped groundwater source protection areas for either public water supplies or group water schemes in the area of the proposed development (National Federation Group Water Schemes only).

No private dwelling houses were identified to be located immediately down-gradient (i.e. downslope; nearest dwelling located in excess of 700m from the location of a proposed wind turbine) of the proposed development (and in particular turbine locations) and, therefore, there is no likelihood to significant effects on groundwater supplies.

3.5.5 *Changes in Site Runoff Volumes*

As calculated in Section **7.3.14 of the EIAR**, the emplacement of the proposed development footprint could result in an average increase in surface water runoff of 20.4m3/d.

3.5.6 *Mitigation*

3.5.6.1 *Approach*

The overarching objective of the proposed mitigation measures is to ensure that all surface water runoff is comprehensively treated and attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A preliminary/outline Surface Water Management Plan (SWMP), incorporating the surface water drainage design has been prepared, see Technical Schedule – Surface Water Management Plan, and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure. The SWMP has had regard to greenfield runoff rates and has been designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

While the SuDS, overall, is an amalgamation of a suite of drainage infrastructure; the overall philosophy is straightforward. In summary:-

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including the area for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle; and
- Following the settlement of silt/sediment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs.

The suite of surface water drainage infrastructure will include interception drains, collector drains swales, sedimats, flow attenuation and filtration check dams, settlement ponds/silt traps, and buffered outfalls.

The design criteria implemented as part of the SuDS are as follows:-

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development run-off during the construction phase;
- To preserve greenfield runoff rates and volumes;

- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces; and
- To manage and control water within the site and allow for the discharge of runoff from the site below the MAC of the relevant surface water regulation value.

It should be noted that the measures set out below refer to the overall mitigation framework within which the SWMP has been prepared; while further measures are also proposed.

3.5.6.2 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water

3.5.6.2.1 Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas where possible by using a 50m buffer. From the constraints map (**Annex 7.2 to EIAR**), it can be seen that apart from some sections of access track, the T7 hardstand, a section of the construction compound along, the north-western corner of the substation along with the watercourse crossing locations, the majority of the proposed development areas (including all turbine locations) are located outside of areas that have been assessed to be hydrologically sensitive.

As described in **Chapter 3 of the EIAR**, specific mitigation measures, incorporated into the design of the development and through implementation of best practice methodologies (discussed below) will be employed where work inside buffer zones is proposed.

The generally large setback distance from sensitive hydrological features means that sufficient space is provided for the installation of proposed drainage mitigation measures (discussed below) and to ensure their effective operation. The proposed buffer zone will ensure:-

- Avoidance of physical damage to watercourses, and associated release of sediment;
- Avoidance of excavations within close proximity to surface water courses;
- Avoidance of the entry of suspended sediment from earthworks into watercourses; and,
- Avoidance of the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

3.5.6.2.2 Mitigation by Prevention

The following section details the measures which will be put in place during the construction phase to ensure that surface water features are protected from the release of silt or sediment and to ensure that all surface water runoff is fully attenuated to avoid the discharge of dirty water.

- Source controls to limit the likelihood for 'dirty water' to occur:-
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with clean washed gravel, filter fabrics, and other similar/equivalent or appropriate systems;
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls to ensure appropriate management of silt laden water:-
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems to fully attenuate silt laden waters prior to discharge:-

- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

It should be noted for this site that an extensive network of land drains already exists, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The integration of the existing land drainage network and the proposed wind farm network is common practice in wind energy developments and will also result in benefits to surrounding agricultural lands.

The main elements of interaction with existing drains will be as follows:-

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed wind farm drainage into the existing site drainage network. This will reduce the likelihood for any increased risk of downstream flooding or sediment transport/erosion;

- Silt traps will be placed in the existing drains upstream of any streams where construction works is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;

- During the operational phase of the wind farm, runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;

- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site;

- Drains running parallel to the existing roads that requiring widening will be upgraded. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles and silt fences will be used during the upgrade works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

3.5.6.2.3 Water Treatment Train

A final line of defence can be provided by a water treatment train such as a "Siltbuster", if required. If the discharge water from construction areas fails to be of a high quality, then a filtration treatment

system (such as a 'Siltbuster' or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This water treatment train will apply for the entirety of the construction phase.

3.5.6.2.4 Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be emplaced within drains down-gradient of all construction areas inside the hydrological buffer zones to provide an additional layer of protection in these areas.

3.5.6.2.5 Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats (sediment entrapment mats, consisting of coir or jute matting) placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

3.5.6.2.6 Management of Runoff from Soil Deposition Areas

It is proposed that excavated soil and peat will be used for reinstatement and landscaping throughout the site and any excess material will be placed in 2 no. deposition areas at the wind farm site, 1 no. soil deposition area and 1 no. peat deposition area.

Excavated peat from grid connection to be used as backfill and landscaping/reinstatement. Excavated soil from grid on public road (as well as road surfacing) to be removed to licenced facility.

Both proposed spoil deposition areas are located outside the 50m stream buffer zone (refer to **Annex 7.2 to the EIAR**).

The proposed deposition areas are natural depressions in the ground, or areas of lower-lying ground, and therefore there might be a requirement to de-water prior to infilling (please refer to Section **7.5.1.2 of the EIAR** for mitigation measures relating to dewatering).

During the initial placement of spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Drainage from overburden deposition areas will ultimately be routed to an oversized swale and a number of settlement ponds and a 'Siltbuster' with appropriate storage and settlement capacity, designed for a '1-in-100 year 6-hour return' period, before being discharged to the on-site drains.

Spoil deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised, soil/peat deposition areas will no longer be a likely source of silt laden runoff. Settlement ponds will be left in place until the areas have stabilised.

3.5.6.2.7 Grid Connection Installation Works

Temporary silt fencing/silt trap arrangements will be placed within existing roadside/field drainage features along the grid connection to remove any suspended sediments from the works area. The trapped sediment will be removed and disposed at an appropriate licenced facility. The bare ground re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

3.5.6.2.8 Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if prolonged or intense rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:-

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;

- Meteo Alarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;

- 3 hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;

- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3 hour record is given and is updated every 15 minutes. Radar images are not predictive; and,

- Consultancy Service: Met Eireann provide a 24 hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:-

- >10 mm/hr (i.e. high intensity local rainfall events);

- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,

- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:-

- Secure all open excavations;

- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,

- Avoid working during heavy rainfall and for up to 24-hours after heavy events to ensure drainage systems are not overloaded.

3.5.6.2.9 Timing of Site Construction Works

The construction of the site drainage system will be carried out, at the respective location, prior to other activities being commenced. The construction of the drainage system will only be carried out

during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and functional for all subsequent construction works.

3.5.6.3 *Excavation Dewatering and Potential Impacts on Surface Water Quality*

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be put in place;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build up of water in the excavation;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of wind farm excavations by the Environmental Manager will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

3.5.6.4 *Potential Release of Hydrocarbons during Construction and Storage*

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:-

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;

- All bunded areas will have 110% capacity of the volume to be stored;

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. No refuelling will be permitted at works locations within the 50m hydrological buffer. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;

- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;

- Spill kits will be readily available to deal with any accidental spillage in;

- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and

- An outline emergency plan for the construction phase to deal with accidental spillages is contained within **Technical Schedule 1 – Environmental Incident and Emergency Response Plan**. This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the detailed CEMP.

3.5.6.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Measures to avoid contamination of ground and surface waters by wastewaters will comprise:- The provision of self contained port-a-loos (chemical toilets) with an integrated waste holding tank will be installed at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;

- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,

- No water will be sourced on the site, nor will any wastewater be discharged to the site

3.5.6.6 Release of Cement-Based Products

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:-

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, emplacement of pre-cast products, will take utilised;

- All watercourse crossings will utilise pre-cast products and the use of wet-cement products within the hydrological buffer will be avoided insofar as possible;

- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds with waters being tankered and stored in the temporary construction compound, removed off site and disposed of at an approved licensed facility. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;

- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,

- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

3.5.6.7 Morphological Changes to Surface Water Courses & Drainage Patterns

The following mitigation measures are proposed:-

- Where possible, all proposed new stream crossings will be clear span bridges (bottomless culverts) and the stream beds will remain undisturbed. No in-stream excavation works at the crossing locations are proposed and therefore there will be no impact on the stream at the proposed crossing location;

- Where internal wind farm electrical cabling of grid connection cabling will pass above or below the existing culvert and will not directly interfere with the culvert;

- At the time of construction, all guidance/best practice requirements of the Office of Public Works (OPW) or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;

- As a further precaution, in-stream construction work (should it be required for any reason) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);

- During the near stream construction works (i.e. within the 50m buffer zone), double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase; and

- All new or revised watercourse crossings (watercourses mapped on OSI mapping) will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

The proposed Bracklyn Wind Farm will not alter the hydrology or water balance of the catchments/watercourses downstream of the proposed site, therefore the proposed development will not affect any proposed bog rehabilitation plans that might be carried out in the future on any adjoining

boglands. Any rehabilitation plans that are carried out will also have to be done in a manner that will not affect upstream drainage and therefore no effects on the proposed Bracklyn Wind Farm site are anticipated.

3.5.6.8 Potential Hydrological Impacts on Designated Sites

The proposed mitigation measures for protection of surface water quality, which will include buffer zones and robust drainage control measures (i.e. interceptor drains, swales, settlement ponds), will ensure that the quality of runoff from proposed development areas will be very high.

As stated in **Section 7.6.1.1 of the EIAR**, there could potentially be an "imperceptible, temporary impact" on local streams and rivers which, if occurs, would be extremely localised and of a very short duration (i.e. hours). Therefore, significant indirect hydrological or water quality effects on the downstream River Boyne and River Blackwater SAC will not occur.

3.6 Air and Climate

The greatest likelihood of effects on air quality during the construction phase is from construction dust emissions and the potential for nuisance dust. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of an outline Dust Minimisation Plan (see **Annex 8.2 to EIAR**).

A detailed Dust Minimisation Plan will be formulated prior to the construction phase of the project Measures to be included within the Dust Minimisation Plan include:-

- Access tracks and public roads in the vicinity of the site shall be regularly cleaned to remove mud, aggregates and debris and maintained as appropriate. All road sweepers shall be water assisted;
- Any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions;
- Vehicles delivering material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- Public roads in the vicinity of the site shall be regularly inspected for cleanliness and cleaned as necessary;

- In the event of dust nuisance occurring outside the site boundary, movement of materials will be immediately terminated and satisfactory procedures implemented to rectify the problem before the resumption of operations;

- If issues persist and the above measures are not satisfactorily controlling dust emissions, a wheel cleaning system with rumble grids to dislodge accumulated dust and mud prior to leaving the site should be installed; and

- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions;

- Material handling systems and site stockpiling of materials 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;

- The dust minimisation plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

- At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust will be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

3.7 Archaeology and Cultural Heritage

As part of the EIAR (Chapter 9), an Archaeological, Architectural and Cultural Heritage Assessment was prepared for the wind farm development. The assessment presents all known existing archaeological sites, provides a summary of potential impacts associated with the development of the proposed wind farm and also provides relative mitigation measures.

There are fourteen recorded monuments within 1km of the proposed development as described in **Section 10.4.2 of the EIAR**. The majority are ringforts although there is also a flat cemetry, an earthwork, a field system and two tower houses. There are six protected structures (three in Co. Meath and three in Co. Westmeath) within the landholding and fifty-four protected structures in Co. Meath

within 5km of the proposed development (**see 10.4.9 of the EIAR**). The following mitigation measures are proposed:

- A post-consent pre-construction archaeological geophysical survey shall be carried out in all areas of land take associated with the proposed turbine bases and crane hardstands. The geophysical survey will be carried out under licence to the Department of Housing, Local Government and Heritage;

- Post-consent pre-construction test trenching shall be carried out in all areas of land take associated with the proposed turbine bases and hardstands, as well as along the access roads leading to Turbine 3 and Turbine 11. Test trenching will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during test trenching. Test trenching will be cognisant of the results of the geophysical survey. Further recommendations, which may include preservation in situ or archaeological excavation, may be made on completion of the test trenching programme;

- Archaeological monitoring of all excavations associated with construction of the proposed wind farm shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;

- Archaeological monitoring of all excavations associated with the proposed grid connection shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring; and

- Archaeological monitoring of all excavations associated with the proposed road upgrades shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring.

Given their proximity to existing heritage features, it is recommended that micrositing should not be considered in respect of Turbine 3 or Turbine T11 should it result in turbines being moved closer to the Recorded Monuments in these two areas.

The micrositing of other infrastructure, within the tolerances outlined in **Chapter 3 of the EIAR**, will not result in any adverse effect on archaeological, architectural or cultural heritage features.

3.8 Noise

Construction activities will be completed in accordance with the provisions, where relevant, of BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise which offers detailed guidance on the control of noise & vibration from demolition and construction activities. The relevant practices to be adopted during construction shall include:-

- 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 Authorities 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; and
- Keeping site access tracks even to mitigate the potential for vibration from HGVs.

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 noisy/vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- Regular maintenance and servicing of plant items.

The following list of measures will be implemented, as relevant, to ensure compliance with the relevant construction noise criteria:

- No plant or machinery will be permitted to cause a 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 may be required to operate 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 **Table 11.6 of the EIAR** using methods outlined in 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, including the delivery of construction materials, shall generally be restricted to between 07:00hrs and 19:00hrs Monday to Friday and between 07:00hrs and 13:00hrs on Saturdays, with no operations on Sundays or public holidays. However, to ensure that optimal use is made of good weather periods, at occasional critical periods within the construction programme (i.e. concrete pours, turbine component deliveries and turbine erection) or in the event of an emergency; activities may be necessary outside out of these hours.

Based on assessment of the geological composition of the site undertaken to date, it is concluded that significant levels of rock are not present. In the unlikely event that rock is encountered, rock breaking

may be employed to utilise this rock in the construction of access tracks or hardstands. If rock breaking is required, the following measures will be implemented, where necessary, to mitigate noise emissions:-

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency;
- Ensure all air lines are sealed;
- Use a dampened bit to eliminate a 'ringing' sound;
- Erect an acoustic screen between compressors or generators and noise sensitive area. When possible, line of sight between top of machine and reception point will be obscured; and
- Enclose the breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

3.9 Vibration

The level of vibration from construction activities shall be limited to the values set out in **Table 11.7 of the EIAR**.

Given the substantial distances between locations where notable levels of vibration may take place (e.g. piling at turbine locations or extensive use of vibration rollers in access track construction) and the nearest NSLs, no likely significant effect will be experienced. Therefore, no specific mitigation measures are proposed in respect of these works.

The completion of upgrade works to the haul route (i.e. along the L1504 and L5508) and the transportation of construction materials will occur in close proximity to a number of residential properties along these roads. All dwellings located within 50m of proposed upgrade works and above-referenced local roads are assessed to be modern buildings of sound construction (see **Section 11.3.1.2** of the EIAR) and are not, therefore, assessed as likely to be susceptible to cosmetic or structural damage from the magnitude of vibration predicted to be generated by the proposed upgrade works and traffic movements.

However, and notwithstanding the above; prior to the commencement of development a visual inspection (with photographic record) of all structures (buildings) within 50m of the L1504 and L5508 will be undertaken by a suitably qualified engineer to identify any pre-existing evidence of structural

deterioration. A report on the visual inspection of each property will, on completion, be furnished to the respective property owners. During construction, it is also proposed to undertake occasional inspections to ensure the early identification of any adverse effects.

Following the completion of construction, a similar survey shall be completed and if a deterioration is identified and can be directly attributed to the construction of the proposed development, appropriate action will be immediately undertaken in agreement with the property owner and at the expense of the Applicant. The Planning Authority will also be advised of any necessary remedial work.

As further level of protection to those properties located immediately adjacent to the L5508 (identified as H17, H24 and H77) where it is proposed to increase the width of the existing road carriageway, the following additional mitigation measures are recommended:-

- Prior to the commencement of construction, a dilapidation survey of each property will be undertaken. This survey will form the basis of a report (to be furnished to the property owner) providing detailed description of the condition of the property;

- Crack 'tell-tales' will be installed on any existing cracks that are of concern. These 'tell-tales' will allow the cracks to be carefully monitored and will indicate whether any movement or opening of the cracks has occurred. The tell-tales will be inspected regularly during construction;

- A vibration monitor will be installed at each of the properties and will allow for actual vibration levels to be carefully monitored; ;

- A speed limit of 20 km/h will be put in place for all construction traffic using the L5508 within 100m of each of the above dwellings; and

- Following construction, a further dilapidation survey of the properties will be undertaken and furnished to the property owners. The results of this survey will be compared to that carried out prior to construction and can be used to determine if any damage has been caused to the properties.

With the above mitigation and monitoring measures in place, the likelihood of any damage to buildings, but in particular residential dwellings, will be minimised. Moreover, the regular monitoring of the proposed 'tell-tales' and vibration monitors will give an early indication of vibration levels and will ensure that a timely intervention can be made, and additional mitigation or remedial measures implemented, if adverse effects are assessed as likely to arise.

3.10 Traffic

The likely effects of the proposed development have been identified as being slight to moderate and temporary in nature and associated with short-term construction and decommissioning activities. Cumulative effects could, in the absence of mitigation, rise to 'significant' if the proposed development is constructed at the same time as the proposed Ballivor Wind Farm on adjacent lands. Likely effects during the operational phase have been assessed as being imperceptible and hence mitigation measures are not deemed to be necessary.

In order to avoid significant effects and reduce the predicted magnitude of effects to the greatest possible extent, a suite of mitigation measures are available which will further reduce any likely effects during the construction phase. The following mitigation measures will be implemented:-

- Traffic movements will be limited to 07:00-19:00 Monday to Friday and 07:00–13:00 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 or during extended concrete pours. Where construction activities are necessary outside of the normal working hours, local residents and the Planning Authority will receive prior notification;

- A wheel cleaning facility will be provided, as necessary, to prevent any debris being transferred from site to the adjacent public roads. All drivers will be required to ensure that their vehicle is free from dirt and stones prior to departure from the construction site. Where conditions exist for dust to become friable, techniques such as damping down of the affected areas will be employed and vehicles/loads will be covered to reduce dust emissions;

- A Traffic Management Plan shall be agreed as part of the Construction Environmental Management Plan (CEMP) with the Local Authority prior to the commencement of development. The Traffic Management Plan shall include inter alia confirmed details of construction material haul routes; confirmed details of vehicle specifications; a materials delivery programme; traffic management measures including details of 'Stop/Go' systems, signage, road closures and diversionary routes; and road reinstatement details;

- All works to the public road shall be undertaken in consultation with, and agreed in advance with, the Local Authority;

- All reasonable steps shall be taken to ensure that national and regional routes are used to transport all materials to the site, in so far as is possible;

- Prior to, and post, construction; pavement condition surveys and bridge surveys will be undertaken along all non-national access routes. Given the high-quality and well-maintained nature of motorways and national routes, it is not assessed as necessary to carry out surveys of these carriageways or structures along these routes. Following the completion of the pre-construction survey, any works which are assessed as necessary to facilitate the delivery of components and materials to the proposed development site shall be undertaken, while any deterioration of carriageways or structures identified in the post-construction survey shall be put right at the expense of the developer and to the satisfaction of the Planning Authority;

- Adequate signage shall be provided at entrances providing access, safety and warning information;

- Speed limit compliance; particularly along the L1504, L5508 and L80122; will be emphasised to all staff and contractors prior to the commencement of construction during site induction, and will be strictly enforced throughout the construction phase;

- Sufficient car parking spaces will be available at the contractor's temporary depot/storage area during the construction phase. No parking of cars by persons associated with the proposed development will be permitted on any part of the public road that is not closed to traffic. All staff will be instructed to ensure that private entrances remain unobscured (particularly along the grid connection route);

- Traffic restrictions shall be kept to minimum duration and extent;

- Appropriate traffic management; including maintenance of local access, pedestrian access (where safe to do so) and diversions; shall be implemented to facilitate continued public use of roads where temporary traffic restrictions have to be put in place. Precise details of these measures will be detailed in the Traffic Management Plan to be agreed with the Planning Authority prior to the commencement of development;

- The timing of oversized loads shall be agreed with the relevant local authorities and An Garda Síochána, and all relevant licenses and permits shall be obtained in advance;

- Maximum axle loadings for abnormal/oversized loads shall be strictly enforced in accordance with the Road Traffic (Construction and Use of Vehicles) Regulations 2003 (S.I. No. 5 of 2003);

- A designated contact point and coordinator will be put in place to manage all access arrangements and to interface with the public and the Local Authority;

- No hedgerows or potential breeding habitats to be removed during the summer breeding season; and

- The site shall be closed, and strictly secured, to the public during the construction phase.

The proposed turbine delivery and construction material haul routes will be monitored during construction to identify any damage which may have been caused by construction traffic. Where any damage has been caused by traffic associated with the proposed development, it shall be repaired by the appointed contractor as soon as possible.

3.11 Waste

The measures outlined in the **Spoil Management Plan (Technical Schedule 4), the Waste Management Plan (Technical Schedule 5)** and the measures outlined below will be employed and strictly observed during the construction phase:

- All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations.
- Any material that is removed offsite for landfill disposal (e.g. road surfacing material) will be classified in accordance with Council Decision 2003 (2003/33/EC) in order to confirm that it is suitable for its proposed use or for landfill disposal. Excavated material, which requires offsite disposal, will be classified (where possible) prior to excavation, in order to minimise the amount of material stockpiling at the subject site. Excavated spoil material will be transported from the site using appropriately permitted waste contractors, i.e. hold permits from Westmeath County Council or other authorities permitted to issue permits for waste collection in County Westmeath.
- Surplus material, will be placed at either of the designated Spoil Deposition Areas, one of which is specifically for peat and one specifically for sub-soil.

3.12 Landscape & Shadow Flicker

Aside from construction stage mitigation measures to minimise land and vegetation disturbance and dust emissions, there are no specific mitigation measures to be implemented. The appropriate

management and reinstatement of excavations, in a timely manner, will ensure that any adverse effects caused, for example at site entrances or road upgrade locations, are minimised insofar as possible. Similarly, the progressive reinstatement and landscaping of the site will remediate any short term adverse effects on the local landscape.

The proposed development has embedded landscape and visual mitigation measures that will be implemented to make the development less intrusive and less eye catching on a localised level include:-

- The colour of turbines will be industry standard off-white/light grey semi-matt non-reflective finish;
- Transmission lines between individual turbines and the substation will be placed underground;
- Special care will be taken to preserve any features, insofar as possible, which contribute to the landscape character of the study area; and
- Counter rotation of blade sets will be avoided.

The likely shadow flicker effects have been minimised, and avoided where possible, through the iterative design process and assessment of project alternatives as described at **Chapter 2 of the EIAR**. However; while the proposed development strikes the best balance between the avoidance of likely significant effects and achieving the objectives of the project, shadow flicker effects remain, as discussed above.

Shadow flicker mitigation is available, and widely implemented, on wind farm developments where shadow flicker levels are proven to be in excess of the recommended limits. These mitigation measures effectively limit (curtail) the operation of turbines during the infrequent and rare periods when shadow flicker occurs. In short, if a particular turbine is creating shadow flicker effects at a particular receptor, then the operation of that turbine may be temporarily curtailed. This is usually achieved by turning off the turbines at predetermined times, as predicted by the shadow flicker model, when shadow flicker is proven to occur.

The wind turbines will each be fitted with shadow flicker curtailment software, inherent to their design, to facilitate their shut down as required. If the sun is shining, the software will turn off the turbine at the predetermined times when shadow flicker is predicted to occur based on the prediction model. This approach will be implemented, as necessary, to ensure that actual levels of shadow flicker do not exceed either of the relevant limits.

3.13 Infrastructure and Telecommunications

The proposed wind turbines will, as requested by the IAA and Department of Defence in their respective consultation responses, be fitted with aviation warning lighting in accordance with the specification to be agreed with the IAA and the Planning Authority.

At a maximum of thirty days following the installation of all proposed turbines, 'as-constructed details' will be provided to the IAA to allow for the updating of mapping charts, including:-

- The number of wind turbines;
- WGS-84 coordinates of each turbine;
- Ground elevation of each turbine (Malin Head OD);
- Blade tip elevation of each turbine (Malin Head OD);
- Height of Turbine;
- Contour maps at the requisite scale; and
- A note of which turbines have been fitted with obstacle warning lights.

In the event that the obstacle warning lights fail or if there are plans to withdraw them from use for a period of time, the IAA will be contacted, via AISOPs@iaa.ie, as a matter of urgency, to request that a NOTAM (Notice to Airmen) is issued concerning the absence of obstacle lights. The following information will be provided to the IAA:-

- Obstacle ID;
- Obstacle type;
- Obstacle Position;
- Elevation; and
- Colour of Light.

The Department of Defence shall also be notified in the event of a failure of the installed warning lights.

It should also be noted, however, that the proposed wind turbines will be fitted with an uninterruptable power supply (UPS) to ensure that the aviation warning lights remain operational even in the event of a power outage. This UPS is sufficient for a period of twelve hours; after which, the warning lights can be powered by a small generator should the power outage continue.

Extensive consultation with telecommunications providers has confirmed that significant adverse effects on existing telecommunication links are unlikely to arise from the operation of the proposed development. While the proposed development is assessed as unlikely to interfere with any microwave links, all operators will be kept informed of any changes to the layout (e.g. micrositing) should these occur to ensure that compliance with telecommunications constraints is maintained.

In their consultation response, 2rn recommended that a protocol agreement be entered into to ensure that any complaints received from the local public concerned are appropriately remediated. This is a standard protocol for such development proposals and has been agreed between the parties and is enclosed at **Annex 13.3 to the EIAR)**.

While assessed to be unlikely, if significant signal interference in any form is identified and is directly attributed to the proposed development, appropriate remedial measures will immediately be undertaken. A range of technical measures are available to mitigate any instances of interference including signal amplifiers, active deflectors and relay transmitters, repeater stations, booster units, realignment of domestic aerials, installation of higher quality aerials and the installation of suppression equipment. Remedial works will be promptly undertaken to ensure uninterrupted telecommunication, broadcasting and mobile phone service provision.

3.14 Construction Sequence

The Contractor's proposed sequence of works will have regard to the implementation of all environmental mitigation measures.

The outline construction sequence of the development is as follows:

- Install environmental protection/mitigation measures including buffer zones for any tree root protection, or badger setts or protected zones as outlined in ecological report on the distribution of protected flora or invasive species.
- Traffic management measures to be implemented in advance of commencement of haul route upgrade works. Works to be completed to ensure unimpeded access during the construction of the proposed development;
- Upgrade works to the L5508 will be commenced;
- Surface water protection measures to be installed;
- The construction of the site entrances, ensuring that requisite traffic visibility splays are provided;

- Establishment and continued management of spoil deposition areas;
- Progressive construction of internal on-site access tracks;
- Construction of the temporary construction compound for off-loading materials and equipment, and to accommodate temporary site offices;
- Construction of bunded areas for oil, fuel and lubricant storage tanks;
- As the internal access tracks progress to each turbine location, foundation excavations for the turbines will commence and foundations laid. The hardstanding areas will be constructed as track construction advances;
- Construction of site control building;
- Other temporary upgrade works along the turbine component haul route will be commenced;
- As on-site access tracks progress, internal wind farm cabling ducting and cabling will be installed;
- Installation of turbines will commence once the on-site access tracks, hardstands, foundations and drainage measures are in place and the road upgrade works are complete. It is anticipated that each turbine will take approximately 1 no. week to install. Three cranes will be used for this operation. As each turbine is completed, the electrical connections will be made;
- Decommissioning of the temporary meteorological mast and installation of the permanent meteorological mast will then take place; and
- Progressive site reinstatement, restoration and landscaping including re-profiling and of spoil deposition areas and peat storage areas, removal of temporary construction compound and turbine storage areas; erection of post-and-wire fencing around turbines, access tracks and at site entrances; and erection of gates and vegetation at site entrances.

The construction method for the proposed substation and grid connection will consist of the following general sequence:-

- The construction of the site entrances and access tracks;
- Site preparatory and groundworks associated with the substation compound footprint including control building;
- Construction of the control buildings;

- Construction of bases or plinths for electrical apparatus, including Electricity Storage System containers;
- Erection of palisade fencing around substation;
- Installation of internal and external electrical apparatus in control buildings and within compound area;
- Site preparatory and groundworks associated with the strain tower foundations,
- Erection of end masts;
- Installation of underground electricity line between substation and end masts;
- Commissioning and testing of electrical apparatus;
- Connection of underground electricity line to the 110kV Mullingar-Corduff electricity transmission line;
- Final commissioning of all electrical equipment and apparatus; and
- Progressive site reinstatement, restoration, landscaping and planting proposals including the installation of stockproof fencing and the erection of gates.

Once the turbines are installed and the substation and electrical system completed, the turbines will be tested and commissioned.

A detailed Construction Management Plan (CMP) for construction will be prepared by the Contractor in advance of all construction activities and will incorporate all mitigation measures recommended in this report. This report will be issued to the Contractor to ensure that all environmental mitigation measures required will be captured in the detailed CMP.

3.15 Outline Method Statements

This CEMP and its future versions/revisions will form part of the Contract for Bracklyn Wind Farm. It will therefore be updated and revised during the different stages of the development. The Contractor will address all of the mitigation measures and best practice construction methods detailed within the above consent in his design and in any detailed environmental plans as required by this CEMP or the Contract.

Please refer to the Schedule of Mitigation Measures (Annex 1.8 of the EIAR) which provides all mitigation measures proposed in the EIAR and associated documents.

Where any mitigation measures or construction methods described in other documents deviate in any way from those contained within this CEMP, the Contractor will abide by whichever is the most onerous and stringent in terms of environmental protection.

3.16 Scheme Amendments

Scheme Amendments will be recorded in Table 3.3. These amendments do not include changes to the scheme design which are completed in accordance with the existing planning consent; instead, this refers to changes in the design of the wind farm for which additional approvals and / or consents may be required from Westmeath County Council and/or Meath County Council. For example, amendments to track layouts or turbine locations outside of approved micrositing boundaries as per the current grant of planning permission.

The purpose of recording Scheme Amendments here is to provide a record of any changes in the design and siting of the wind farm infrastructure such that any associated environmental impacts and mitigation measures may be appropriately instigated through this CEMP.

TABLE 3.3 SCHEME AMENDMENTS

Reference	Date	Scheme Amendment Description	Environmental Sensitivities potentially Impacted by Scheme Amendment.

3.17 Register of Variations

Where any variations to the Technical Schedules and CEMP are required (either as a result of Scheme Amendments or through corrective actions or improvements noted and undertaken on site) these will be recorded in Table 3.4, Register of Variations. Furthermore, all changes to construction methods, design, mitigation and the implications of these changes and authorising personnel will be recorded in Table 3.4.

TABLE 3.4 REGISTER OF VARIATIONS			
No.	Variation Description	Authorising Personnel	Completion Date

4 COMMUNICATION PLAN

4.1 Introduction

Both the Contractor and the Client will appoint Project Managers to the project. These Project Managers will be the main points of contact between the two parties. The Contractors team will report directly to the Construction Project Manager, with all Client staff reporting directly to the Client Project Manager.

It is envisaged that main project communications will take the form of structured reporting arrangements and meetings.

All issues in relation to environmental management/monitoring will be reported to the Site EM/Resident Engineer. The Contractor's Environmental Manager (EM)/Resident Engineer (RE) shall report to the Contractor and Client on a regular basis.

4.2 Contact Sheets

Table 4.1 provides a list of Bracklyn Windfarm Ltd., Contractor and relevant third party contact details. This table should be updated and kept current by the Contractor for the duration of the Contract.

TABLE 4.1 CONTACT SHEETS

Company	Position	Name	Telephone
Bracklyn Windfarm Ltd.	Client Project Manager		
Contractor	Site Manager / EM		
Contractor	Contracts Manager		
Contractor	General Manager		
Contractor	Foreman		
Contractor	Ecological Clerk of Works (ECoW)		
Bracklyn Energy Ltd.	Construction Project Manager		

4.3 Meetings Reports and Consultations

Table 4.2 lists all meetings and consultations as required by the Contract. The table also provides details on the schedule/frequency, scope & objectives and attendees / responsibility for each meeting.

4.4 Roles & Responsibilities

Roles and responsibilities for environmental management, monitoring and reporting are detailed in Table 4.3. The Contractor's EM/Resident Engineer will be responsible for the delivery of all elements of the Environmental Management Plan. The Contractor's EM/ Resident Engineer will retain all responsibility for issuing, changing and monitoring the Environmental Management Plan.

4.5 Reporting Procedures

Figure 4.1 provides a diagrammatic outline of the general tasks and communication lines, based on the roles described in Tables 4.2 and 4.3 and tasks detailed in the Technical Schedules. The Contractor will update this information as part of the detailed CEMP.

Technical Schedule TS1, Environmental Incident and Emergency Response Plan, includes a figure illustrating the communications plan for reporting procedures for all potential environmental risks, hazards or incidents which may relate to ecology, water quality, dust, noise or archaeology.

Environmental reporting to statutory and non-statutory bodies, such as Westmeath County Council, Inland Fisheries Ireland, Department of Culture, Heritage and the Gaeltacht, will be managed by the relevant Contractor in accordance with an agreed reporting schedule.

TABLE 4.2 MEETINGS, REPORTS AND CONSULTATIONS			
Meeting/Report	**Schedule/Frequency**	**Scope & Objective**	**Attendees/Responsibilities**
A Record of all meetings, checks, permissions and licenses will be retained within Section 4 of this CEMP			
Site Inductions	All new site personnel and visitors		Contractor to organize and maintain records
Weekly environmental meetings	Weekly	To provide updates on environmental mitigation measures and performance and identify actions for improvement. The Contractor's EM is required to maintain a Pollution Prevention Measures Register (PPMR) in which mitigation measures put into place will be listed and checked weekly to assess the requirement for maintenance. The results of these checks will be discussed at the meeting and corrective actions agreed as required.	Attendance required: ECoW, Contractor's EM, Site Manager, and any other relevant personnel or statutory consultees where necessary.
Monthly Environmental Report & Monthly Environmental Management Group Meeting	Monthly	To provide a compiled record of weekly meeting minutes and environmental performance and monitoring results (e.g. air, noise or water quality monitoring as appropriate). To identify any areas / action for improvement.	To be prepared by EM. Report to be issued to the Contractor and Construction Project Manager before the end of each calendar month. Report to be discussed at the monthly meeting with recommendations for improvement passed to the Contractor in written format
Final Environmental Report	Upon completion of construction works	The final report will document the environmental and ecological effects of the construction period. The evidence for effects will be based on findings included in the minutes of weekly meetings and monthly meetings, together with other recording information maintained by the EM. The report will relate results to residual effects predicted in the EIS.	The Final Report will be prepared by the EM. The report will be made available to the Contractor, Construction Project Manager and Planning Authority, if required.

TABLE 4.2 MEETINGS, REPORTS AND CONSULTATIONS			
Meeting/Report	**Schedule/Frequency**	**Scope & Objective**	**Attendees/Responsibilities**
Environmental Checks and Monitoring of Mitigation Works	As required in advance of construction works regular checks should also be made at least every 14 days.	Environmental Checks are to be carried out in advance of construction works. This will comprise an on-site meeting / inspection to confirm the appropriate use of identified mitigation measures and highlight any further issues / measures which may be relevant prior to commencement of works in any area. As a minimum, Environmental Checks will be completed at each main piece of site infrastructure (turbine bases, construction compounds, sub-station, control room) prior to works commencing in that area. Advance checks will be undertaken no less than every 100m of constructed or upgraded access track. Environmental Checks will include: • Checks for visual evidence of contamination / sediment alongside watercourses, nearby working areas and in areas of surface water discharge. • Regular checks of all plant and equipment to identify any oil or fuel leaks to confirm the condition of the plant. • Inspection of drainage and erosion and sediment control measures. Additional checks should be made before, during (where safe to do so) and immediately following anticipated storm events or periods of continuous or heavy intermittent rainfall over one or more days. • Environmental checks will also encompass a review of – Waste management procedures – General site tidiness – Temporary materials storage (extracted materials stockpiles) and restoration works and – Peat stability	Environmental checks will be undertaken by the Contractor, supervised by the ECoW and EM where appropriate. The ECoW/EM may also undertake regular checks, either independently or in conjunction with the Contractor's checks as required. The Contractor and ECoW/EM will retain a record of all inspections / findings of Environmental Checks within Section 4 of this CEMP. All records will be made available for audit / review. All records will also be made available for discussion during regular meetings as scheduled herein.

TABLE 4.2 MEETINGS, REPORTS AND CONSULTATIONS			
Meeting/Report	**Schedule/Frequency**	**Scope & Objective**	**Attendees/Responsibilities**
		– Signs of any mammal activity on site – Buffer zones (if any) are being maintained – Monitoring of any new Third Schedule part 1or 2 species within the wind farm site	
Environmental Audit	At least once every month.		Environmental Audits may be carried out by the Contractor, or Bracklyn Windfarm Ltd. at any time during the works. Audit procedures and forms are included within Section 4 and TS1. These will be followed / completed by the Employer when undertaking environmental audits and may also be adopted by the Contractor, unless alternative procedures and forms are submitted and approved as part of the Contractor's detailed CEMP.
Liaison with regulator / statutory Consultees	As Required	Provide regular updates to relevant authority on environmental performance and maintain good working relationships with the regulatory bodies.	Contractor and ECoW/EM where required. Meetings will be initiated as required by Planning Condition, Technical Schedules or as agreed throughout the duration of the construction phase. The Contractor is responsible for obtaining all relevant permissions, consents, licenses and permits. Some permits may require application and implementation by an appropriately qualified person. In these instances, the Contractor will consult with the ECoW or other specialist Environmental Consultants where required.

TABLE 4.3 ROLES AND RESPONSIBILITIES	
Position	**Roles and Responsibilities**
Construction Project Manager	The Construction Project Manager will: Ensure that the Contractor has obtained the relevant approvals and licenses and consents from regulatory bodies and statutory consultees where required. Ensure that the Contractor has submitted all relevant documentation to the ECoW and Project EM, liaise with the Site Manager and the ECoW/EM and ensure that corrective actions and variations to the CEMP have been instigated.
Project Site Manager/Engineer	The Site Manager will provide liaison between the ECoW/EM and the Contractor where environmental sensitivities, instruction for environmental performance improvements or corrective actions are requested by the ECoW, EM or other appropriate person(s) as a result of environmental checks or audits conducted by these person(s). The Site Manager will ensure that all notifications of environmental sensitivities and incidents as well as other general observations on environmental performance are reported back to the Construction Project Manager. The Project Site Manager is responsible for review and further development of the CEMP.
ECoW: Ecological Clerk of Works	The ECoW will work with Bracklyn Windfarm Ltd. and the Contractor to ensure compliance with best practice and with all environmental mitigation and monitoring requirements as detailed within the ES, relevant planning conditions and CEMP. Where a particular ecological concern exists at the site, or specific habitat management activities are to be undertaken in conjunction with the main civils construction works, a Specialist Ecologist / Environmental Consultant may also be required unless the ECoW is suitably qualified to undertake the particular ecological responsibilities. The main roles of the ECoW are as follows: • Organise start-up meeting / Tool box talks with the Contractor to agree working methods, specifically including communications; weekly schedules; monitoring of data storage; and preparation of plans indicating location of key features including mitigation measures, monitoring points and sensitive habitats. • Maintain a weekly presence on site during the main construction works. • Organise a minimum of weekly meetings with the Site Manager and / or Foreman, to allow briefing on the programme of works on site and to provide on-site guidance during construction. Note: It is essential that the Contractor supplies information on proposed works and scheduling to the ECoW in advance in order to anticipate and address any issues, specifically including drainage, buffer /protection zones, silt mitigation measures, cabling, roads, turbine bases, met masts, compounds, landscaping, topsoil removal, storage and replacement, vegetation reinstatement and restoration works, planting, felling and habitat management. • Highlight the need for compliance with planning conditions. **Note: If failures occur and actions are taken which contravene legislation then the ECoW has the power to stop works in the affected area with immediate effect and the appropriate statutory agency and planning officer will be informed. These actions will only be taken where appropriate. Notification to stop works will be by verbal means, followed up with written confirmation recording the time and date of the instruction, personnel involved and reasons for the instruction. Upon recommencement of works, details of any corrective actions and / or remedial measures implemented will be recorded within Section 4.**

TABLE 4.3 ROLES AND RESPONSIBILITIES	
Position	**Roles and Responsibilities**
	• Give tool box talks as agreed with the site contractor to address key areas, including water pollution prevention, protected species management, and on-site biodiversity. • Monitor potential environmental impacts, including: – Use of and storage of oils and toxic chemicals on site, e.g. cement – Dewatering of excavations (including turbine bases) – Silt control – Water management, including working in or close to watercourses – Protection of ecological interests, e.g. protected species and habitats • Identify environmentally-sensitive areas and ecological hazards for demarcation by the Contractor • Produce written reports to the Contractor following site visits and meetings. This includes monthly reports and a final report.
Specialist Ecologist / Environmental Consultant	Where a Specialist Ecologist / Environmental Consultant is employed, this person(s) will: • Provide advice and maintain regular liaison with the Project Site Manager, Project Manager, ECoW, EM, and Contractor and / or other specialist Environmental Consultant as and when required. • Undertake specific monitoring activities and reporting as defined in agreed documentation prepared as part of the planning process.
Contractor Appointments	
Construction Manager	[The Contractor is required to specify roles and responsibilities for each individual below]
Site Agent	[To Be Confirmed]
Foreman	[To Be Confirmed]
EM	[To Be Confirmed]
Other Nominated Person(s)	[To Be Confirmed]

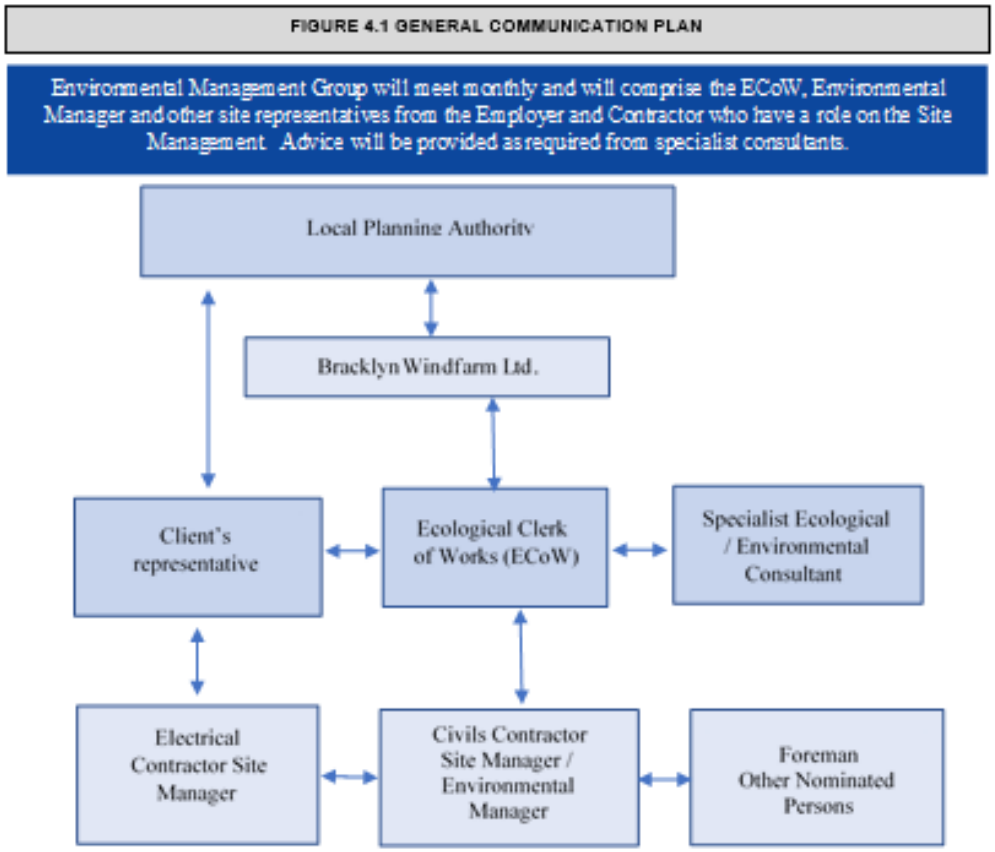

Figure 4.1 General Communication Plan

4.6 Training, Awareness and Competence

All site personnel will receive environmental awareness information as part of their initial site briefing. The detail of the information should be tailored to the scope of their work on site. This will ensure that personnel are familiar with the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

The CEMP will be posted on the main site notice board during the project. The environmental performance at the site will be on the agenda of the monthly project management meetings for the project. Elements of the CEMP will be discussed at these meetings including objectives and targets, the effectiveness of environmental procedures etc. Two-way communication will be encouraged by inviting all personnel to offer their comments on environmental performance at the site.

4.7 Emergency Preparedness and Response

An emergency preparedness and response procedure are required to prevent environmental pollution incidents. Suitable spill kits and absorbent material for dealing with oil spills will be maintained on site. In the event of pollution or potential risk of pollution, Westmeath County Council and Meath County Council will be informed immediately. In the case of water pollution, in addition to Westmeath County Council, Inland Fisheries Ireland will also be informed immediately. In the case of new developments in relation to badgers on site. the Department of Culture, Heritage and the Gaeltacht will be informed.

5 CORRESPONDENCE, RECORDS & REPORTS

5.1 Requirements

The Contractor will insert / file all communication records and reports associated with Environmental Management and implementation of this CEMP under this Section 5. As a guide, the following sub-sections of filed information will be required (at a minimum):

A) Meeting minutes and attendance record

B) Weekly Environmental Reports

C) Monthly Environmental Reports

D) Environmental Checks

E) Audit Reports

F) Ecology documentation and monitoring records

G) Pollution Prevention, including a Pollution Prevention Measures Register

H) Water Quality documentation and monitoring records

I) Archaeology documentation and monitoring records

J) Ground Risk, including a Geotechnical Risk Register

K) Waste Management documentation

L) Licensing and Consents: copies of all permissions, consents, licenses and permits and related correspondence. A summary record of all such documents shall also be provided as per Table 5.1 of this CEMP.

M) General Correspondence: all other relevant internal and external communication records relating to environmental management issues and implementation of the CEMP.

N) Training Records

O) Toolbox Talk Records

P) EM Reports

All of these documents and records will be made available for inspection in the site office. The documentation will be maintained and will be reviewed on a regular basis with revisions controlled in accordance with the site quality plan.

5.2 Environmental Audits

The Contractor's EM will consult and assist with the Client EM in evaluating compliance with applicable legislation by means of a monthly Environmental Audit.

A blank Environmental Audit Report form is included in TS1 Environmental Incident and Emergency Response Plan.

All completed audit report forms and records of corrective actions (and close outs) must be filed within this Section of the CEMP.

5.3 Environmental Consents, Licenses & Permits

The Contractor's EM (or otherwise nominated responsible person(s), in conjunction with the ECoW, will complete the summary record for all applicable permissions, consents, licenses and permits obtained for the site. This record will follow the format provided in Table 5.1.

TABLE 5.1 RECORD OF ENVIRONMENTAL CONSENTS, LICENSES AND PERMITS ISSUED		
Consents, Licenses & Permits	**Governing Legislation**	**Licensed Activity**
Pollution Control & Hydrology		
Section 50 consents for watercourse crossing (application in progress)	EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010 and Section 50 of The Arterial Drainage Act, 1945.	Construction, Replacement or Alteration of Bridges and Culverts.
Biodiversity		
Waste Management / Contaminated Land		
Noise / Vibration		
Archaeology		
Transport		
Other		

5.4 Environmental Monitoring and Measuring

All of the mitigation measures outlined in Section 3.0 will be monitored, where applicable. The Contractor will put in place a program of monitoring for dust, noise, vibration and water sampling in accordance with the requirements of this CEMP. A separate Ecological and Environmental Monitoring Proposals Document has been prepared and should be read in conjunction with this CEMP.

Copies of all records will be maintained in the site office and will be reviewed by the Contractor.

5.5 Non-Conformance, Corrective and Preventative Action

Non-Conformance Notices will be issued where there is a situation where limits associated with activities on the project are exceeded, or there is an internal/external complaint associated with environmental performance.

Non-Conformance is the situation where essential components of the Environmental Management Statement (EMS) are absent or dysfunctional, or where there is insufficient control of the activities and processes to the extent that the functionality of the EMS in terms of the policy, objectives and management programmes, is compromised.

Correction will be required in order to improve the identified non-conformance. The EMS and all its components must conform to the CEMP, objectives and targets and the requirements of the ISO 14001 management standard. In the event of non-conformance with any of the above, the following must be undertaken:

- Cause of the non-compliance;
- Develop a plan for correction of the non-compliance;
- Determine preventive measures and ensure they are effective;
- Verify the effectiveness of the correction of the non-compliance;
- Ensure that any procedures affected by the corrective action taken are revised accordingly.

Responsibility must be designated for the investigation, correction, mitigation and prevention of non-conformance.

6 TECHNICAL SCHEDULES & AVAILABLE INFORMATION

6.1 Technical Schedules

Various Technical Schedules have been prepared by Jennings O'Donovan and Partners Ltd. as listed in Table 6.1. These are intended to provide a benchmark for best practice and to define Bracklyn Windfarm Ltd.'s minimum requirements for environmental management and mitigation.

6.2 Contractor Requirements

The Contractor is required to further develop the Technical Schedules into detailed site and works specific environmental plans, method statements and procedural documents. Table 6.1 provides a summary of the content of the Technical Schedules and the Contractor's obligations for their further development.

TABLE 6.1 LIST OF TECHNICAL SCHEDULES

TS 1	Environmental Incident and Emergency Response Plan	The Contractor will prepare a detailed Environmental (Incident and Emergency) Response Plan. This will include procedures for dealing with containment of accidental chemical or fuel spills, potential overload of the drainage system by silt during unforeseen adverse weather conditions etc.
TS 2	Surface Water Management Plan	The SWMP has described how the site drainage system will operate to minimise modification and disruption to the existing site hydrology. This includes an outline of the proposed drainage maintenance and management regime post-construction. The contractor is obliged to implement the SWMP.
TS 3	Water Quality Monitoring Plan (WQMP)	The WQMP is to be agreed with Westmeath County Council and Meath County Council upon which, the contractor will be obliged to implement it.
TS 4	Spoil Management Plan (SMP)	The SMP has estimated the volume of spoil that will be generated during the construction phase, and it outlines the locations where the material can be re-used on site. The contractor is obliged to implement the SMP.
TS5	Waste Management Plan (WMP)	A WMP is intended to implement reduction and effective management of resources and waste during the early design stages of the wind farm construction, through to completion, such that legal compliance is met; project build costs are minimised; a framework for continuous improvement and best practice is implemented and maintained; and carbon emissions and other negative environmental impacts associated with the production and management of waste materials are

TABLE 6.1 LIST OF TECHNICAL SCHEDULES		
		minimised. The WMP provides an outline of the minimum requirements to be contained within the Contractor's detailed WMP. TS5 also provides an outline of the anticipated waste management procedures and routes that may apply during construction. In preparation of the detailed WMP, the Contractor will liaise the local authority and relevant bodies to determine requirements for, and obtain, licenses and consents associated with waste management and foul water discharge from the site where appropriate.