Environmental Impact Assessment Report

Proposed Derrinlough Wind Farm, Co. Offaly

Volume 1

Non-Technical Summary and Main Report

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NON-TECHNICAL SUMMARY

Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared by MKO on behalf of Bord na Móna Powergen Ltd who intends to apply to An Bord Pleanála for planning permission for a proposed wind farm development located in Derrinlough and adjacent townlands, Co. Offaly.

The townlands in which the wind farm site, ancillary works and grid connection are located, are listed in Table 1.

Table 1 Townlands within which the proposed development is located

Townland	
Ballindown	Derryad (Eglish by)
Balliver	Derrymullin and Loughderry
Broughal	Drinagh
Carrick (Garrycastle by)	Galros East
Clongawny More	Galros West
Cloonacullina	Guernal
Clooneen	Kilcamin
Coolreagh or Cloghanhill	Lumcloon
Cortullagh or Grove	Mullaghakaraun Bog
Crancreagh	Stonestown
Dernafanny	Timolin
Derrinlough	

The proposed development will encompass 21 No. wind turbines up to a tip height of 185m and will have a maximum export capacity (MEC) in excess of 85MW. On the 25th November 2019, An Bord Pleanála decided that the proposed development falls within the scope of Strategic Infrastructure Development under Section 37A of the Planning and Development Acts 2000 to 2019.

The proposed development, known as Derrinlough Wind Farm, will be located on Clongawny and Drinagh Bogs which are part of the Boora peat production bog group in Co. Offaly. Although peat extraction has currently ceased at the site, it continues to comply with the requirements of the IPC licence for Boora bog group (IPC Licence Register No. P0500-01) which is regulated by the Environmental Protection Agency (EPA).

The Derrinlough Briquette Factory is located between the two bogs, along the N62 on the eastern side of the road. This plant processes the peat from a number of bogs in the midlands into briquettes and consists of the factory and a number of ancillary buildings. The briquette factory is in operation since

1960. The surrounding bogs were developed and drained during the 1950's in order to be available to the Briquette factory when it commenced processing in 1960.

The land uses and types within the proposed development site are a mixture of bare cutover and cutaway peat, re-vegetation of bare peat, commercial forestry, telecommunications (a 30m Mast) and wind measurement (a single 100m anemometry mast on Clongawny Bog). There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to the Briquette Factory.

The ESB owned, peat powered, West Offaly Power Station, which is scheduled to close in 2020, is a significant piece of energy infrastructure in the area and is located immediately south of Shannonbridge with the peat supplied from the surrounding Bord na Móna bogs.

Grid infrastructure in the area includes a 400 kV line from Moneypoint to Woodland Station near Dublin which runs approximately 3km to the south of the site. There are two 220 kV lines, one running south from Shannonbridge approximately 1km to the west of Clongawny bog and another running eastwards from Shannonbridge approximately 7 km to the north of both bogs. There is also a 110 kV network in the area with two lines running to the north of Clongawny and Drinagh, one line to the west of Clongawny and one line to the east of Drinagh.

Need for the Proposed Development

The EU adopted Directive (2009/28/EC) on the Promotion of the Use of Energy from Renewable Sources in April 2009 which includes a common EU framework for the promotion of energy from renewable sources. The Directive sets a mandatory national target for the overall share of energy from renewable sources for each Member State.

To ensure that the mandatory national targets are achieved, Member States must follow an indicative trajectory towards the achievement of their target as outlined in Ireland's National Renewable Energy Action Plan (NREAP). Ireland's mandatory national target is to supply 16% of its overall energy needs from renewable sources by 2020. This target covers energy in the form of electricity (RES-E), heat (RES-H) and transport fuels (RES-T). The contribution of renewables to gross final consumption (GFC) was 9.5% in 2016, compared to the 2020 target of 16% ('Energy in Ireland 1990-2016', SEAI, December 2017). Furthermore, In March 2019, the Government announced a renewable electricity target of 70% by 2030. The proposed development is likely to be operational before 2030 and would therefore contribute to this 2030 target. More recently, the EPA reported that Ireland is set to fall far short of all of its carbon emissions reduction targets for both 2020 and 2030 despite climate action measures in the National Development Plan (EPA, June 2019).

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Irelands environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption. The CAP identifies a need for 8.2GW of onshore wind generation. Only 3.7GW is in place as of December 2019, therefore Ireland needs to more than double its installed capacity of wind generation. The CAP presents clear and unequivocal support for the provision of additional renewable energy generation and presents yet further policy support for increased wind energy.

Economic Benefits

The proposed wind farm project will be capable of providing power to approx. 58,315 households every year and will result in the net displacement of between approximately 90,000 and 170,000 tonnes of Carbon Dioxide (CO_2) per annum, depending on the fossil fuel source to which it is compared.

The proposed development will have both long-term and short-term benefits for the local economy including job creation (estimated at 100-120 jobs during the construction, operational and maintenance phases of the proposed development), local authority commercial rate payments and a Community Benefit Scheme.

There are substantial opportunities available for areas where wind farms and other types of renewable energy developments are located, in the form of Community Gain Funds. Based on the current proposal, a Community Gain Fund in the region of €10 million will be made available over the lifetime of the project. The value of this fund will be directly proportional to the installed capacity and/or energy produced at the site and will support and facilitate projects and initiatives including youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects.

Recreational Benefits

In addition to the economic and environmental benefits of the proposed development, there will be potential social and recreational benefits associated with the proposed Recreational Amenity pathway for use by members of the local and wider community alike. The peatland habitat at both Clongawny and Drinagh Bogs is attractive to both locals and visitors to the area because of its history and variety of vegetation. Sections of the new site roads of the proposed development will be developed and promoted for walking and cycling activities. This proposal is based on the current use of the wider area as an informal walking route; where the proposed amenity facilities will allow for a safer and improved visitor experience and allow the site to be more openly available to walkers, trail runners, cyclists and other recreational users. The proposed development will also facilitate linkages to the wider area and to both existing and proposed amenity walkways.

Purpose and Structure of this EIAR

The purpose of this EIAR is to document the current state of the environment in the vicinity of the proposed development site and to quantify the likely significant effects of the proposed development on the environment. The EIAR submitted by the applicant provides the relevant environmental information to enable the Environmental Impact Assessment (EIA) to be carried out by the competent authority.

The EIAR project team comprises a multidisciplinary team of experts with extensive experience in the assessment of wind energy developments and in their relevant area of expertise. Each chapter of this EIAR has been prepared by a competent expert in the subject matter. The chapters of this EIAR are as follows:

1. *Introduction*
2. *Background to the Proposed Development*
3. *Consideration of Reasonable Alternatives*
4. *Description of the Proposed Development*
5. *Population and Human Health*
6. *Biodiversity*
7. *Ornithology*
8. *Land, Soils and Geology*
9. *Hydrology and Hydrogeology*
10. *Air and Climate*
11. *Noise and Vibration*
12. *Landscape and Visual*
13. *ArchaeologicalCultural Heritage*
14. *Material Assets (including Traffic and Transport, Telecommunications and Aviation)*
15. *Interactions of the Foregoing*
16. *Schedule of Mitigation*

A Natura Impact Statement has also been prepared in line with the requirements of the Habitats Directive and will be submitted to the Planning Authority as part of the planning application documentation.

Background to the Proposed Development

This chapter of the Environmental Impact Assessment Report (EIAR) presents information on renewable energy and climate change policy and targets, the strategic planning context for the proposed development, the site selection and design process, a description of the proposed development site and planning history, the assessment of reasonable alternatives, scoping and consultation, and the cumulative impact assessment process.

Energy and Climate Change Targets

Renewable energy development is recognised as a vital component of Ireland's strategy to tackle the challenges of combating climate change and ensuring a secure supply of energy. The June 2018 *'Off Target Report'* published by the Climate Action Network (CAN) Europe, which ranks EU countries ambition and progress in fighting climate change, listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate and renewable energy targets and is also off course for its unambitious 2030 emissions target.

The Department of Climate Change, Action & Environment (DCCAE) reported in their *'Fourth Progress Report on the National Renewable Energy Action Plan'* December 2017 that Ireland will achieve 13% of its 16% RES target by 2020. SEAI in their report *'Ireland's Energy Targets – Progress, Ambition & Impacts'* (April 2016) estimates that Irelands inability to achieve its 2020 renewable energy targets will result in fines of between €65 million and €130 million per percentage shortfall on its overall binding target after 2020 until it meets its targets. The latest data available from Eurostat show that as of the 2018 figures, Ireland is still considerably below meeting its 16% target and at the end of 2018 sat at 11.1%.

The SEAI's *'Energy in Ireland 2019'* report provides the most up to date figures available (from 2018) in relation to energy production and consumption in Ireland. The 2019 report found that wind generation accounted for 28.1% (normalised) of all electricity generated, further, wind energy accounted for 84% of the renewable energy generated in 2018. In relation to the findings of this SEAI report it is clear that wind energy represents the strongest and most deployable renewable energy resource available to reduce dependence on fossil fuels in Ireland. While it is clear that additional deployment is on-going, it is also apparent that it is unlikely that the 2020 targets for renewable electricity generation will be met.

Offaly County Council Development Plan 2014-2020

The Offaly County Development Plan 2014-2020 (CDP) is the principal instrument that is used to manage change in land use in the County. The Plan sets out the Council's strategic land use objectives and policies for the overall development of the County up to the year 2020 and beyond. A core strategy of the plan surrounds the need for adapting to climate change, it is stated that:

> *"To ensure that development promoted, supported or facilitated by the Development Plan provides for the adaptation to climate change and the promotion of renewable energy where possible including the increased risk of flooding."*

The Plan, through its inclusion of an Energy Strategy, acknowledges the importance of energy to the local economy ensuring that the County is positioned in order to compete for future investment in generation capacity. The County Development Plan 2014-2020 sets a number of objectives in relation to energy/ renewable energy which include the following:

- RDP–08: It is Council policy to support the development of renewable energy in rural areas, where it is considered appropriate i.e. where it is demonstrated that such development will not result in significant environmental effects. Such development will be assessed on a case-by-case basis.
- RDP–09: It is Council policy to encourage and facilitate the development of local and community based renewable energy projects in the county, notwithstanding their suitability and additional considerations such as location, nature of use, compliance with relevant guidelines and scale, where it can be demonstrated that such proposals are feasible.
- RDP–11: It is Council policy to encourage expansion and employment in industries such as agriculture, horticulture, forestry, peatlands, food, crafts, tourism and energy.

In relation to energy the following objectives have been set to aid the plan in meeting its goals during the duration of the development plan:

- **EP–01**: It is Council policy to support national and international initiatives for limiting emissions of greenhouse gases and to encourage the development of renewable energy sources.
- **EP–02**: It is Council policy to facilitate the continual development of renewable energy sources having regard to the proper planning and sustainable development of the area concerned, the protection of amenities, landscape sensitivities, European Sites, biodiversity, natural heritage, and built heritage, and where such proposals comply with policy contained in the County Development Plan, in the interests of proper planning and sustainable development.
- **EP–03**: It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out.
    - The Area around Corracullin Bog, (Area 4 in Wind Energy Strategy), is omitted from the Wind Energy Development Area.
- **EP–05**: It is Council policy that applications for wind energy development outside of the wind energy development areas open for consideration identified in Map 3.2 will not normally be permitted except when it can be demonstrated that the proposal falls into the following category:
    - Category A: Single Turbines that are sited close to and specifically relate to the operations of an industrial/commercial premises or a school, hospital or other community-related premises. Supporting evidence must be provided detailing that the development will only facilitate and is only related to the operation of the business or community facility.
    - Each proposal within this category will be open for consideration outside of the wind energy development areas and subject to site specific assessment in accordance with relevant guidance.
- **EO–01**: It is an objective of the Council to achieve a reasonable balance between responding to government policy on renewable energy and in enabling the wind energy resources of the county to be harnessed in an environmentally sustainable manner. This will be implemented having regard to the Council's Wind Energy Strategy as follows:

- In Areas open for consideration for Wind Energy Development, as identified in Map 3.2;
- In all other areas, Wind Energy Developments shall not normally be permitted except as provided for under exemption provisions and as specifically described in Section 5.4 of the Wind Energy Strategy and Policy EP–05.

Scoping and Consultation

A comprehensive scoping and consultation exercise was undertaken during the preparation of the EIAR. This included:

- *Circulation of a detailed Scoping Document, providing details of the application site, the proposed development and the proposed scope of the EIAR.*
- *Pre-planning meetings with Offaly County Council and An Bord Pleanála*
- *Public consultation including the appointment of a nominated Community Liaison Officer, Community Information Sessions, house-to-house calls, meetings and dissemination of information packs and leaflets.*

Section 2.6 of the EIAR describes the detailed community consultation that has been ongoing in the area around the proposed development site.

Consideration of Reasonable Alternatives

Article IV of the EIA Directive as amended by Directive 2014/52/EU states that the information provided in an Environmental Impact Assessment Report (EIAR) should include a description of the reasonable alternatives studied by the developer which are relevant to the project and its specific characteristics and an indication of the main reasons for the option chosen, taking into account the environmental effects. The consideration of alternatives typically refers to alternative design, technology, location, size and scale. A 'Do Nothing Scenario' i.e. an outline of what is likely to happen to the environment should the Project not be implemented, should also be included.

In implementing the 'Do-Nothing' scenario i.e. if the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

However, the opportunity to capture a significant part of County Offaly's renewable energy resource would be lost, as would the opportunity to contribute to meeting National and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, a development contribution, rates and investment would also be lost. Also, the proposed Recreational Benefits outlined above would be lost as well as the potential connectivity with Lough Boora Parklands. On the basis of the positive environmental effects arising from the project, the do–nothing scenario was not the chosen option.

Bord na Móna owns circa 80,000 hectares of land, primarily in the midlands of Ireland. An assessment of potential future uses of this landbank was published by Bord na Móna in 2011 in a document entitled *'Strategic Framework for the Future Use of Peatlands'*. This report identifies the potential for the development of renewable energy (in particular Wind Energy) and other developments on Bord na

Móna lands. The Project Ireland 2040 National Planning Framework identifies a range of key future planning, development and place-making policy priorities for the Eastern and Midland Region that includes:

> *"Harnessing the potential of the region in renewable energy terms across the technological spectrum from wind and solar to biomass and, where applicable, wave energy, focusing in particular on the extensive tracts of publicly owned peat extraction areas in order to enable a managed transition of the local economies of such areas in gaining the economic benefits of greener energy."*

Consequently, when considering suitable locations for the proposed development, the assessment was confined to lands within the Bord na Móna landholding only as these lands have been identified in a national and regional context as being suitable for this type of development. Bord na Móna conducted a technical review of lands which are either cut away or will be cut away before 2030. A review of the Offer Process Application Information that is provided on the publicly available EirGrid website was also undertaken. Following a site-specific assessment it was determined that Derrinlough (Clongawny/Drinagh) is one of the suitable sites for wind energy development with a low potential for environmental effects and proximity to a potential grid connection.

Solar energy is an alternative source of renewable electricity generation that could be considered for this site; however, to achieve the same energy output, a solar development would require a significantly larger footprint. In addition, a solar development would have a higher potential environmental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity (habitat loss). For this reason, wind energy is considered the most suitable renewable electricity generation option for the site.

It is proposed to install 21 turbines, each with a potential 3-5-megawatt (MW) power output range, achieving an approximate 88.2 MW output. The turbine model to be installed on the site will be the subject of a competitive tendering process with a maximum height of 185m from top of foundation to blade tip. A similar wind energy output could also be achieved on the site by using smaller turbines (for example 2.5 MW machines); however, this would necessitate the installation of over 35 turbines. This greater turbine quantity would result in the wind farm occupying a greater footprint, with a larger amount of supporting infrastructure required (i.e. roads etc.), increasing the potential for negative environmental impacts to occur on biodiversity, hydrology and traffic and transportation. Likewise, smaller turbines would fail to make the most efficient use of the wind resource passing over the site. The 21 turbines with a maximum 185m tip height proposed for Derrinlough takes account of all site constraints and the distances to be maintained between turbines and features such as roads and houses, while maximising the wind energy potential of the site. The 21-turbine layout selected for the site has the smallest development footprint of the other alternatives considered, while still achieving the optimum output at a more consistent level than would be achievable using different turbines.

Alternatives to the layout of the 21 turbines and ancillary infrastructure were also considered for the proposed Derrinlough Wind Farm. The final design takes account of all site constraints (e.g. ecology, ornithology, hydrology, peat depths etc.) and design constraints (e.g. setback distances from houses and third-party lands/infrastructure and distances between turbines on-site etc.). It also takes account of the results of all site investigations and baseline assessments that have been carried out during the EIAR process in addition to feedback from the relevant statutory and non-statutory organisations, local authorities and ongoing discussions with the local community.

Alternative transport routes for the delivery of wind turbine components were assessed as part of the design of the proposed development. The proposed route was considered to be the preferred route given the limited road upgrade work required and its proved suitability for the transport of turbine components for the recently constructed Meenwaun Wind Farm, located directly to the southwest of the proposed development site.

The site layout aims to avoid any environmentally sensitive areas. Where loss of habitat occurs in the site, this has been mitigated with the proposal of enhancement lands. The alternative to this approach is to encroach on the environmentally sensitive areas of the site and accept the potential environmental effects and risk associated with this. The best practice design and mitigation measures set out in this EIAR will contribute to reducing any risks and have been designed to break the pathway between the site and any identified environmental receptors. The alternative is to either not propose these measures or propose measures which are not best practice and effective and neither of these options is sustainable.

The final design is considered the optimal layout given it has the least potential for environmental effects.

Description of the Proposed Development

The overall layout of the proposed development is shown on Figure 4.1. This drawing shows the proposed locations of the wind turbines, electricity substation, construction compounds, internal roads layout and the site entrances. Detailed site layout drawings of the proposed development are included in Appendix 4.1 to this EIAR.

The 21 no. proposed wind turbines will have a tip height of up to 185 metres. Within this size envelope, various configurations of hub height, rotor diameter and blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 185 metres above top of foundation. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics, with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be multi-ply coated to protect against corrosion. It is proposed that the turbines would be of an off-white or light grey colour so as to blend into the sky background.

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level on a granular sub-base after the excavation of soil and peat. The size of the foundation will be determined by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. The turbine foundation transmits any load on the wind turbine into the ground. Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position.

To provide access within the site of the proposed development, to connect the wind turbines and associated infrastructure, approximately 29.3 kilometres of access roads will need to be constructed including the upgrade 450m of existing access road.

Two permanent, pre-cast concrete underpasses are proposed as part of the proposed development.The first underpass will traverse beneath the N62, immediately north of Derrinlough Briquette Factory. This underpass will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used during the operational phase to provide access to facilitate wind farm maintenance.A second underpass is proposed in Clongawny bog beneath an existing Bord na Móna railway line. This underpass will also be used for amenity purposes and for wind farm maintenance during the operational phase.

It is proposed to construct an electricity substation within the site of the proposed development as shown in Figure 4.1. The proposed substation site is located within an area adjacent in the north eastern section of the site off the proposed new site road and just south of the north eastern site entrance off the R357 Regional Road.

Two substation control buildings will be located within the substation compound. The wind farm control buildings will include staff welfare facilities for the staff that will work on the proposed development during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.

Each turbine will be connected to the on-site electricity substation via an underground 33 kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in cable ducts approximately 1.3 metres below the ground surface, along the sides of or underneath the internal roadways. A connection between the proposed development and the national electricity grid will be necessary to export electricity from the proposed wind farm. This connection will originate at the proposed onsite substation and will be connected to the national grid via either an underground grid connection cable or overhead line which will connect into the existing 110 kV transmission line located approximately 300m north of the substation. Planning permission is being sought for the overhead line and underground cabling options, however, only one option will be used to connect the proposed development to the national electricity grid.

Two permanent anemometry masts are proposed as part of the proposed development. The anemometry masts will be equipped with wind monitoring equipment at various heights. The masts will be will be slender free standing structures up to 120 metres in height.

Five temporary construction compounds are proposed as part of the proposed development. The construction compounds will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors.

It is estimated that approximately 392,684m3 of peat and spoil will be excavated during the construction of the proposed development. This peat and spoil will be managed by means of placement/spreading along site the proposed infrastructure elements, where suitable. Approximately 735,275m3 of crushed is required for the construction of the proposed development. It is proposed to source stone from local, authorised quarries.

Three entrances are proposed for the construction stage of the proposed development in order to transport turbine components, materials and equipment to the site. The entrance can be described as follows:

- Existing entrance off the N62 to Drinagh Bog;
- Existing entrance off the N62 to Clongawny Bog; and
- Existing entrance off the R357 which connects Drinagh and Noggus Bog.

It is proposed that the large wind turbine plant will be delivered via the M6 before turning south onto the N52 at Junction 5 (Tullamore/Kilbeggan). The route follows the N52 south, bypassing Tullamore to the east and passing through the settlements of Blue Ball, Kilcormac and Five Alley. Deliveries will turn right onto the N62 (at the junction known as Kennedy's Cross) and will proceed northwards towards Cloghan to the proposed site entrances, immediately north of Derrinlough Briquette Factory. A new temporary arrangement will be required at Kennedy's Cross, located in the townland of Ballindown, (junction of the N52 and N62 National Secondary Roads), comprising construction of a new junction bypass road across third party lands, to facilitate the delivery of turbine components and other abnormal loads. The proposed new road will measure approximately 160 metres in length.

The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. There is an existing drainage system and surface water discharges from the site which are regulated by the Environmental Protection Agency (Licence Ref. P0500-01). The proposed development drainage design for the proposed development has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones around the existing natural drainage features have been used to inform the layout of the proposed development.

It is estimated that the construction phase will take approximately 24 to 30 months from starting onsite to the full commissioning of the wind farm. The construction phase can be broken down into three main phases, 1) civil engineering works: 18 months, 2) electrical works: 18 months, and 3) turbine erection and commissioning: 9 months.

During the operational phase, each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation and site tracks will also require periodic maintenance.

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the proposed development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB/EirGrid.

Population and Human Health

One of the principle concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values, shadow flicker, noise and health and safety.

The wind farm site is located approximately 3km east of Banagher town and 2km south of Cloghan village, in which the main services are located. The nearby town of Birr lies approximately 7km south of the proposed development where local amenities including a community centre, church and shop are located. There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself although it is proposed to develop a recreational and amenity facility as part of the Proposed Development.

The Study Area for the Population and Human Health assessment was defined by the 7 No. District Electoral Division (DED)s within and adjacent to the development site. The population of the DEDs within the Study Area increased by 1.6% between 2011 and 2016, growing from 4,530 to 4,601 persons, respectively, with the rate of population change unevenly distributed between the DEDs. The levels of employment within the 7 No. DEDs in the 'Employer/Manager', 'Higher Professional' and 'Non-Manual' categories in the Study Area were lower than those recorded for the State and County Offaly, while those recorded within the 'Semi-Skilled', 'Un-Skilled', 'Farmer', 'Agricultural Worker' and 'Own Account' categories were higher. The highest level of employment within the Study Area was recorded in the 'Other' category.

As stated above, approximately 100-120 jobs could be created during the construction, operation and maintenance phases of the proposed development with most construction workers and materials sourced locally, thereby helping to sustain employment in the construction trade. This will have a Short-Term Significant Positive Impact.

There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised in Chapter 5 of this EIAR. Although there have been no empirical studies carried out in Ireland on the effects of wind farms on property prices, it is a reasonable assumption based on the available international literature that the provision of a wind farm at the proposed location would not impact on the property values in the area.

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. An indoor phenomenon, it may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Shadow flicker effect lasts only for a short period of time and happens only in certain specific combined circumstances. Current guidelines recommend that shadow flicker at neighbouring dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. The closest occupied dwelling is 762m from the nearest proposed turbine, with 82 dwellings located within 1.5km of the turbine locations. The potential flicker that will occur at houses located within the area surrounding the proposed development was calculated using the WindFarm software package and a regional sun factor of 26.6% was applied. Of the 82 No. residential properties modelled, it is predicted that 34 No. properties may experience daily shadow flicker in excess of the 2006 DoEHLG guideline threshold of 30 minutes per day. However, this prediction does not consider wind direction or screening provided by intervening vegetation and topography.

Where shadow flicker exceedances are experienced a site visit will be undertaken firstly to determine the level of occurrence, existing screening and window orientation. If annoyance is found, suitable mitigation measures as outlined in Chapter 5 will be employed at the potentially affected properties to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any dwelling within the 1.5km study area. The same mitigation strategies also demonstrate that the proposed Derrinlough Wind Farm can be brought in line with the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019) should they be adopted while this application is in the planning system.

Impacts on human beings during the construction and operational phases of the proposed development are described in Chapter 5 in terms of health and safety, employment and investment, population, land-use, noise, dust, traffic, tourism, residential amenity, renewable energy production and reduction in greenhouse gas emissions, shadow flicker and interference with communication systems. Where a negative impact was identified, the appropriate mitigation measures will be put in place to ensure that there will be No Adverse Impacts on human beings within the Study Area.

Following consideration of the residual effects (post-mitigation), the proposed development will not result in any significant effects on population and human health. Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on population and human health are not anticipated at international, national or county scale.

Biodiversity

The Biodiversity Chapter assesses the likely significant effects (both alone and cumulatively with other projects) that the proposed development may have on Biodiversity and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

Multidisciplinary walkover surveys and detailed botanical surveys were undertaken on the 21st June 2018, 28th September 2018, 21st and 22nd August 2019, 18th and 19th September 2019 and 5th December 2019. The majority of the survey timings fall within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith et al., 2011). A comprehensive walkover of the entire site was completed.

The habitats on the proposed development site were the subject of a detailed survey and assessment by Bord na Móna ecologists and a habitat map was produced of the entire landholding of the proposed development. This habitat mapping and assessment was undertaken following the Bord na Móna habitat classification scheme and was cross referenced with 'A Guide to Habitats in Ireland' (Fossitt, 2000).

The study area comprises two large cutover raised bogs. Some areas of the site have been out of commercial peat production by Bord na Móna for a significant period of time and thus, vegetation dominated primarily by birch scrub, common cottongrass and marsh arrowgrass, has regenerated over much of these areas. Small areas/remnant of uncut raised bog occur at various locations at its edges of the site, although these areas occur outside of the development footprint.

The construction of the proposed windfarm and associated infrastructure will result in the direct loss of approximately 32.38 hectares (1.95% of the total study area) of revegetated cutover bog which is developing as pioneer poor fen, heath type habitats, bog woodlands and scrub. The areas of uncut raised bog and natural oak, ash, and hazel woodland habitats have been entirely avoided in the design of the project with no potential for any effect thereon. There will be no significant habitat loss associated with the proposed development and a Biodiversity Management Plan and Lepidoptera Management Plan have been prepared. Following the implementation of these Management Plans, the proposed development has the potential to result in Significant Positive Impacts on biodiversity within the study area.

In general, given the highly modified and bare nature of the exposed peat, limited suitable habitat occurs on site for protected faunal species. A number of badger setts were recorded within the study area but were restricted to the peripheries of the site within heavily vegetated stands of semi-mature trees. Evidence of fox, red deer, red squirrel, pine marten, Irish hare and otter were also recorded within the site. In addition, detailed bat and fisheries assessments have been undertaken as part of the detailed baseline assessment, detailed results of which are provided in technical appendices to this EIAR. No evidence of significant populations of these species at more than a local level was recorded. No signs of any additional protected fauna were recorded within the study area during the field surveys.

No Significant Effects on surface water quality, groundwater quality or the hydrological/ hydrogeological regime are identified for the either construction or operational periods of the wind farm development.

Provided that the proposed development is constructed and operated in accordance with the design, and best practice and mitigation measures described within this application, significant impacts on ecology are not anticipated.

Ornithology

The Ornithology chapter assesses the likely significant effects that the proposed development may have on bird species. Firstly, a brief description of the proposed development is provided. This is followed by a comprehensive description of the desk study, survey methodologies and assessment approach followed in order to obtain the information necessary to complete a thorough assessment of the potential effects of the proposed development on bird species. The survey data is presented in full in the EIAR Appendices, with a summary of the field survey results presented within the chapter. Analysis and evaluation of the results is then provided, which discusses the ecological significance of the birds recorded within the study area. Next the Key Ornithological Receptors (KORs) were determined using the NRA evaluation guidelines as described in the Chapter. The identification of Key Ornithological Receptors and the assessment of effects followed a precautionary approach.

The Sensitivity Determination of the KORs was calculated using guidance outlined in Percival (2003). The potential effects to the KORs, resulting from the proposed development are then described in terms of the construction, operation and decommissioning phases of the development. An accurate prediction of the effects is derived following a thorough understanding of the nature of the proposed development along with a comprehensive knowledge of bird activity within the study area.

The potential for effects on designated sites is fully described in the Natura Impact Statement (NIS) that accompanies this application. The findings presented in the NIS conclude that the proposed development will not have an adverse impact on any European Sites, either alone or in combination with other plans or projects.

Based on the detailed assessment, it is considered that the potential effects of the proposed development upon birds will not be significant. Effects associated with habitat loss and fragmentation, disturbance, displacement, collision risk and cumulative effects have been assessed to be no greater than Long-Term Slight Negative Effect (EPA, 2017), for all species with the exception of lapwing.

A Habitat Enhancement Plan has been proposed for lapwing, waterfowl and waders and is fully described within the Chapter and accompanying Appendix 7-8. With the successful implementation of the Habitat Enhancement Plan, the predicted impacts on lapwing will reduce from Moderate to Long Term Slight Effect (EPA, 2017). The implementation of the plan will also have Positive Effects on other KOR species.

The implementation of the prescribed mitigation measures will render any potential effects on avian receptors to Low Significance. In conclusion, No Significant Effects as a result of the proposed development are foreseen on KORs of the study area at any stage of construction, operation or decommissioning, either in isolation or cumulatively with other surrounding windfarms.

Land, Soils and Geology

This chapter assesses the likely significant effects that the proposed development may have on land, soils and geology and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

Based on the peat depth information for the site, the peat varied in depth from 0 to 4.7m with an average of 1.1m. The peat thickness at proposed infrastructure footprints is generally less than 2m. The deeper peat areas across the two bogs have been avoided in the proposed wind farm layout. The peat deposits at the site are underlain by intermittent shell marl deposits and more common grey lacustrine deposits. The lacustrine deposits are underlain by glacial till. Glacial tills are underlain by limestone bedrock.

The proposed development will typically involve removal of peat and subsoils (spoil) for access roads, internal road network, internal cable network, hardstanding emplacement, turbine foundations, substation, crane hardstands, compounds, met mast and the grid connection trench.

Estimated volumes of peat and spoil to be excavated are in the region of 205,260m^3. Excavated peat and spoil will also be used for reinstatement and landscaping works as close to the extraction point as possible. The handling and storage of peat and spoil will be done in accordance with the Peatand Spoil Management Plan which is included as Appendix 4.2 to the EIAR.

Storage and handling of hydrocarbons/chemicals will be carried out using best practice methods. Measures to prevent peat and subsoil erosion during excavation and reinstatement will be undertaken to prevent water quality impacts.

A Geotechnical and Peat Stability Assessment was undertaken for the site (Appendix 8.1) and it demonstrates an acceptable margin of safety, that the site is suitable for the proposed wind farm development and is considered to be at low risk of peat failure. A number of control measures are given in the peat stability assessment to manage all risks associated with peat instability.

No Significant Impacts on the land and soils and geology environment are anticipated during construction, operation, or during decommissioning phases of the proposed development.

The Land, Soils and Geology Assessment confirms there will be no cumulative effects on land soil and geology environment as a result of the proposed development.

Hydrology and Hydrogeology

This chapter assesses the likely significant effects that the proposed development may have on hydrology and hydrogeology and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains also run north / south, and these connect the smaller field drains. Surface water outflows from the bog are located at the northwest and southeast. Both outfalls are drained by gravity. There is also one pumped outfall along the northern boundary of the bog. There is also one internal pumping station that raises water from a low point within the bog basin.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. Drains here typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall, which is pumped, drain by gravity. The northern outfall is a pumping station.

Regionally, the proposed wind farm development site is located in the River Shannon surface water catchment. The proposed development site drains to the northwest via the Island River, Brosna River, and the Little River, and to the south-west to the Rapemills river. All drainage pathways discharge to the River Shannon.

During each phase of the wind farm development (construction, operation and decommissioning) a number of activities will take place on the proposed Derrinlough wind farm site, some of which will have the potential to significantly affect the hydrological regime or water quality at the site or its vicinity. These significant potential impacts generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement-based compounds, with the former having the most potential for impact.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse impacts on water quality and downstream designated sites. A self-imposed 50m stream and lake buffer was used during the design of the proposed development, thereby avoiding sensitive hydrological features.

The surface water drainage plan will be the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of wind farm runoff into local watercourses. This will be achieved by avoidance methods (i.e. stream buffers) and design methods (i.e. surface water drainage plan). Preventative measures also include fuel and concrete management and a waste management plan which will be incorporated into the Construction and Environmental Management Plan.

Overall the proposed development presents No Significant Impacts to surface water and groundwater quality provided the proposed mitigation measures are implemented.

A hydrological assessment of potential impacts on local designated sites was undertaken, and it is concluded using physical and scientific data and by use of proven mitigation measures, that No Significant Adverse hydrological impacts will occur at designated sites as a result of the proposed wind farm development.

No Significant cumulative hydrological impacts on any of the regional surface water catchment or groundwater bodies are anticipated from the proposed Derrinlough wind farm.

Air and Climate

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the construction, operation and decommissioning of the proposed development.

The Environmental Protection Agency (EPA) has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The site of the proposed development lies within Zone D, which represents rural areas located away from large population centres.

Due to the non-industrial nature of the proposed development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR.

The production of energy from wind turbines has no direct emissions as is expected from fossil fuel-based power stations. Harnessing more energy by means of wind farms will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. Some minor short term or temporary indirect emissions associated with the construction of the wind farm include vehicular and dust emissions.

A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-3 of the EIAR) and includes dust suppression measures. In addition, turbines and construction materials will be transported to the site on specified haul routes only. The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary.

Climate Change and Carbon Balance Calculations

Climate change is one of the most challenging global issues facing us today and is primarily the result of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in energy use. Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

In June 2019, the EPA published an update on Ireland's Greenhouse Gas Emission Projections to 2040. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).

Projected greenhouse gas emissions up to 2040 are obtained using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 are implemented. The 'With Additional Measures' scenario assumes the implementation of the "With Existing Measures" scenario and further implementation of the governments renewable and energy efficiency policies including those set out in the National Renewable Energy Action Plan (NREA), the National Energy Efficiency Action Plan (NEEAP) and the National Development Plan 2018-2027.

The EPA Emission Projections Update notes that Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 5% and 6% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction. Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 10 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 9 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The report concludes:

- *"Projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52-67Mt CO_2 equivalent with the gap potentially narrowing to 7-22 Mt CO_2 equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised."*
- *"To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections."*
- "*Ireland still faces significant challenged in meeting EU 2030 targets in the non-ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans."*

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When development such as wind farms are proposed for peatland areas, there will be direct impacts and loss of peat in the area of the development footprint. There may also be indirect impacts where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

Bord na Móna developed a methodology based on their extensive experience for calculating carbon losses and savings from proposed wind farm development. The methodology was informed by the Scottish Governments Carbon Calculator and other relevant information sources such as:

- Multiyear greenhouse gas balances at a rewetted temperate peatland. (Wilson et al., 2016;
- Greenhouse gas Emission Factors. (Wilson et al., 2016);
- Derivation of GHG emission factors for peatlands managed for extraction in the ROI and the UK. (Wilson et al. 2015); and

- The Effect of Management Strategies on Greenhouse Gas Balances in Industrial Cutaway Peatlands in Ireland (The CARBAL Report) (Wilson, D. and Farrell, E.P., 2007).

This was used to assess the effects of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage and operation of wind farm. The methodology reflects the specific nature of the cutaway peat lands upon which the project is proposed to be located. The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and carbon losses due to peatland disturbance. The model also calculates the carbon savings associated with the proposed wind farm development.

Based on the Bord na Móna model calculations as presented above, 192,665 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment, changes in the cycling of mid-merit gas-fired generation units and due to the construction, operation and decommissioning of the proposed development. This represents a fraction (EU FFC – 4.2%) of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project. The volume of CO_2 that will be lost to the atmosphere will be offset by the proposed development between 1 and 2 years of operation, depending on the fuel source to which it is compared.

Construction of the proposed development will have a Short-Term, Imperceptible Negative Effect as a result of greenhouse gas emissions from construction plant and vehicles. Operation of the proposed development will have a Direct Long-Term Moderate Positive Impact on climate as a result of reduced greenhouse gas emissions.

Noise and Vibration

AWN Consulting Limited has been commissioned to conduct an assessment into the likely environmental noise and vibration impacts of the proposed Derrinlough wind farm development (the 'Proposed Development').

The background noise environment in the absence of existing operational wind farm developments has been established through noise monitoring surveys undertaken at several noise sensitive locations (NSL's) surrounding the Proposed Development. Typical background noise levels for day and night periods at various wind speeds have been measured in accordance with best practice guidance contained in the Institute of Acoustics document 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IoA GPG). The results of the background noise survey have been used to derived appropriate noise criteria for the development in line with the guidance contained in 'Wind Energy Development Guidelines for Planning Authorities 2006.

When considering a development of this nature, the potential noise and vibration effects on the surroundings must be considered for two stages: the short-term construction phase and the long-term operational phase.

The assessment of construction noise and vibration and has been conducted in accordance with best practice guidance contained in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration. Subject to good working practice as recommended in the EIAR Chapter, it is not expected that there will be any significant noise and vibration impacts associated with the construction phase and the likely noise from construction activity at the nearest Noise Sensitive Locations (NSL's) is expected to be well below recommended threshold values. The associated construction noise and vibration impacts are not expected to cause any significant effects.

Based on detailed information on the site layout, the likely turbine noise emissions and turbine hub height for the proposed development, a series of 'worst-case' turbine noise prediction models have been prepared for review. The predicted turbine noise levels have been calculated at all NSL's in accordance with the IOA GPG recommendations. The predicted turbine noise levels associated with the Proposed Development in isolation are predicted to be well within the best practice noise criteria curves recommended in Irish guidance document 'Wind Energy Development Guidelines for Planning Authorities 2006. However, the noise modelling calculations identified 5 no. NSL's where the contribution of the Derrinlough turbines could potentially result in a cumulative turbine noise level that exceed the noise criteria curves (i.e. the total turbine noise levels from all permitted and proposed wind farm developments in the area). This assessment has demonstrated that the turbine noise emissions of the Proposed Development can be attenuated for the 5 no. NSL's identified in the calculations such that the Proposed Development will operate in accordance with best practice guidance and in compliance with relevant noise criteria curves. Attenuation of the proposed Derrinlough turbines, if required, will be achieved using low noise operating modes applied to the selected turbine technology under certain wind speeds and directions. Therefore, it is not considered that a significant effect is associated with the Proposed Development.

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

In summary, the noise and vibration impact of the proposed development is not significant considering national guidance for wind farm developments.

Landscape and Visual

This chapter of the Environmental Impact Assessment Report (EIAR) addresses the potential landscape and visual impacts of the proposed Derrinlough Wind Farm. The emphasis is on the likely significant direct and indirect effects of the proposed development. The chapter outlines the assessment methodology and a description of the existing landscape based on relevant guidance. It includes a description of the landscape policy with specific reference to wind energy and the study area in which the proposed development site is located.

Landscape Assessment

The assessment found that there will be No Adverse Effects on Landscape designations in Counties Tipperary and Galway. Of the County Offaly Areas of High Amenity only the nearest 'Lough Boora Parklands' will experience landscape effects.

The majority of Co. Offaly protected views and scenic routes within the study area will not experience landscape or visual effects. Those with predicted visibility of the proposed turbines, V10, V11, V12, V16 and V17 as well as the two scenic amenity routes, residual visual effects assessed from carefully selected viewpoints range from 'No Effect' to 'Moderate'.

In terms of landscape character, the greatest landscape effects ("Significant") will be experienced in the provisional LCA for Offaly *Central Wetlands*, where the turbines will be located. However, these are mitigated by site design and the characteristics of the site and surrounds which are typical of the LCA. Any other effects on other LCAs would be indirect, as the proposed development might be visible within the LCAs but located outside those other LCAs.

Although, it was found that the proposed turbines would add to the cumulative landscape status, the character of the individual LCAs in terms of wind energy would only change in the provisional Offaly LCA in which the turbines are proposed.

Visual Assessment

The visual impact assessment was based on viewpoints. These were identified after compiling a list of key visual receptors within the study. A preliminary visual receptor assessment excluded those visual receptors that showed no theoretical visibility on the Zone of theoretical Visibility mapping or during site visits alongside designated views whose focus was in the opposite direction of the site. All other key visual receptors were selected as viewpoint locations.

The visual assessment concluded that residual visual effects of "Moderate" was deemed to arise at three of the 16 viewpoint locations. All other viewpoints were assessed as resulting in Slight (7), Not Significant (5). At one viewpoint no visual effect was found.

Furthermore, it was shown that although the ZTV mapping shows widespread theoretical visibility, actual visibility in this generally flat terrain is restricted by the amplified effects of localised screening and changes in local topography.

The cumulative visual effects are considered acceptable, as from most viewpoints there is clear visual cohesion between the proposed turbines and other wind energy developments and the difference in scale or design does not contrast excessively. When compared to the nearest existing turbines, the proposed development is at a lower level, thus there is no great difference in terms of turbine height between the existing and proposed turbines when seen alongside each other.

Archaeological, Architectural and Cultural Heritage

This chapter comprises an assessment of the potential impact of the proposed development on the Cultural Heritage resource. Cultural Heritage includes archaeology, architectural heritage and any other tangible assets. The assessment was based on GIS based mapping, ZTV and Viewshed analysis to assist with the assessment of impacts on setting followed by a desktop analysis of all baseline data and a comprehensive programme of field inspection of the proposed infrastructure within the proposed development site boundary.

Twenty-eight recorded monuments are located within the proposed development site boundary, 14 of which are now redundant records. The wind farm layout has taken their location into consideration in that no RMPs are within the footprint of any proposed infrastructure; therefore, No Direct Impacts to any of the aforementioned sites will occur.

The archaeological potential of the bog is considered to be high taking into consideration the RMPs within the Clongawny and Drinagh bogs, the stray finds spots, evident from the National Museum topographical files, as well as the Mesolithic site of Lough Boora only 6km from the nearest proposed turbine. The discovery of Early Bronze Age activity and a Neolithic stone axe in the nearby Meenwaun windfarm (discovered during archaeological testing and monitoring during construction) is further evidence of human activity in the immediate vicinity of the proposed development site. The walkover survey did not reveal any further archaeological features either on the field surfaces or within drains examined. The overgrown nature of the bog in some areas is somewhat limiting in terms of the discovery of new finds/features. The bogs were subject to peatland surveys in the 1990s and again in the 2009. The re-assessment survey in 2009 had also noted the overgrown nature of the bog and the number of sites had diminished at this stage. The milling and peat reduction that has happened in the intervening period is likely to have removed any surviving features on the field surfaces.

Peat depth data for the bogs suggests that the remaining peat depths vary significantly from 0m up to 4.7m. The impacts on potential unknown sub-surface features is addressed by means of pre-development archaeological testing and monitoring.

Indirect effects on the setting of National Monuments within 10km, RMPs within 5km and RPS/NIAH within 5km were included in order to assess impacts on setting in the wider landscape. Viewshed analysis and a review of the ZTV was undertaken to establish the nature and degree of impacts on the setting of National Monuments. These potential impacts are considered to be 'slight' to 'not significant'. Impacts to setting of RMPs within 5km was undertaken and this included 116 monuments within 5km, the majority occurring between 4 and 5km of the nearest proposed turbine. Impacts to RMPs in the wider setting is considered to be 'slight-moderate'. Impacts to built heritage within 5km of the proposed turbines is also considered to be 'slight-moderate' since none are located within the immediate vicinity.

The substation and grid connection works were also assessed and included in the assessment. Mitigation measures in the form of site monitoring of the construction works is recommended. No known documented cultural heritage features are located within the footprint of the substation and grid connection works. The only junction accommodation works that will take place to facilitate turbine delivery are at Kennedy's Cross in a greenfield site. No RMPs or any other cultural heritage features are located within its footprint. Archaeological monitoring at the construction stage is recommended.

An assessment of cumulative impacts was also undertaken taking into consideration projects within 20km of the proposed development. This included all permitted, proposed and existing turbines as well as quarries which will be utilised to provide stone to the Derrinlough wind farm. No Direct Cumulative Impacts will occur. Some increases in impacts to the visual setting of some cultural heritage sites will occur taking into consideration all turbines (if constructed).

Material Assets

Traffic and Transport

The traffic and transport assessment of the proposed development considers the effects that traffic generated by the proposed development, including the abnormal-size vehicles required to deliver the turbine plant equipment, would have on the surrounding highway network. It should be noted that abnormal weight loads are not a feature of the turbine delivery vehicles. They are abnormal in size only. All construction and delivery vehicles for the proposed development will be subject to the standard axle weight requirements set out under Road Traffic Regulations and therefore the loadings from construction traffic will not exceed the relevant standards.

An abnormal size load delivery route is proposed as follows: From the M6 Motorway turnoff onto the N52 at Kilbeggan, before heading southbound on the N52 towards Tullamore for approximately 8km. The route then bypasses Tullamore on the N52 to the east and south for a further 8km before heading south west for a further 30 km on the N52, passing through the villages of Blue Ball and Kilcormac, in the direction of the town of Birr. The route then turns right onto the N62, using a temporary bypass of the existing junction (known as Kennedy's Cross), just to the north of Birr, heading due north for approximately 8km to the parts of the proposed site. The proposed access junctions are located approximately 200m north of the access to the existing Bord na Móna Briquette Factory.

Three entrances are proposed for the construction stage of the proposed development in order to transport turbine components, materials and equipment to the site. All are existing Bord na Móna machinery entrances which have been in use by the machinery involved in peat harvesting activities. Entrances proposed are as follows:

- Existing entrance off the N62 to Drinagh Bog;
- Existing entrance off the N62 to Clongawny Bog; and
- Existing entrance off the R357 which connects Drinagh and Noggus Bog.

The main entrances for the construction phase of the proposed development are located along the N62. These two entrances will provide access east and west into Drinagh and Clongawny bogs, respectively and will be designed to facilitate both materials delivery to the site (stone, steel and concrete) as well as large oversize components such as turbine blades and tower sections. Upgrade works will be required to these entrance locations in order to accommodate access and egress of turbine delivery and construction vehicles. Following the construction phase of the proposed development, the upgraded areas of these entrances will be closed by erecting fencing, however they may need to be reopened during the lifetime of the development should replacement blades or other abnormal loads be required to access the site.

The access off the R357 will be used for delivery of substation components and materials required for the construction of the substation and grid connection works only and will not be used to provide access for turbine components. As such, this site entrance will have a comparatively low level of construction traffic and associated material deliveries. Minor upgrade works will be required to this entrance location in order to accommodate access and egress of construction vehicles. This entrance will be upgraded after construction to provide permanent access to a proposed amenity car park. In addition, the existing machine pass off the L7009 Local Road will be upgraded to provide permanent access to the proposed substation and local access to the proposed amenity pathway during the operational phase.

The delivery route for general HGV construction traffic may vary depending on the location of quarries and the suppliers used for stone and other materials required to construct the proposed development. Based on the location of quarries in the vicinity of the Proposed Development and the fact that deliveries of stone comprise the majority of deliveries to from the site.

It is estimated that a maximum of 100-120 staff members will be employed on the site at any one time during the site preparation and groundworks stage of construction, reducing to a maximum of 80 staff at any one time during the turbine construction stage. If a worst case is assumed that all staff will travel to /from the site by car, at an average of 2 persons per car, then a total of 120 pcu movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 80 pcu trips during the turbine construction stage.

It is estimated that the wind farm will be unmanned once operational and will be remotely monitored. Traffic associated with the operational phase of the wind farm will be from the wind farm operator, Eirgrid personnel visiting the substation, and maintenance personnel who will visit individual turbines. It is estimated that the traffic volumes that will be generated by the development once it is operational will be minimal, with a likely approx. 2 staff employed on site at any one time.

The successful completion of this project will require significant coordination and planning, and a comprehensive set of traffic management measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional temporary traffic generated by the proposed wind farm. The range of measures are set out in the Construction and Environmental Management Plan (CEMP) which will be implemented during construction and these measures include the appointment of a traffic management coordinator, agreement of a delivery programme with Offaly County Council, use of temporary signage, management of site access and provision of information to local residents.

Telecommunications and Aviation

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path.

Although it was noted that there was not potential for interference from RTÉ Transmission Network (operating as 2rn), it is standard practice of 2rn to produce a Protocol Document for wind farm developments, which will be signed by the developer. The Protocol Document ensures that in the event of any interference occurring to RTÉ television or radio reception due to operation of a wind farm, the required measures as set out in the document, will be carried out by the developer to rectify this. The Protocol Document ensures that the appropriate mitigation is carried out in the event of any unanticipated broadcast interference arising to RTÉ television or radio reception as a result of the proposed wind farm.

No scoping response was received from Ripple.com, Airspeed, Comreg, Department of Defence - Telecoms, and EMR Solutions.

Of the scoping responses received from telephone, broadband and other telecommunications operators, Eir (Meteor), ESB Telecoms, Tetra Ireland Communications, Three Ireland, and Vodafone Ireland requested buffers to be added to existing links within the area. The requested buffers have been incorporated into the final proposed turbine layout and therefore, the proposed development does not overlap with any of the telecoms links or clearance zones as requested by operators.

In July 2018, a scoping response was received from the Department of Defence which set out lighting requirements for turbines, as follows:

1. *Single turbines or turbines delineating corners of a wind farm should be illuminated by high intensity obstacle strobe lights.*
2. *Obstruction lighting elsewhere in a wind farm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight.*
3. *Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (NM) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment.*

The final design layout was sent to the Department of Defence on the 8th November 2019 and a response restating item 3, as above, was returned on 7th December 2019. In response to the lighting requirements requested by the Department of Defence, the turbines will be included on mapping, fitted obstruction lighting and entered into aircraft navigation databases to ensure they will be avoided during flight.

The Irish Aviation Authority (IAA) replied on the 25th June 2018 to a scoping request from MKO outlining recommended conditions should the project be granted a consent:

1. *Agree an aeronautical obstacle warning light scheme for the wind farm development*
2. *Provide as-constructed co-ordinates in WGS84 format together with ground and tip height elevations at each wind turbine location*
3. *Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.*

All of the above requests will be complied with should the proposed development receive a grant of planning permission.

In summary, there will be no significant impact on telecommunications and aviation as a result of the proposed development.

Interactions of the Foregoing

Chapters 5 to 14 of this EIAR identify the potential significant environmental effects that may occur in terms of Population and Human Health, Biodiversity, Ornithology, Land, Soils and Geology , Hydrology and Hydrogeology, Air and Climate, Noise and Vibration, Landscape and Visual, Cultural Heritage and Material Assets, as a result of the proposed development. All of the potential significant effects of the proposed development and the measures proposed to mitigate them have been outlined in the main EIAR. However, for any development with the potential for significant environmental effects there is also the potential for interaction between these potential significant effects. The result of interactive effects may exacerbate the magnitude of the effects or ameliorate them or have a neutral effect.

A matrix is presented in Chapter 15 of the EIAR to identify interactions between the various aspects of the environment already discussed in the EIAR. The matrix highlights the occurrence of potential positive or negative impacts during both the construction and operational phases of the proposed development. Where any potential interactive impacts have been identified, appropriate mitigation is included in the relevant sections (Chapters 5–14) of the EIAR.

1. INTRODUCTION

1.1 Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared by McCarthy Keville O'Sullivan Ltd. (MKO) on behalf of Bord na Móna Powergen Ltd., as part of an application for planning permission for the construction of a wind energy development in Derrinlough and adjacent townlands, Co. Offaly, as listed in Table 1.1 Townlands within which the proposed development is located below.

The proposed wind energy development will encompass 21 No. wind turbines up to a tip height of 185 metres above the top of the foundation and will have a maximum export capacity (MEC) in excess of 85MW. The application meets the threshold for wind energy set out in the Seventh Schedule of the Planning and Development Acts 2000 to 2019 and is therefore being submitted directly to An Bord Pleanála as a Strategic Infrastructure Development (SID) in accordance with Section 37E of the Planning and Development Acts 2000 to 2019.

Table 1.1 Townlands within which the proposed development is located

Townland	
Ballindown	Derryad (Eglish by)
Balliver	Derrymullin and Loughderry
Broughal	Drinagh
Carrick (Garrycastle by)	Galros East
Clongawny More	Galros West
Cloonacullina	Guernal
Clooneen	Kilcamin
Coolreagh or Cloghanhill	Lumcloon
Cortullagh or Grove	Mullaghakaraun Bog
Crancreagh	Stonestown
Dernafanny	Timolin
Derrinlough	

The proposed development, known as Derrinlough Wind Farm, will be located on Clongawny and Drinagh Bogs which are part of the Boora peat production bog group in Co. Offaly. Although peat extraction has currently ceased at the site, it continues to comply with the requirements of the IPC licence for Boora bog group (IPC Licence Register No. P0500-01) which is regulated by the Environmental Protection Agency (EPA).

The two bogs have a total area of approximately 2,360 hectares. Combined they are approximately 6 kilometres (km) long in a north/south direction and 9km wide in an east/west direction at their widest point. The closest settlements to the site are Cloghan which is located approximately 2km to the north and Fivealley which is located approximately 2.5km to the south. Other settlements and towns in the area include Banagher (c. 3km west), Ferbane (c. 6km north) Birr (c. 7km south-west) and Shannonbridge (c. 15km north-west). The site location is shown on Figure 1.1.

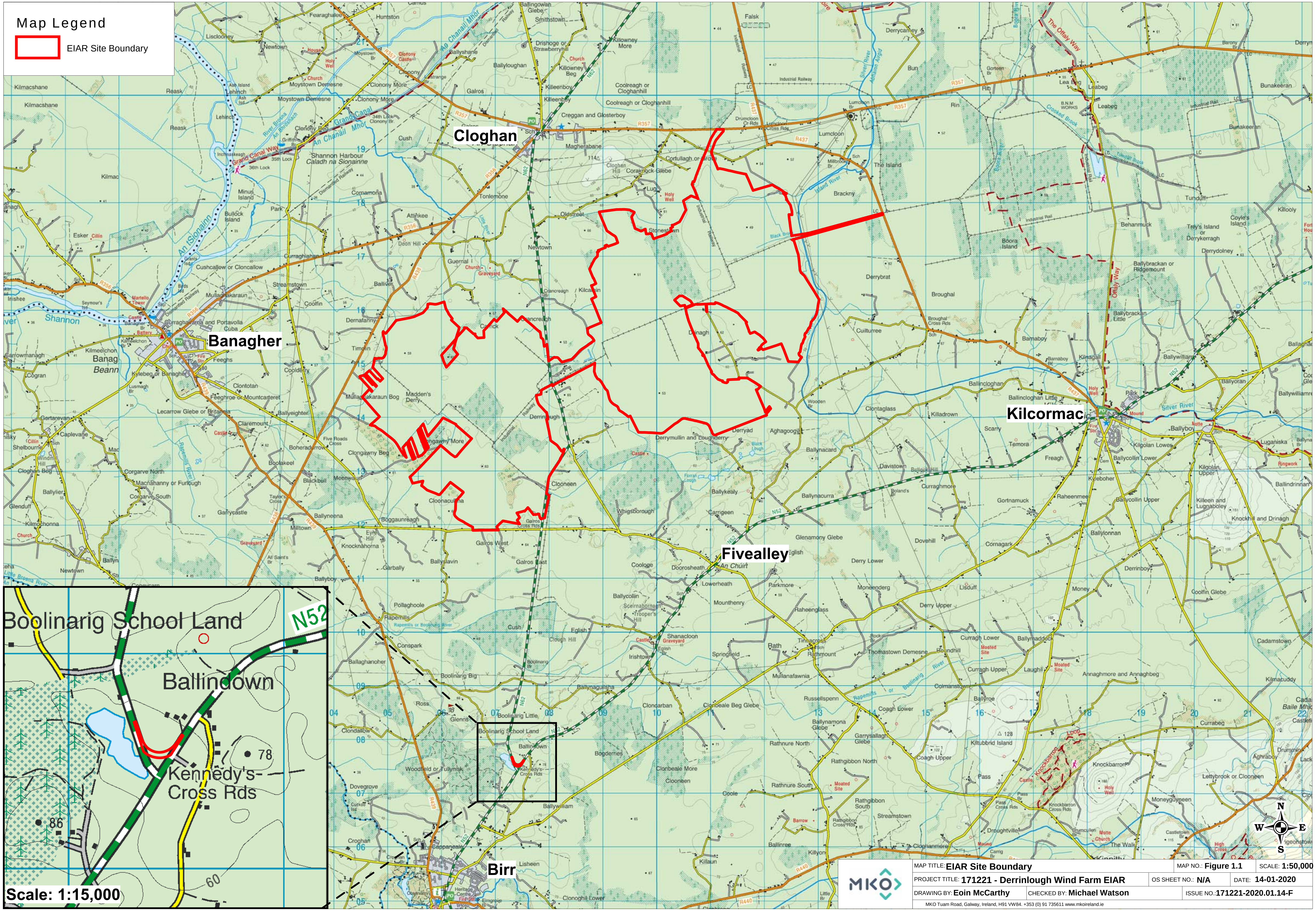
The Derrinlough Briquette Factory is located between the two bogs, along the N62 on the eastern side of the road. This plant processes the peat from a number of bogs in the midlands into briquettes and consists of the factory and a number of ancillary buildings. The briquette factory is in operation since 1960. The surrounding bogs were developed and drained during the 1950's in order to be available to the Briquette factory when it commenced processing in 1960.

The land uses and types within the proposed development site are a mixture of bare cutover and cutaway peat, re-vegetation of bare peat, commercial forestry, telecommunications (a 30m Mast) and wind measurement (a single 100m anemometry mast on Clongawny Bog). There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to the Briquette Factory.

The surrounding land uses and types comprise a mixture of forestry, agricultural land, a mosaic of active peat extraction, cutover and cutaway peatland, amenity (e.g. Lough Boora Parklands) and wind energy. The operational Meenwaun Wind Farm is located adjacent to the southwestern boundary of the proposed development site.

The ESB owned, peat powered, West Offaly Power Station which is scheduled to close in 2020, is a significant piece of energy infrastructure in the area and is located immediately south of Shannonbridge with the peat supplied from the surrounding Bord na Móna bogs.

Grid infrastructure in the area includes a 400 kV line from Moneypoint to Woodland Station near Dublin which runs approximately 3km to the south of the site. There are two 220 kV lines, one running south from Shannonbridge approximately 1km to the west of Clongawny bog and another running eastwards from Shannonbridge approximately 7 km to the north of both bogs. There is also a 110 kV network in the area with two lines running to the north of Clongawny and Drinagh, one line to the west of Clongawny and one line to the east of Drinagh.



Map Legend
EIAR Site Boundary
Cloghan
Banagher
Kilcormac
Fivealley
Birr
Boolinarig School Land
Ballindown
Kennedy's-Cross Rds
N52
Scale: 1:15,000
MKO
MAP TITLE: EIAR Site Boundary
MAP NO.: Figure 1.1
SCALE: 1:50,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
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1.2 Legislative Context

On the 25th November 2019, An Bord Pleanála decided that the proposed development falls within the scope of Strategic Infrastructure Development under Section 37A of the Planning and Development Acts 2000 to 2019.

The consolidated European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive'), has been transposed into Irish planning legislation by the Planning and Development Acts 2000 to 2019 and the Planning and Development Regulations 2001 to 2019. The EIA Directive was amended by Directive 2014/52/EU which has been transposed into Irish law with the recent European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018). Most of the provisions of the new regulations came into operation on the 1st of September 2018 with a number of other provisions coming into operation on the 1st of January 2019.

Accordingly, this EIAR complies with the EIA Directive as amended by Directive 2014/52/EU. To the extent relevant and necessary, regard has been had to the existing provisions of the Planning and Development Act 2000 to 2019 and the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018.

The Environmental Impact Assessment (EIA) of the proposed project will be undertaken by An Bord Pleanála, as the competent authority.

Article 5 of the EIA Directive as amended by Directive 2014/52/EU provides where an EIA is required, the developer shall prepare and submit an environmental impact assessment report (EIAR). The information to be provided by the developer shall include at least:

a) *a description of the project comprising information on the site, design, size and other relevant features of the project;*
b) *a description of the likely significant effects of the project on the environment;*
c) *a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*
d) *a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;*
e) *a non-technical summary of the information referred to in points (a) to (d); and (f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.*

In addition, Schedule 6 to the Planning and Development Act 2000 to 2019 sets out the information to be contained in an EIAR, with which this EIAR complies.

MKO was appointed as environmental consultant on the proposed project and commissioned to prepare this EIAR in accordance with the requirements of the EIA Directive as amended by Directive 2014/52/EU.

The relevant classes/scales of development that normally require Environmental Impact Assessment (EIA) are set out in Schedule 5 of the Planning and Development Regulations 2001 to 2019. The relevant class of development in this case relates to "installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output greater than 5 megawatts", as per Item 3(i) of the Schedule. The proposed development exceeds 5 turbines and 5 Megawatts in scale, and therefore is subject to EIA.

The EIAR provides information on the receiving environment and assesses the likely significant effects of the proposed project on it and proposes mitigation measures to avoid or reduce these effects. The function of the EIAR is to provide information to allow the competent authority to conduct the Environmental Impact Assessment (EIA) of the proposed project.

All elements of the project, (including the wind turbines and associated infrastructure, substation, grid connection and turbine delivery route) have been assessed as part of this EIAR.

1.2.1 EIAR Guidance

The Environmental Protection Agency (EPA) published its *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017), which is intended to guide practitioners preparing an EIAR in line with the requirements set out in the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

In preparing this EIAR regard has also been taken of the provisions of the '*Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment*', published by the Department of Housing, Planning and Local Government (DHPLG) in August 2018 to the extent these guidelines are relevant having regard to the enactment of the revised EIA Directive.

The European Commission also published a number of guidance documents in December 2017 in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU as amended by 2014/52/EU) including '*Guidance on Screening*', '*Guidance on Scoping*' and '*Guidance on the preparation of the Environmental Impact Assessment Report*'. MKO has prepared the EIAR with regard to these guidelines also.

1.2.2 Wind Energy Development Guidelines for Planning Authorities

The relevant considerations under the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government (DOEHLG), 2006) have also been taken into account during the preparation of this EIAR.

The '*Wind Energy Development Guidelines for Planning Authorities*' (DoEHLG, 2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the document '*Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review*' (December 2013), the '*Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach'* (June 2017), and the Draft Revised Wind Energy Development Guidelines (December 2019). A consultation process in relation to the 2019 document commenced on the 12th of December 2019 and is currently being undertaken by the Department of Housing, Planning and Local Government (DoHPLG).

Should the revised Wind Energy Guidelines be adopted in advance of a planning decision being made on the proposed development, with current noise and shadow flicker thresholds being amended, if necessary, the proposed development is capable of complying with any revised noise and shadow flicker requirements by implementing mitigation through use of the turbine control systems. Further detail on this is provided in the relevant chapters.

1.3 The Applicant and Project Background

The Proposed Project is being brought forward by Bord na Móna Powergen Ltd., the 'Applicant'. Bord na Mona Powergen Ltd. is a subsidiary of Bord na Móna plc.

Bord na Móna plc is a publicly owned company, originally established in 1946 to develop and manage some of Ireland's extensive peat resources on an industrial scale, in accordance with government policy at the time. Bord na Móna's lands extend to approximately 80,000 hectares in total and are located mainly in the Irish midlands. Bord na Móna Powergen currently manages and operates a portfolio of thermal and renewable assets, namely Edenderry Power Plant a peat/biomass generating unit, Cushaling peaking plant, Bellacorick, Mountlucas, Bruckana and Oweninny wind farms, and the Drehid landfill gas facility.

In 2015, Bord na Móna published its 'Sustainability Statement 2030', which sets out the company's commitment to transition to peat-free electricity generation by 2030. Renewable energy generation, including solar power, biomass and wind power, is a key component of this transition. In October 2018, Bord na Móna announced its strategy to decarbonise, accelerating moves away from its traditional peat business into renewables, resource recovery and new sustainable businesses. Bord na Mónas target is for 75% of energy being generated by the company being renewable by 2020. Their aim to accelerate the development of renewable energy is a move to support national climate and energy policy targets.

Bord na Móna has a long track record of developing energy projects, dating back to the development of the first generation of peat-fired power stations. Renewable energy is a strategic growth area for the company and is aligned with its corporate strategy, which includes reducing carbon emissions.

1.4 Brief Description of the Proposed Development

The proposed development comprises the construction of 21 No. wind turbines and all associated works. The proposed turbines will have a blade tip height of up to 185 metres above the top of the foundation. The applicant is seeking a ten-year planning permission. The full description of the proposed development, as per the public planning notices, is as follows:

- i. *21 No. wind turbines with an overall blade tip height of up to 185 metres and all associated hard-standing areas.*
- ii. *2 No. permanent Anemometry Masts up to a height of 120 metres.*
- iii. *Provision of new and upgraded internal site access roads, passing bays, amenity pathways, amenity carpark and associated drainage.*
- iv. *2 No. permanent underpasses in the townland of Derrinlough. One underpass will be located beneath the N62 and one will be located beneath an existing Bord na Móna rail line.*
- v. *1 No. 110 kV electrical substation, which will be constructed in the townland of Cortullagh or Grove. The electrical substation will have 2 No. control buildings, associated electrical plant and equipment and a wastewater holding tank.*
- vi. *5 No. temporary construction compounds, in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh and Cortullagh or Grove.*
- vii. *All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation.*
- viii. *2 No. temporary security cabins at the main construction site entrances in the townland of Derrinlough.*
- ix. *All works associated with the connection of the proposed wind farm to the national electricity grid, which will be to the existing Dallow/Portlaoise/Shannonbridge 110 kV line.*
- x. *Removal of existing meteorological mast.*

xi. *Upgrade of existing access and temporary improvements and modifications to existing public road infrastructure to facilitate delivery of abnormal loads including locations on the N52 and N62; construction access for delivery of construction materials at locations on the N62 and R357; operational access onto L7009 in the townland of Cortullagh or Grove and amenity access off R357 and L7005.*
xii. *All associated site works and ancillary development including signage.*
xiii. *A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.*

Current and future wind turbine generator technology will ensure that the wind turbine model, chosen for the proposed development, will have an operational lifespan greater than the 30-year operational life that is being sought as part of this application.

Modern wind turbine generators typically have an output of between 3.0 and 6MW. For the purposes of this EIAR a wind turbine model with a rated output of 4.2MW has been chosen as this is considered to be representative of the typical turbine capacity currently available. Therefore, based on 21 no. wind turbines, the proposed wind turbines will have a combined output of 88.2MW.

The layout of the proposed development has been constraints-led, thereby avoiding the environmentally sensitive parts of the site.

The site boundary for the purposes of this EIAR, corresponds to the red-line boundary included in the planning application for the proposed development and encompasses an area of approximately 2,360 hectares. Where the 'site' is referred to in this EIAR, this means the primary study area for the EIAR. In some cases, the study area extends beyond the red-line boundary depending on the requirements of individual assessments. Where this occurs, the extent of the study area will be outlined in the relevant chapter, as required. The proposed permanent footprint of the proposed development measures approximately 34.2 hectares, which represents approximately 1.45% of the primary study area.

The EIAR Site Boundary is illustrated on Figures 1.2a and 1.2b. Aerial views of the EIAR Site Boundary are shown in Figures 1.3a and 1.3b.

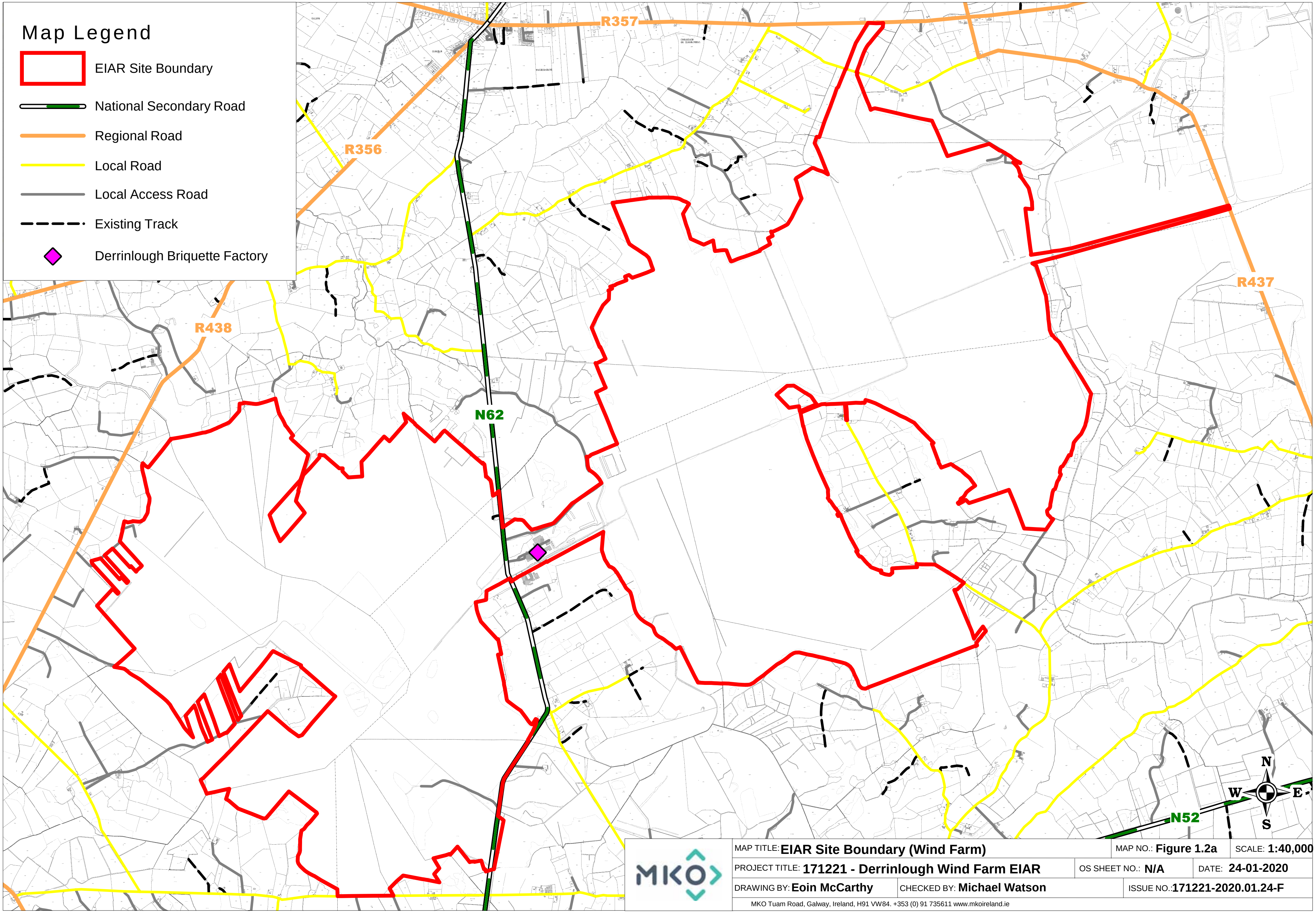
The proposed grid connection forms part of the planning application and its potential significant effects are assessed within the EIAR. It is proposed to construct a 110kV substation within the site and to connect from here to the existing Dallow/Portlaoise/Shannonbridge 110 kV overhead line, located in the northwest of the site. Connection will be via either overhead line or underground cabling. The connection route measures approximately 280 metres in total.

The proposed development will require the construction of a short bypass, located just north of the existing junction between the N52 and N62 National Secondary Routes, for the purposes of abnormal load delivery. The bypass will measure approximately 160 metres and will only be in use during the turbine delivery stage of the proposed development after which the existing boundaries will be reinstated. During the operational phase of the proposed development, the bypass will only be used should an abnormal load need to be delivered to the site, and the boundaries reinstated

The potential significant effects of all elements of the proposed project, including grid connection and the proposed N62/N52 junction bypass, have been assessed as part of this EIAR.

A significant minimum separation distance from houses of 750 metres has been achieved with the project design.

The proposed development is described in detail in Chapter 4 of this EIAR.



MAP TITLE: EIAR Site Boundary (Wind Farm)
MAP NO.: Figure 1.2a
SCALE: 1:40,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
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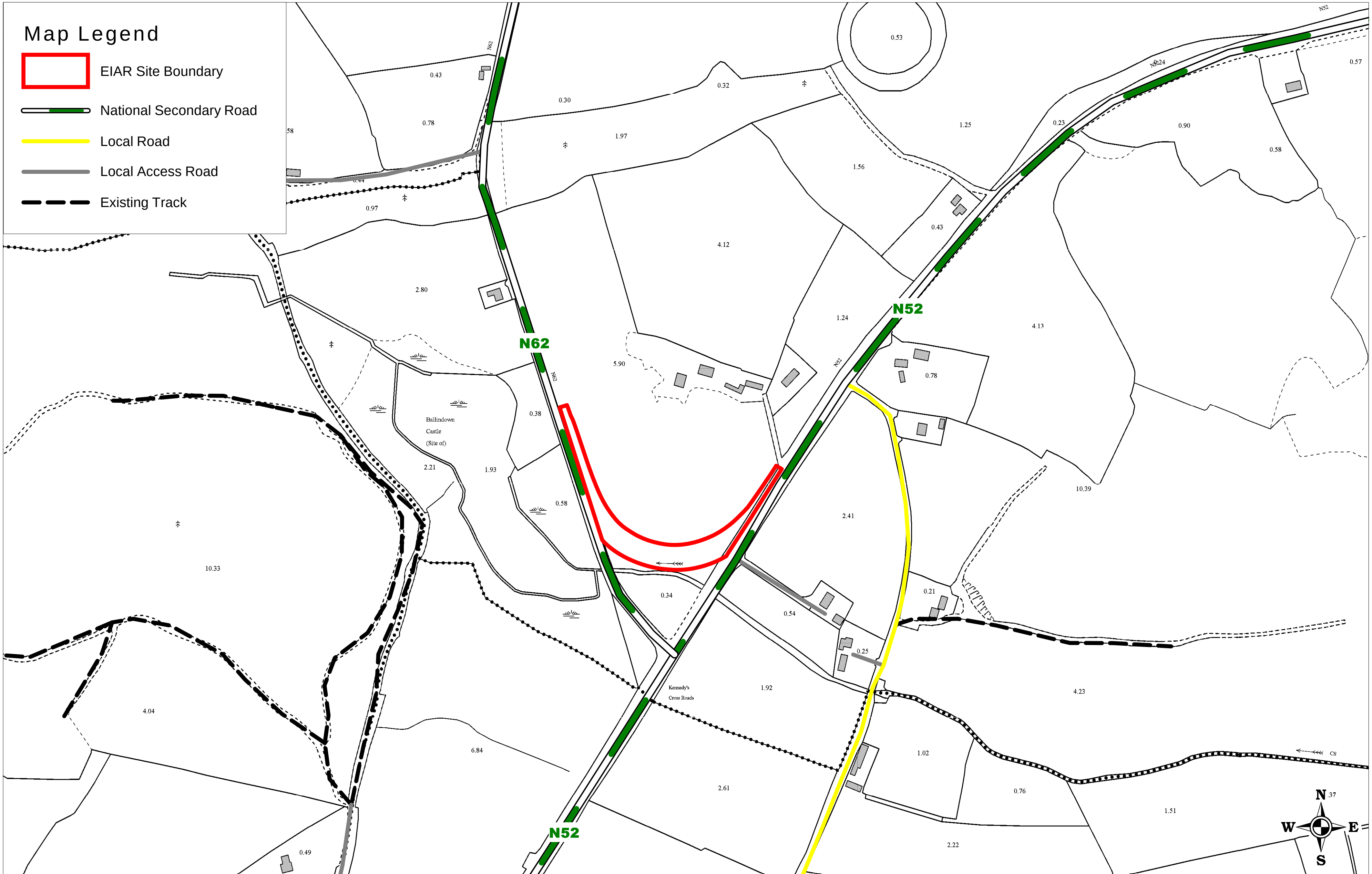

MAP TITLE: **EIAR Site Boundary (N52/N62 Junction Bypass)** | MAP NO.: **Figure 1.2b** | SCALE: **1:5,000**

PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR** | OS SHEET NO.: **N/A** | DATE: **24-01-2020**

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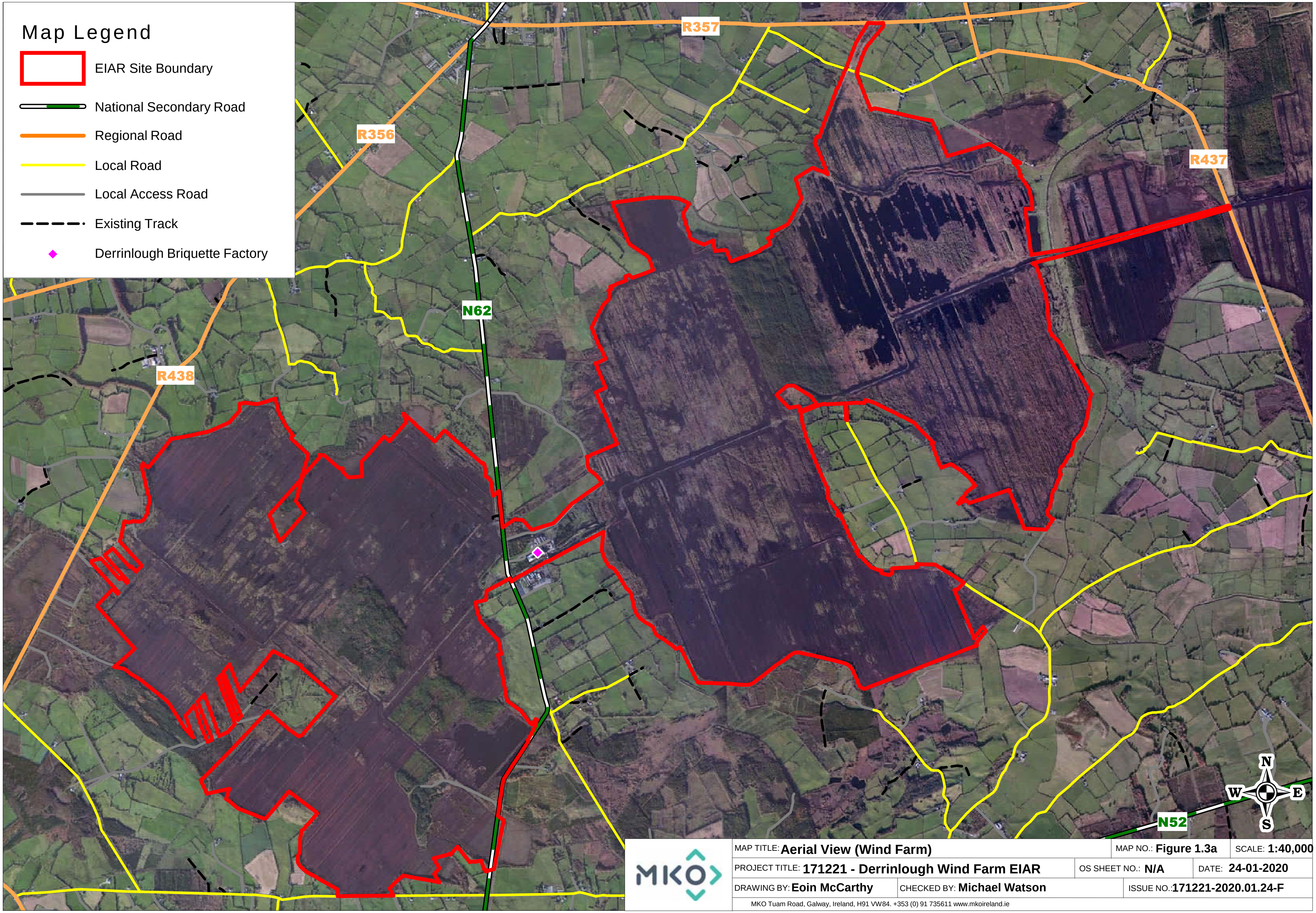
Map Legend
EIAR Site Boundary
National Secondary Road
Regional Road
Local Road
Local Access Road
Existing Track
Derrinlough Briquette Factory
R357
R356
R437
N62
R438
N52
N
W
E
S
MAP TITLE: Aerial View (Wind Farm)
MAP NO.: Figure 1.3a
SCALE: 1:40,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
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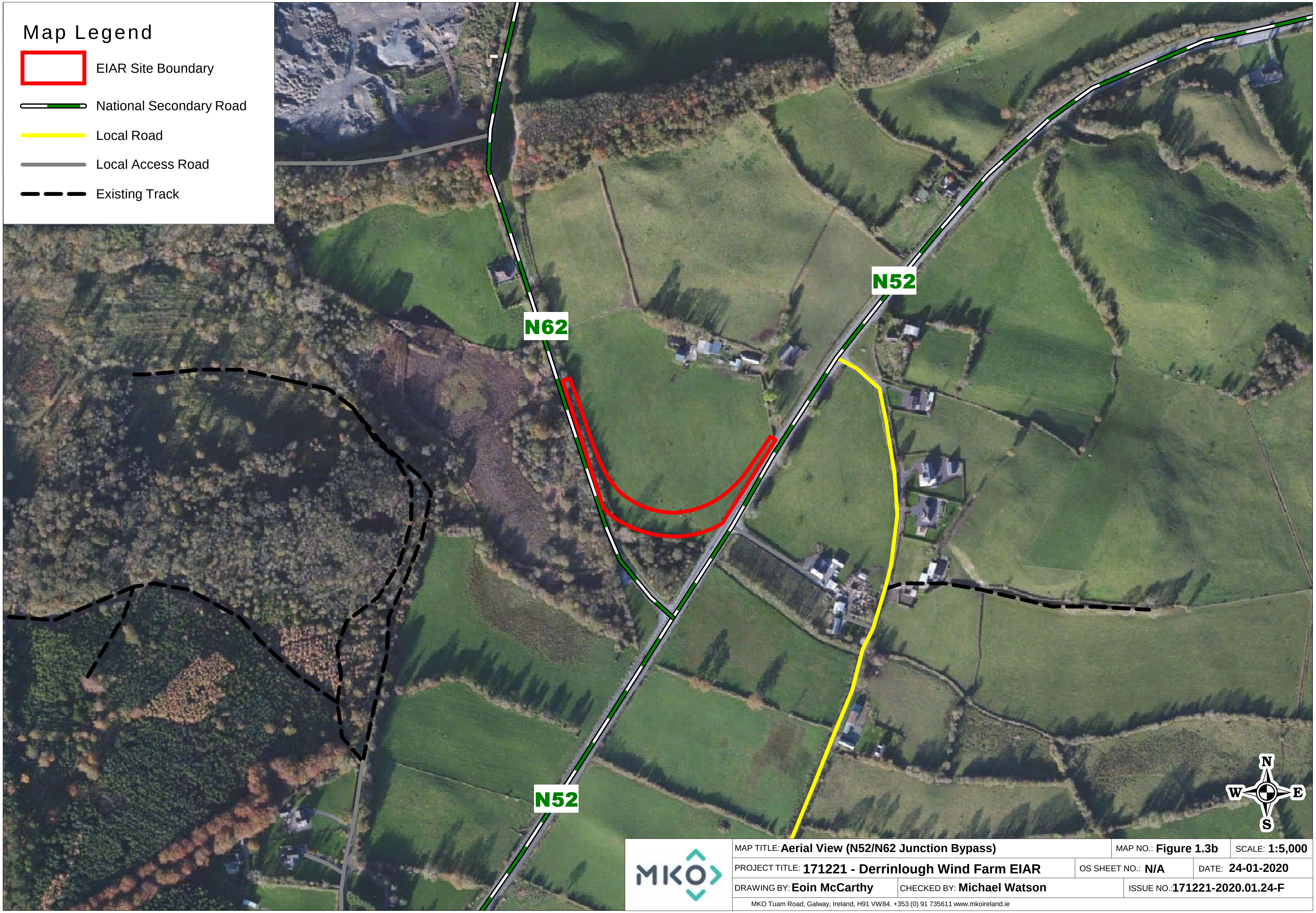

MAP TITLE: **Aerial View (N52/N62 Junction Bypass)** | MAP NO.: **Figure 1.3b** | SCALE: **1:5,000**

PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR** | OS SHEET NO.: **N/A** | DATE: **24-01-2020**

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1.5 Need for the Proposed Development

1.5.1 Overview

It is now clear that Ireland will not meet its 2020 target for renewable energy with the Sustainable Energy Authority of Ireland (SEAI) reporting in May 2019 that 13 per cent of Ireland's energy will come from renewable sources by 2020, three per cent short of our European target of 16 per cent (SEAI, May 2019). Ireland faces significant challenges through efforts to meet EU targets for renewable energy by 2030 and its commitment to transition to a low carbon economy by 2050. Further detail can be found in Section 2.3.3 of this EIAR.

In March 2019, the Government announced a renewable electricity target of 70% by 2030. The proposed development is likely to be operational before 2030 and would therefore contribute to this 2030 target. More recently, the EPA reported that Ireland is set to fall far short of all of its carbon emissions reduction targets for 2030, despite climate action measures in the National Development Plan (EPA, June 2019). As such, the proposed Derrinlough wind energy development is critical to helping Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels.

The need for the proposed project is driven by the following factors:

1. *A legal commitment from Ireland to limit greenhouse gas emissions under the Kyoto protocol to reduce global warming;*
2. *A requirement to increase Ireland's national energy security as set out in the Energy White Paper;*
3. *A requirement to diversify Irelands energy sources, with a view to achievement of national renewable energy targets and an avoidance of significant fines from the EU (the EU Renewables Directive);*
4. *Provision of cost-effective power production for Ireland which would deliver local benefits; and*
5. *Increasing energy price stability in Ireland through reducing an over reliance on imported gas.*

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment (DoCCAE). The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Irelands environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption. The CAP identifies a need for 8.2GW of onshore wind generation. Only 3.7GW is in place as of December 2019, therefore Ireland needs to more than double its installed capacity of wind generation. The CAP presents clear and unequivocal support for the provision of additional renewable energy generation and presents yet further policy support for increased wind energy. Further information relating to the Climate Action Plan can be found in Chapter 2, Section 2.4.5.

. Section 2.4 in Chapter 2 of this EIAR on Background to the Proposed Development, presents a full description of the international, national and regional renewable energy policy context for the proposed project. Section 2.4 addresses climate change, including Ireland's current status with regard to meeting greenhouse gas emission reduction targets.

1.5.2 Climate Change and Greenhouse Gas Emissions

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal the Paris Agreement. The Paris Agreement sets out a global action plan to avoid dangerous climate change by limiting global warming to well below 2°C above pre-industrial levels. Under the Paris Agreement, the EU and Governments also agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries and to undertake rapid reductions thereafter in accordance with the best available science.

The International Panel on Climate Change (IPCC) has put forward its clear assessment that the window for action on climate change is rapidly closing and that renewable energy sources such as wind will have to grow from 30% of global electricity at present to 80% by 2050 if we are to limit global warming to below 2 degrees[1] and in accordance with the COP 21 agreement to limit global warming to well below 2˚C above pre-industrial levels.

In this regard, the Government enacted the Climate Action and Low Carbon Development Act 2015, which provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy.

The Energy White Paper, published by the Government in 2015, notes that "The use of renewables in electricity generation in 2014 reduced CO_2 emissions by 2.6 Mt and avoided €255 million in fossil fuel imports".

It is estimated that the proposed renewable energy development with a potential output of approximately 88.2MW from the proposed wind turbines. The proposed development will result in the net displacement of between approximately 90,000 and 170,000 tonnes of Carbon Dioxide (CO_2) per annum, depending on the fuel source to which it is compared. The carbon offsets resulting from the proposed development are described in detail in Section 10.2.3 of Chapter 10: Air and Climate.

1.5.3 Energy Security

At a national level, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas. In 2015, the cost of all energy imports to Ireland was approximately €4.6 billion, with Ireland being one of the most energy import-dependent countries in the European Union, importing 88% of its fuel that year, up from 85% in 2014. This fell to €3.4 billion in 2016 (due mainly to reduced gas imports), rose to approximately €4 billion in 2017 and to approximately €5 billion in 2018. Ireland's import dependency in 2018 was 67%, down 21% from 2015, however, Ireland is still one of the more import dependent countries in the EU, with the EU average being just over 50% ('Energy in Ireland 2019', SEAI, 2019).

Ireland continues to be hugely energy import-dependent leaving it exposed to large energy price fluctuations as a minimum and possibility of fuel shortages if a major energy crisis were to occur. The international fossil fuel market is growing increasingly expensive and is increasingly affected by international politics which can add to price fluctuations. This volatility will be increased as carbon prices increase in the future. This has implications for every Irish citizen.

The SEAI has stated that our heavy dependence on imported fossil fuels "is a lost opportunity in terms of keeping this money here in Ireland and further developing our abundant renewable resources".

The cost of carbon credits is included in all electricity traded, and the price of electricity generated by coal is particularly vulnerable due to its high carbon emissions per unit of electricity generated. Coal still generates almost 25% of Ireland's electricity, but the Programme for Government[2] called for a review of options to replace it with low carbon alternatives within a decade. Any steps to reduce this

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1 IPCC Fifth Assessment Synthesis Report, Intergovernmental Panel on Climate Change AR5 Report

2 *Department of Communications, Climate Action and Environment, National Climate Policy, available at:* https://www.dccae.gov.ie/en-ie/climate-action/topics/climate-action-at-a-national-level/Pages/default.aspx

dependence on imported fossil fuels will add to financial autonomy and stability in Ireland. The use of Ireland's indigenous energy resources, such as wind, will contribute to a reduction in energy imports.

The Energy White Paper 2015 notes "There will be a substantial increase in the cost of carbon in the short and medium term, through the EU Emissions Trading Scheme". Any steps to reduce dependence on imported fossil fuels will add to financial autonomy and stability in Ireland. As the White Paper notes:

> *"In the longer term, fossil fuels will be largely replaced by renewable sources"*.

1.5.4 Competitiveness of Wind Energy

While Ireland has a range of renewable resources, as the White Paper states "[Onshore Wind] is a proven technology and Ireland's abundant wind resource means that a wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."

In fact, the cost of support is more than offset by the fact that adding large quantities of wind to the wholesale market drives down auction prices in any half hour trading period when the wind is blowing, i.e. for 80% of the hours of the year. Wind is capable of an average capacity factor of 31.7%[3], which is its average output throughout the year relative to its maximum output. However, wind is generating power at some level for 80% of the hours of the year. EirGrid's website has more detailed information. A Poyry study from 2015 showed that reaching our targets in 2020 would reduce wholesale prices by more than costs of new grid infrastructure, backup and the subsidies paid to wind, resulting in a net saving of €43m per year in 2020. The EU has noted that Ireland has one of the lowest costs of supporting renewables mainly because onshore wind is on a par with the cost of power from conventional generation when a full cost benefit analysis is undertaken.

1.5.5 EU 2020 Renewable Energy Targets

The burning of fossil fuels for energy creates greenhouse gases, which contribute significantly to climate change. These and other emissions also create acid rain and air pollution. Sources of renewable energy that are utilised locally with minimal impact on the environment are necessary to meet the challenges of the future. The EU adopted Directive (2009/28/EC) on the Promotion of the Use of Energy from Renewable Sources in April 2009, which includes a common EU framework for the promotion of energy from renewable sources.

The Directive sets a mandatory national target for the overall share of energy from renewable sources for each Member State. This package is designed to achieve the EU's overall 20:20:20 environmental target, which consists of a 20% reduction in greenhouse gases, a 20% share of renewable energy in the EU's total energy consumption and a 20% increase in energy efficiency by 2020. To ensure that the mandatory national targets are achieved, Member States must follow an indicative trajectory towards the achievement of their target as outlined in Ireland's National Renewable Energy Action Plan (NREAP).

Ireland's mandatory national target is to supply 16% of its overall energy needs from renewable sources by 2020. This target covers energy in the form of electricity (RES-E), heat (RES-H) and transport fuels (RES-T). The contribution of renewables to gross final consumption (GFC) was 11% in 2018, compared to the 2020 target of 16% ('Energy in Ireland – 2019 Report, SEAI, December 2019). Furthermore, the Department of Communications, Climate Action & Environment (DoCCAE) reported most recently in

[3] *Energy in Ireland 2019 Report (Table 17) (SEAI, December 2019). Report available at: https://www.seai.ie/publications/Energy-in-Ireland-2019-.pdf*

their 'Fourth Progress Report on the National Renewable Energy Action Plan' (December 2017) that Ireland will achieve 13% of its 16% RES target by 2020.

For RES-E alone, Ireland has set a national target of 40% by 2020 as outlined in NREAP. Government policies identify the development of renewable energy, including wind energy, as a primary strategy in implementing national energy policy.

Noted above and further emphasised in the most recent SEAI report, 'Energy in Ireland – 2019 Report' (SEAI, December 2019); the share of renewable electricity (RES-E) was recorded at 33.2% in 2018, out of their 40% target; further reporting that Ireland is not on track to meet its 2020 renewable energy target.

More recently, new analysis from EirGrid, has shown that 32% of electricity demand in Ireland during 2018 was met by renewable sources[4]. This shows a positive increase in renewable energy in Ireland from that previously recorded in 2017, but still highlights a shortfall relative to the 2020 target and the significant progress required to meet our targets and beyond 2020.

1.5.6 EU 2030 Renewable Energy Targets

In March 2019, the Minister for Communications, Climate Action & Environment, Richard Bruton, announced a renewable electricity target of 70% by 2030 for Ireland. This commitment will also from part of a new Climate Action Plan that is being overseen by the Government and targeted to make it into Ireland's National Energy & Climate Plan by the end of 2019. The Joint Committee on Climate Change Action recommended in their recent report, 'Climate Change: A Cross- Party Consensus for Action' (March 2019), that new climate change legislation be enacted by the Oireachtas in 2019 to include:

- A target of net zero economy-wide GHG emissions by 2050;
- A provision for a 2030 target, consistent with the GHG emissions reduction pathway to 2050 to be set by 2020 by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council;
- Provision for five-yearly carbon budgets, consistent with the emissions reduction pathway to 2030 and 2050 targets, to be set by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council; and
- A target for the renewable share of electricity generation of 70% by 2030.

As noted previously, Ireland will not meet its 2020 renewable energy targets. It is now more critical than ever that we continue to progress renewable energy development in Ireland so that we are successful in meeting our 2030 target. Further detail on the EU 2030 targets is noted in Chapter 2, Section 2.4.

1.5.7 Reduction of Carbon Emissions and Other Greenhouse Gases

This production of renewable energy will assist in achieving the Government's and EU's stated goals of ensuring safe and secure energy supplies, promoting an energy future that is sustainable and competitively priced to consumers whilst combating energy price volatility and the effects of climate change. The Energy White Paper in 2015 outlines an ambitious Greenhouse gas reduction target of between 80% to 95% compared to 1990 levels out to 2050. Furthermore, if national carbon emissions

4 http://www.eirgridgroup.com/newsroom/renewables-demand-record/index.xml

targets are divided out amongst each county, each Local Authority may be responsible for meeting its own targets.

Recent EU and World Health Organisation reports estimate that poor air quality accounted for premature deaths of almost 600,000 people in Europe in 2012[5]. In Ireland, the premature deaths attributable to air pollution are estimated at 1,200 people as outlined in 'Ireland's Environment – An Assessment' (EPA, 2016.) The report states that the pollutants of most concern are NO_x, (the collective term for the gases nitric oxide and nitrogen dioxide, PM (particulate matter) and O_3 (ozone). The EPA report goes on to state that:

> *"Ireland has considerable renewable energy resources, only a fraction of which are utilised to address our energy requirements.*
>
> *Wind, ocean, solar, hydro and geothermal energy do not produce GHG (greenhouse gas) emissions or emissions of air pollutants such as particulates, sulphur dioxide and nitrogen dioxide. Use of these renewable resources can have **considerable co-benefits for human health and ecosystems**. Meeting energy requirements from renewable resources can provide significant economic and employment benefits at local to national scales."*

The proposed development therefore represents an opportunity to further harness Ireland's significant renewable energy resources, with valuable benefits to air quality and in turn to human health. The consumption of fossil fuels for energy results in the release of particulates, sulphur dioxide and nitrogen dioxide to our air. The use of wind energy, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, results in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2, thereby resulting in cleaner air and associated positive health effects.

1.5.8 Economic Benefits

In addition to helping Ireland avoid significant fines and reducing environmentally damaging emissions, the proposed project will have significant economic benefits. At a national level, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas. As detailed above, in 2018 the cost of all energy imports to Ireland was approximately €5 billion with imported fossil fuels accounting for 67% of all energy consumed ('Energy in Ireland 2019', SEAI, 2019).

The SEAI report 'Energy in Ireland 2019' indicated that renewable electricity (mostly wind energy) during 2018 and compared to 2016:

- Displaced €430 million in fossil fuel imports;
- Reduced CO_2 emissions by 4 million tonnes; and
- Did not add to consumer bills.

The 2014 report 'The Value of Wind Energy to Ireland', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

The proposed development will be capable of providing power to supply approximately 58,315 households every year, as presented in the calculations in Section 4.3.1.6 of Chapter 4: Description of the Proposed Development of this EIAR.

5 www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report

At a Regional Level, the proposed development will help to supply the rising demand for electricity, resulting from renewed economic growth. The 'All-island Generation Capacity Statement 2017 – 2026' (SONI and Eirgrid, 2017) notes that electricity demand on the island of Ireland is expected to grow by 17% over the next ten years. Much of this growth is expected to come from new data centres in Ireland.

The proposed development will have several significant long-term and short-term benefits for the local economy including job creation, local authority commercial rate payments and a Community Benefit Scheme.

The annual commercial rate payments from the proposed development to Offaly County Council, will be redirected to the provision of public services within Co. Offaly. These services include items such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

It is estimated that the proposed project will create approximately 100-120 jobs during the construction, operational and maintenance phases of the proposed development. During construction, additional employment will be created in the region through the supply of services and materials to the development. In addition to this, there will also be income generated by local employment from the purchase of local services i.e. travel and lodgings.

There are substantial opportunities available for areas where wind farms and other types of renewable energy developments are located, in the form of Community Gain Funds. Based on the current proposal, a Community Gain Fund in the region of €10 million will be made available over the lifetime of the project. The value of this fund will be directly proportional to the installed capacity and/or energy produced at the site and will support and facilitate projects and initiatives including youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects.

Further details on the proposed Community Gain proposals are presented in Section 4.5 and Appendix 2.3 of this EIAR.

1.6 Recreational Benefits

In addition to the economic and environmental benefits of the proposed development, there will be potential social and recreational benefits associated with the proposed Recreational Amenity pathway.

The proposed development and all its associated infrastructure creates a unique opportunity to develop an amenity area for use by members of the local and wider community alike. The peatland habitat at both Clongawny and Drinagh Bogs is attractive to both locals and visitors to the area because of its history and variety of vegetation. Sections of the new site roads of the proposed development will be developed and promoted for walking and cycling activities. This proposal is based on the current use of the wider area as an informal walking route; where the proposed amenity facilities will allow for a safer and improved visitor experience and allow the site to be more openly available to walkers, trail runners, cyclists and other recreational users, as outlined in Section 4.6 and Appendix 4.4 of this EIAR. The proposed development will also facilitate linkages to the wider area and to both existing and proposed amenity walkways.

This will provide a long-term benefit to both the local community and visitors to the area.

1.7 Purpose and Scope of the EIAR

The purpose of this EIAR is to document the current state of the environment in the vicinity of the proposed development site and to quantify the likely significant effects of the proposed development on the environment in accordance with the requirements of the EIA Directive, as amended. The compilation of this document served to highlight any areas where mitigation measures may be necessary in order to protect the surrounding environment from the possibility of any negative impacts arising from the proposed development.

It is important to distinguish the Environmental Impact Assessment (EIA) to be carried out by An Bord Pleanála, from the EIAR and the accompanying planning application. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect effects of the proposed development on the following:

- Population and Human Health,
- Biodiversity,
- Land, Soil, Water, Air, Climate,
- Material Assets, Cultural Heritage and the Landscape
- Interactions between these factors.

The EIAR submitted by the applicant provides the relevant environmental information to enable the EIA to be carried out by the competent authorities. The information to be contained in the EIAR is prescribed Article 5 of the revised EIA Directive described in Section 1.4 above.

1.8 Structure and Content of the EIAR

Volume 1 of this EIAR uses the grouped structure method to describe the existing environment, the potential impacts of the proposed development thereon and the proposed mitigation measures. Background information relating to the proposed development, scoping and consultation undertaken and a description of the proposed development are presented in separate sections. The grouped format sections describe the impacts of the proposed development in terms of human beings, biodiversity, soils and geology, hydrology and hydrogeology, air and climate, noise and vibration, landscape and visual, cultural heritage and material assets such as traffic and transportation, together with the interaction of the foregoing.

The chapters of this EIAR are as follows:

- Introduction
- Background to the Proposed Development
- Consideration of Reasonable Alternatives
- Description of the Proposed Development
- Population and Human Health
- Biodiversity (excluding Birds)
- Ornithology
- Land, Soils and Geology
- Hydrology and Hydrogeology
- Air and Climate
- Noise and Vibration
- Landscape and Visual
- Archaeological, Architectural and Cultural Heritage
- Material Assets (including Traffic and Transport, Telecommunications and Aviation)
- Interactions of the Foregoing
- Schedule of Mitigation and Monitoring Measures

The EIAR also includes a Non-Technical Summary, which is a condensed and easily comprehensible version of the EIAR document. The non-technical summary is laid out in a similar format to the main EIAR document and comprises a description of the proposed development followed by the existing environment, impacts and mitigation measures presented in the grouped format.

The photomontage booklet pertaining to Chapter 12: Landscape and Visual is included as Volume 2 of this EIAR.

Appenidices to the chapters isted above are included in Volume 3 of this EIAR.

1.8.1 Description of Likely Significant Effects and Impacts

As stated in the Draft *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* (EPA, 2017), an assessment of the likely impacts of a proposed development is a statutory requirement of the EIA process. The statutory criteria for the presentation of the characteristics of potential impacts requires that potential significant impacts are described with reference to the extent, magnitude, complexity, probability, duration, frequency, reversibility and trans-frontier nature (if applicable) of the impact.

The classification of impacts in this EIAR follows the definitions provided in the Glossary of Impacts contained in the following guidance documents produced by the European Commission (EC) and the Environmental Protection Agency (EPA):

- *'Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report'* (EC, 2017)
- *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017'* (EPA, 2017).
- *'Revised Guidelines on the Information to be contained in Environmental Impact Statements – Draft September 2015'* (EPA, 2015)
- *'Advice Notes for Preparing Environmental Impact Statements – Draft September 2015'* (EPA, 2015).
- *'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003)
- *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002)

Table 1.2, below, presents the glossary of impacts as published in the EPA guidance documents. Standard definitions are provided in this glossary, which permit the evaluation and classification of the quality, significance, duration and type of impacts associated with a proposed development on the receiving environment. The use of pre-existing standardised terms for the classification of impacts ensures that the EIA employs a systematic approach, which can be replicated across all disciplines covered in the EIAR. The consistent application of terminology throughout the EIAR facilitates the assessment of the proposed development on the receiving environment.

Table 1.2 Impact Classification Terminology (EPA, 2017)

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
	Profound	An effect which obliterates sensitive characteristics
Extent and Context	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions
Probability	Likely	Effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
	Unlikely	Effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented

Impact Characteristic	Term	Description
Duration and Frequency	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effect lasting over sixty years
	Reversible	Effects that can be undone, for example through remediation or restoration
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Type	Indirect	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out
	Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

Each impact is described in terms of its quality, significance, extent, duration and frequency and type, where possible. A 'Do-Nothing' impact is also predicted in respect of each environmental theme in the

EIAR. Residual impacts are also presented following any impact for which mitigation measures are prescribed. The remaining impact types are presented as required or applicable throughout the EIAR.

Any potential interactions between the various aspects of the environment assessed throughout this EIAR are presented in Chapter 15: Interaction of the Foregoing.

1.9 Project Team

1.9.1 Project Team Responsibilities

The companies and staff listed in Table 1.3 EIAR Project Teamwere responsible for completion of the EIAR of the proposed development. Further details regarding project team members are provided below.

The EIAR project team comprises a multidisciplinary team of experts with extensive experience in the assessment of wind energy developments and in their relevant area of expertise. The qualifications and experience of the principal staff from each company involved in the preparation of this EIAR are summarised in Section 1.8.2 below. Each chapter of this EIAR has been prepared by a competent expert in the subject matter. Further details on project team expertise are provided in the Statement of Authority at the beginning of each impact assessment chapter.

Table 1.3 EIAR Project Team

Consultants	Principal Staff Involved in Project	EIAR Input
MKO Tuam Road Galway	Brian Keville Michael Watson Jimmy Green Eoin McCarthy Pat Roberts Dervla O' Dowd Padraig Cregg David McNicholas John Hynes Julie O'Sullivan Dr. Úna Nealon David Naughton Ian Hynes Joanna Mole Owen Cahill Eoin Gilson Aoife Joyce Paul Sweeney James Newell Joseph O'Brien	Project Managers, Scoping and Consultation, Preparation of Natura Impact Statement and the following Chapters: - 1. Introduction - 2. Background to the Proposed Development - 3. Consideration of Reasonable Alternatives - 4. Description of the Proposed Development - 5. Population and Human Health - 6. Biodiversity - 7. Ornithology - 10. Air and Climate - 12. Landscape and Visual - 14. Material Assets (non-Traffic) - 15. Interaction of the Foregoing - 16. Schedule of Mitigation Measures

Consultants	Principal Staff Involved in Project	EIAR Input
Hydro Environmental Services 22 Lower Main Street Dungarvan Co. Waterford	Michael Gill David Broderick Adam Keegan	Flood Risk Assessment, Drainage Design and Preparation of the following Chapters: › 8. Land, Soils and Geology › 9. Hydrology and Hydrogeology
Fehily Timoney & Company The Grainstore Singletons Lane Bagnelstown Co. Carlow	Gerry Kane Paul Jennings Ian Higgins	Preparation of Peat Stability Assessment and Peat and Spoil Management Plan
AWN Consulting The Tecpro Building Clonsgaugh Business & Technology Park Dublin 17	Damian Kelly Dermot Blunnie	Baseline Noise Survey and Preparation of Chapter 11: Noise and Vibration
Tobar Archaeological Services Saleen Midleton Co. Cork	Annette Quinn Miriam Carroll	Preparation of Chapter 13: Archaeological, Architectural and Cultural Heritage
Alan Lipscombe Traffic and Transport Consultants Claran, Headford, Co. Galway	Alan Lipscombe	Preparation of Chapter 14: Material Assets - Traffic and Transport
Tom Gittings - Ecological Consultant	Dr. Tom Gittings	Input and Review of Ornithological and Ecological scope of works; peer review of

Consultants	Principal Staff Involved in Project	EIAR Input
Ecological Consultant 3 Coastguard Cottages Roches Point Whitegate Co. Cork		Biodiversity and Ornithology chapters of the EIAR.

1.9.2 Project Team Members

1.9.2.1 MKO

Brian Keville B.Sc. (Env.)

Brian Keville has over 17 years' professional experience as an environmental consultant having graduated from the National University of Ireland, Galway with a first class honours degree in Environmental Science. Brian was one of the founding directors of environmental consultancy, Keville & O'Sullivan Associates Ltd., prior to the company merging in 2008 to form McCarthy Keville O'Sullivan Ltd., and whom recently rebranded as MKO (March 2019). Brian's professional experience has focused on project and environmental management, and environmental impact assessments. Brian has acted as project manager and lead-consultant on numerous environmental impact assessments, across various Irish counties and planning authority areas. These projects have included large infrastructural projects such as roads, ports and municipal services projects, through to commercial, mixed-use, industrial and renewable energy projects. The majority of this work has required liaison and co-ordination with government agencies and bodies, technical project teams, sub-consultants and clients.

Michael Watson, MA; Miema CEnv PGeo

Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland and then a prominent private environmental and hydrogeological consultancy prior to joining MKO in 2014. Michael's professional experience includes managing Environmental Impact Assessments, EPA License applications, hydrogeological assessments, environmental due diligence and general environmental assessment on behalf of clients in the wind farm, waste management, public sector, commercial and industrial sectors nationally. Michaels key strengths include project strategy advice for a wide range and scale of projects, project management and liaising with the relevant local authorities, Environmental Protection Agency (EPA) and statutory consultees as well as coordinating the project teams and sub-contractors. Michael is a key member of the MKO senior management team and as head of the Environment Team has responsibilities to mentor various grades of team members, foster a positive and promote continuous professional development for employees. Michael also has a Bachelor of Arts Degree in Geography and Economics from NUI Maynooth, is a Member of IEMA, a Chartered Environmentalist (CEnv) and Professional Geologist (PGeo).

Jimmy Green BA, MRUP; MIPI

Jimmy Green holds the position of Senior Planner in MKO and has a wide range of experience in project management and coordination, planning research, analysis, and retail planning. Jimmy has extensive planning experience in both the public and private sectors having worked as an Assistant Planner in Donegal County Council and subsequently as both an Executive and Senior Executive Planner in Galway County Council prior to joining private practice in October 2004. Since moving into the private sector he has provided consulting services to a wide range of private and public sector clients, and his experience includes planning application project management, environmental impact assessment preparation, retail impact assessment, development potential reporting, preparation of linguistic impact statements and submissions to Development Plans/Local Area Plans. Jimmy has a Bachelor of Arts Degree in Human and Physical Geography from National University Ireland Galway and a Masters in Regional and Urban Planning from University College Dublin. Jimmy is also a corporate member of the Irish Planning Institute.

Eoin McCarthy B.Sc. (Env.)

Eoin is Senior Environmental Scientist with McCarthy O'Sullivan Ltd. with over 8 years of experience in private consultancy. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Eoin took up his position with McCarthy Keville O'Sullivan in June 2011. Eoin's key strengths and areas of expertise are in project management, environmental impact assessment, wind energy site selection and feasibility assessment. Eoin's main area of expertise in terms of project management is in the wind energy sector. He has overseen some of the largest SID Wind Energy Projects in Ireland in recent years. In his role as project manager, Eoin works with and co-ordinates large multidisciplinary teams including members from MKO's Environmental, Planning, Ecological and Ornithological departments as well as sub-contractors from various fields in the preparation and production of EIARs. He has held the role of project manager on over 500MW worth of wind energy projects, with more projects in the pipeline. Within MKO Eoin plays a large role in the management of and sharing of knowledge with junior members of staff and works as part of a large multi-disciplinary team to produce EIA Reports.

Pat Roberts B.Sc. (Env.)

Pat Roberts is a Senior Ecologist and director of the Ecology team with McCarthy O'Sullivan Ltd. with over 12 years post graduate experience of providing ecological services in relation to a wide range of developments at the planning, construction and monitoring stages. Pat holds B.Sc.(Hons) in Environmental Science. Pat has extensive experience of providing ecological consultancy on large scale industrial and civil engineering projects. He is highly experienced in the completion of ecological baseline surveys and impact assessment at the planning stage. He has worked closely with construction personnel at the set-up stage of numerous construction sites to implement and monitor any prescribed best practice measures. He has designed numerous Environmental Operating Plans and prepared many environmental method statements in close conjunction with project teams and contractors. He has worked extensively on the identification, control and management of invasive species on numerous construction sites. Prior to taking up his position with MKO in June 2005, Pat worked in Ireland, USA and UK as a Tree Surgeon and as a nature conservation warden with the National Trust (UK) and the US National Park Service. Pats key strengths include his depth of knowledge and experience of a wide range of ecological and biodiversity topics and also in his ability to understand the requirements of the client in a wide range of situations. He currently manages the ecological team within MKO and ensures that the outputs from that team are of a very high standard and meet the requirements of the clients and relevant legislation and guidelines. He is a full member of the Chartered Institute of Ecologists and Environmental Managers (CIEEM).

Dervla O'Dowd B.Sc. (Env.)

Dervla O'Dowd is a Senior Ecologist and Project Manager with McCarthy O'Sullivan Ltd. with twelve years of experience in environmental consultancy. Dervla graduated with a first class honours B.Sc. in Environmental Science from NUI, Galway in 2005 and joined Keville O'Sullivan Associates in the same year. Dervla has gained extensive experience in the project management and ecological assessment of the impacts of various infrastructural projects including wind energy projects, water supply schemes, road schemes and housing developments nationwide and has also been involved in the compilation of Environmental Impact Statements, with emphasis on sections such as Flora and Fauna, and acted as EIS co-ordinator on many of these projects. Dervla has also provided site supervision for infrastructural works within designated conservations areas, in particular within aquatic habitats, and has also been involved in the development of environmental/ecological educational resource materials and major ecological surveys of inland waterways. Currently, Dervla is responsible for coordinating ecological work, in particular ornithological surveys required on major infrastructural projects, with emphasis on wind energy projects. Dervla's key strengths and areas of expertise are in project management, project strategy, business development and survey co-ordination to ensure the efficient operation of the Ornithology team's field survey schedule. Dervla holds full membership of the Chartered Institute of Ecology and Environmental Management.

Padraig Cregg B.Sc. (Zoo.), M.Sc. (Eco.)

Padraig Cregg is a Senior Ornithologist with McCarthy O'Sullivan Ltd. with over 8 years of experience in both private practice and NGOs. Padraig holds a BSc (Hons) in Zoology and Masters in Evolutionary and Behavioural Ecology. Prior to taking up his position with McCarthy Keville O'Sullivan in December 2018, Padraig worked as a Senior Ornithologist and held previous posts with TOBIN Consulting Engineers, Energised Environments Ltd in Scotland, WSP Environment and Energy Ltd in Scotland and BirdWatch Ireland. Padraig has specialist knowledge in designing, executing and project managing ornithological assessments, primarily in the renewable industry. Padraig's key strengths and areas of expertise are in ornithology and ecology surveying and in writing Natura Impact Statements (NIS) and the Biodiversity chapter of Environmental Impact Assessment Reports (EIAR) to accompany planning applications. Since joining MKO Padraig has been involved in designing, executing and project managing the ornithological assessment on over 20 proposed wind farm developments. He has played a key role in project managing these planning applications through the statutory planning system, with more projects in the pipeline. Within MKO Padraig plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIAR and NIS Reports.

John Hynes M.Sc. (Ecology), B.Sc.

John Hynes is a Senior Ecologist with McCarthy O'Sullivan Ltd. with over 7 years of experience in both private practice and local authorities. John holds a B.SC in Environmental Science and a M.Sc. in Applied Ecology. Prior to taking up his position with MKO in March 2014, John worked as an Ecologist with Ryan Hanley Consulting Ltd. and Galway County Council. John has specialist knowledge in Flora and Fauna field surveys. Geographic Information Systems, data analysis, Appropriate Assessment, Ecological Impact Assessment and Environmental Impact Assessment. John's key strengths and areas of expertise are in project management. GIS and impact assessment. Since joining MKO John has been involved as a Senior Ecologist on a significant range of energy infrastructure, commercial, national roads and private/public development projects. Within MKO John plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIS Reports. John has project managed a range of strategy and development projects across the Ireland and holds CIEEM membership.

David McNicholas B.Sc. (Env.), M.Sc. (EHSM)

David McNicholas is a Senior Ecologist at McCarthy Keville O'Sullivan, Planning & Environmental Consultants. David holds a BSc (First Class Hons) Environmental Science and an MSc (Hons) Environmental, Health and Safety Management. David has 9 years' professional ecological consultancy experience. David specialises in the preparation of EIAs, EcIAs and NISs including ecological surveys and monitoring. David has worked on all phases of wind farm development from feasibility/ scoping, ecological surveys, preparation of full EIS chapters, construction phase environmental monitoring and post-construction ecological monitoring. David has worked as an Ecological Clerk of Works (ECoW) during the construction phase of ten large scale wind farms in Ireland and Northern Ireland, gained significant experience on the implementation of the environmental and ecological measures. David is a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM).

Julie O'Sullivan, B.Sc. M.Sc.

Julie is an Ecologist with MKO. She holds a BSc (Hons) in Biology from University College London and a Masters in Ecological Assessment from University College Cork. Prior to taking up her position with MKO, Julie gained experience in practical habitat management and developed a range of field skills in plant, habitat, bird and bat surveying through working with several conservation organisations in the UK and Ireland including the RSPB, Cumbria Wildlife Trust and Bat Conservation Trust. Julie has experience surveying birds through her involvement with the RSPB in Northern Ireland. Julie is trained in bat survey, terrestrial invertebrate and freshwater macroinvertebrate sampling and in taking vegetation relevés of vascular plants and bryophytes. She also has experience in habitat identification, habitat mapping, Annex I habitat quality assessment and Phase 1 habitat survey. Julie has worked within our Ornithology Team on several renewable energy developments, utilising a broad range of bird survey methodologies including vantage point surveys, breeding raptor, adapted brown and shepherd and waterfowl distribution surveys. Julie was part of a team of bird usage surveyors working on the Shannon/Fergus Estuary. Within MKO Julie is responsible for independently carrying out and planning Ornithological field surveys in accordance with required Scottish Natural Heritage standards as part of the ornithology team, and for carrying out bat surveys, habitat surveys, and Appropriate Assessment screenings as part of the ecology team.

Úna Nealon PhD, B.Sc.

Úna Nealon is a Project Ecologist with McCarthy O'Sullivan Ltd. with over 8 years of experience in consultancy, research and conservation management. After gaining a first class honours degree in Environmental Science at NUIG, Úna worked as an Environmental Consultant for OES Consulting where she gained experience in multidisciplinary ecological surveys and impact assessment. In addition, she has held research roles in Tanzania and Madagascar, studying local flora and fauna, and developing conservation management plans. Before joining MKO in June 2016, she completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. Úna's primary expertise lies in bat ecology, particularly in relation to wind farm EIA. Beyond this, she is a skilled general ecologist, with experience in flora identification, habitat classification, GIS mapping, mammal surveys, Ecological Impact Assessment and Appropriate Assessment. Since joining MKO, Úna has been responsible for managing bat survey requirements for a variety of wind and solar energy planning applications, as well as other commercial, residential and infrastructure projects. This includes scope development, roost assessments, acoustic surveying, sonogram analyses, impact assessment and report writing. Within MKO, she works as part of a multi-disciplinary team to quickly identify potential ecological constraints and to produce EIS Reports, Appropriate Assessment Screening Reports and Natura Impact Statements. Úna is a member of the Irish Ecological Association, Bat Conservation Ireland and is Secretary of Galway Bat Group.

David Naughton B.Sc. (Env.)

David Naughton is an Ecologist with two years of professional experience, working within the Ornithology Department for MKO. David graduated with an honours B.Sc. degree in Environmental Science from NUIG in 2016. David has a wide range of ecological experience including bird surveys, vegetation surveys, terrestrial invertebrate surveys, freshwater invertebrate surveys, river surveys for salmonids and other fish species, small mammal surveys and habitat identification. David is also very accomplished in GIS software systems for use in interpreting ecological data. David has experience in report writing and has been involved the production of several EIS/EIARs for various windfarm projects as well as numerous interim bird survey reports issued to clients on an ongoing basis. David has also been responsible for the production of collision risk modelling for bird activities at several windfarm sites over the past year, many of which have been peer reviewed by experts in CRM and were found to be appropriate. David's key strengths and areas of expertise are applications of GIS systems, including viewshed analysis and collision risk modelling, project management, survey planning and analysing and interpreting large scale datasets. Since joining MKO David has been involved in a wide range of various projects, acting as project manager for many bird survey projects while providing a pivotal contact link between clients and field surveyors.

Ian Hynes B.Sc. (Env.)

Ian Hynes is a Graduate Ecologist with McCarthy Keville and O'Sullivan Ltd., joining in December of 2017. Ian holds a B.Sc. (Hons) in Environmental Science from National University of Ireland, Galway. Ian has a broad knowledge of ecology including invertebrate surveys and identification, vegetation surveys, small mammal surveys and habitat identification. Ian also has over 4 years of experience using GIS software systems including ArcGIS and QGIS and MapInfo to present ecological data. As part of his final year thesis Ian gained valuable experience in report writing, data input, invertebrate and plant identification. Ian also liaised with members of the AranLIFE project and local landowners on Inis Oirr, Aran Islands in the summer of 2016 while completing his thesis. Ian's key strengths are in Data management and GIS/MapInfo software. Since joining the Ornithology team at McCarthy Keville & O'Sullivan Ltd. He has been involved in a number of windfarm projects, utilising his skills to compile data and create maps for surveys and figures.

Joanna Mole BSc PGDipLA MSc CMLI

Joanna Mole is a Landscape and Visual Impact Assessment Specialist and Chartered Landscape Architect with McCarthy O'Sullivan Ltd. with over 16 years of experience in both private practice and local authorities. Joanna holds a BSc (Hons) in Landscape Design & Plant Science from Sheffield University, a Postgraduate Diploma in Landscape Architecture from Leeds Beckett University, and a MSc in Renewable Energy Systems Technology from Loughborough University. Prior to taking up her position with MKO in October 2017, Joanna worked as a Landscape Architect with Kav-Banof in Israel and held previous posts with CSR in Cork, LMK in Limerick, Geo Architects in Israel and Groundwork Bridgend in South Wales. Joanna is a Chartered Landscape Architect with specialist knowledge in Landscape and Visual Impact assessments for projects ranging from individual houses to large windfarms, cycle route design and landscape contract management. Since joining MKO Joanna has been involved in projects such as energy infrastructure, extraction industry and residential projects. Joanna holds chartered membership of the British Landscape Institute since 1998 and has been an examiner for British Landscape Institute professional practice exam.

Owen Cahill B.Sc., M.Sc.

Owen is an Environmental Engineer with McCarthy O'Sullivan Ltd. with over 11 years of experience in the environmental management and construction industries. Owen holds BSc. (Hons) and MSc. in Construction Management and a Masters in Environmental Engineering. Prior to taking up his position with MKO in October 2013, Owen worked as an Environmental Officer with Kepak and prior to which he held a post with Pentland Macdonald Contaminated Land & Water Specialists in Northern Ireland. Prior to working in planning and environmental consultancy, Owen was employed within the construction industry where he gained significant experience on a variety of civil, residential and commercial projects. Owen's wide ranging multi sector experience has provided him with specialist knowledge and understanding of the challenges in the planning and delivery of developments with the minimum environmental impact and with practicality and constructability in mind. Owen's key strengths and areas of expertise are in project management, environmental impact assessment, wind energy and solar energy construction and environmental management planning and waste permit management. Since joining MKO Owen has been involved as a Project Manager on a range of energy infrastructure, commercial, residential, waste facility and quarry projects as well as managing the licensing requirements of a number of EPA licensed facilities. Within MKO Owen plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIS Reports. Owen has project managed the Environmental Impact Assessment of a range of development projects across the Ireland and holds Affiliate Membership with the Institute of Environmental Management & Assessment and is currently awaiting interview and assessment to become a Full Member and Chartered Environmentalist.

Eoin Gilson B.Sc., M.Sc.

Eoin is an Environmental Scientist with McCarthy O'Sullivan Ltd. who took up his position in October 2018. Eoin holds a BSc (Hons) in Microbiology and a MSc (Hons) in Applied Environmental Science. Eoin has specialist knowledge in environmental field surveys, data analysis and renewable energy systems. Eoin's key strengths and areas of expertise are in data management, report writing and environmental monitoring and management. On joining MKO Eoin has been involved on a range of renewable energy infrastructure projects, working as part of a large multi-disciplinary team to produce EIA Reports.

Aoife Joyce B.Sc., M.Sc.

Aoife Joyce is a Graduate Ecologist with MKO Planning and Environmental Consultants with experience in research, consultancy and drilling contractors. Aoife is a graduate of Environmental Science (Hons.) at NUI Galway, complemented by a first class honours MSc in Agribioscience. Prior to taking up her position with MKO in May 2019, Aoife worked as an Environmental Scientist with Irish Drilling Ltd. and held previous posts with Inland Fisheries Ireland and Treemetrics Ltd. She has a wide range of experience from bat roost identification, acoustic sampling, soil and water sampling, Waste Acceptability Criteria testing, electrofishing, mammal and habitat surveying to GIS, Environmental Impact Assessments (EIAs) and mapping techniques. Since joining MKO, Aoife has been involved in deploying bat detectors and weather stations nationwide, dawn and dusk bat detection surveys, sound analysis, mapping and report writing. Within MKO, she works as part of a multidisciplinary team to help in the production of ecological reports and assessments. Aoife is a member of Bat Conservation Ireland and Qualifying CIEEM.

Paul Sweeney BA. MSc.

Paul Sweeney is a Graduate Planner with MKO having joined the team in April 2018. Paul holds a BA (Hons) in Geography and English and a Masters in Planning and Sustainable Development from University College Cork where he graduated in 2017. Since joining MKO, Paul has started to develop experience in a range of sectors through various projects and planning issues with a current focus within the Environmental and Energy sector.

James Newell

James holds the position of CAD and Information Technology Technician with MKO since joining the Company in May 2006. Prior to joining MKO, he worked as a graphic designer and illustrator for over eight years. In recent years James' role has extended to include all wind farm visual modelling completed by the company. He is proficient in the use of MapInfo GIS software in addition to AutoCAD and other design and graphics packages.

Joseph O'Brien

Joseph O'Brien joined MKO in 2016 and holds the position of CAD Technician. Joseph holds a BA Honours Level 8 Modelmaking, Design and Digital Effect, Institute of Art Design and Technology (IADT), Dun Laoghaire & City & Guilds Level 3 2D &3D AutoCAD certificates. Joseph's role entails various wind and solar farm projects which require various skills such as mapping, aerial registration and detailed design drawings for projects.

1.9.2.2 Hydro Environmental Services

Michael Gill

Michael Gill is an Environmental Engineer with over ten years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIA/EIS assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions.

David Broderick

David Broderick is a hydrogeologist with over seven years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies. David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIAs for a range of commercial developments.

Adam Keegan

Adam Keegan is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

1.9.2.3 Fehily Timoney & Company

Fehily Timoney & Company Ltd. (FT) recently acquired AGEC Ltd. adding to their growing geotechnical team. The geotechnical aspects of the project, which have been incorporated into the Land, Soils and Geology Chapter and the Hydrology and Hydrogeology Chapter of the EIAR, were completed by Fehily Timoney & Company Ltd. FT (previously AGEC) has extensive experience in the production of Peat Stability Assessments for wind energy developments. They provide specialist geotechnical engineering and engineering geology advice to local authorities, contractors and consultants, particularly for infrastructure projects forming part of the National Development Plan and also for private commercial and residential developments as they move on to sites with more complex ground conditions.

Gerry Kane

Gerry Kane joined AGEC Ltd. (now part of Fehily Timoney & Company Ltd.) as a Geotechnical Engineer in 2008. Gerry graduated from IT Carlow in 2008 with a BEng (Hons) degree in Civil Engineering. Gerry is a Geotechnical Engineer with over seven years' experience in geotechnical design and analysis, supervision and interpretation of ground investigations, foundation and earthwork design, supervision of construction of bulk earthworks and structure foundations, slope stability analysis, desk studies and walkover surveys. Previous and current experience in the wind energy field has included work for wind farm developments in Ireland, Northern Ireland, Scotland, Wales and England. This work has covered Peat Stability Assessment Reports, Soils and Geology Chapters of EIAR's, site assessments for wind farm developments and the investigation of peat failures at wind farm sites.

Ian Higgins

Ian is a geotechnical engineer with 20 years' experience in the design and supervision of construction of bulk earthworks, geotechnical foundation design, geotechnical monitoring and reviewing, reinforced earth design, slope stability assessments and 3rd party checking of piling and ground improvement designs. Ian's experience also includes the design, supervision and interpretation of ground investigations, including desk studies, walkover surveys, hazard mapping of rock excavations and slopes.

Ian has experience in many areas of civil engineering including highways, railways, energy projects and commercial developments.

1.9.2.4 AWN Consulting Ltd.

Damian Kelly

Damian Kelly (Technical Director) holds a B.Sc. from DCU and a M.Sc. from QUB. He has over 20 years' experience as an acoustic consultant and is a Member of the Institute of Acoustics. He has extensive knowledge in the field of noise modelling and prediction, having developed many of the largest and most complex examples of proprietary noise models prepared in Ireland to date. He has extensive modelling experience in relation to wind farm, industrial and road infrastructure projects. He is a sitting member of the committee of the Irish Branch of the Institute of Acoustics.

Dermot Blunnie

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng. from the University of South Wales, a M.Sc. from the University of Derby and IOA Diploma in Acoustics and Noise Control from the Institute of Acoustics. He has over 11 years' experience as an acoustic consultant and is a member of the Institute of Acoustics. He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

1.9.2.5 Tobar Archaeological Services

Tobar Archaeological Services is a Cork-based company entering its ninth year in business. They offer professional nationwide services ranging from pre-planning assessments to archaeological excavation, and cater for clients in state agencies, private and public sectors.

Tobar's Directors, Annette Quinn and Miriam Carroll, are licensed by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs to carry out excavations in Ireland and have carried out work directly for the National Monuments Services of the Department of the Environment, Heritage and Local Government. Tobar Archaeological Services has a proven track record and extensive experience in the wind farm industry from EIAR stage through to construction stage when archaeological monitoring is frequently required.

1.9.2.6 Alan Lipscombe Traffic and Transport Consultants

In January 2007 Alan Lipscombe set up an independent traffic and transportation consultancy providing advice for a range of clients in the private and public sectors.

Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning

Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic and transport modelling, including for numerous wind farm developments, and is an accomplished analyst who has experience of a wide variety of modelling packages and methods.

1.9.2.7 Dr. Tom Gittings – Ecological Consultant

Dr Tom Gittings has been trading as an independent ecological consultant since 2001. He has over 24 years' experience as a professional ecologist and is a full member of the Chartered Institute of Ecology and Environmental Management. Tom completed his PhD in Entomology in 1994. From 1995-2001 Tom worked for the RPS Group environmental consultancy, as an Ecological Consultant (1995-1998), Associate Ecologist/Office Manager (1998-2000) and Technical Director (2000-2001). From 2001-2009, Tom carried out research into forest and wetland biodiversity in University College Cork. During this period, Tom also developed a portfolio of independent consultancy work, and, since 2010, he has worked as a full-time independent consultant. Tom has extensive experience in a wide range of ecological disciplines and applications. He has carried out numerous specialist ecological surveys and assessments as well as project managing large-scale Environmental and Ecological Impact Assessments. Since 2010, a major focus of his work has been carrying out research into waterbird interactions with aquaculture and shellfisheries and preparing Appropriate Assessments of coastal SPAs using the results of this research. Other major areas of his work in recent years have included bird surveys for windfarms and powerlines, large-scale habitat surveys, and specialist entomological and ornithological surveys.

1.10 Difficulties Encountered

There were no technical difficulties encountered during the preparation of this EIAR.

1.11 Viewing and Purchasing the EIAR

Copies of this EIAR will be available online, including the Non-Technical Summary (NTS), on the website of An Bord Pleanála, under the relevant Planning Reference Number (to be assigned on lodgement of the application).

- An Bord Pleanála: http://www.pleanala.ie/

This EIAR and all associated documentation will also be available for viewing at the offices of both An Bord Pleanála and Offaly County Council. The EIAR may be inspected free of charge or purchased by any member of the public during normal office hours at the following address:

- An Bord Pleanála,
64 Marlborough Street,
St. Rotunda,
Dublin 1

- Offaly County Council,
Áras an Chontae,
Charleville Road,
Tullamoore,
Co. Offaly

The EIAR will also be available to view online via the Department of Planning, Housing and Local Government's EIA Portal, which will provide a link to the planning authority's website on which the application details are contained. This EIA Portal was recently set up by the Department as an electronic notification to the public of requests for development consent which are accompanied by an EIAR.

(https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal)

The EIAR will also be available to view online on its dedicated SID website: https://www.derrinloughwindfarmplanning.ie

2. BACKGROUND TO THE PROPOSED DEVELOPMENT

This section of the Environmental Impact Assessment Report (EIAR) presents information on renewable energy and climate change policy and targets, the strategic planning context for the proposed development, a description of the proposed development site and planning history, scoping and consultation, and the cumulative impact assessment process.

2.1 Introduction

This section of the EIAR presents the various policies and targets which have been put in place at the various scales in relation to renewable energy. The details below set out the need for the proposed development to aid in Ireland meeting its national targets and European commitments in relation to climate change and decarbonisation. As is discussed throughout this chapter all of the latest projections have shown that Ireland is not set to meet its 2020 targets. Within this chapter the information is presented and assessed under the following:

- Renewable Energy Resources,
- EU Legislation,
- Progress on Targets, and,
- National Energy Projections.

The proposed development comprises the provision of a wind farm which will generate renewable energy and provide it for use onto the national grid. The need to decarbonise the economy and reduce emissions has always been imperative, however, in recent years the urgency involved has become clearer to all stakeholders. The Climate Action Plan published by the Government in 2019 has clearly identified the need for and urgency of change, it states:

> *"The accelerating impact of greenhouse gas emissions on climate disruption must be arrested. The window of opportunity to act is fast closing, but Ireland is way off course.... The shift in climate is bringing profound shifts of desertification, rising sea levels, displaced population, profound challenges to the natural world, and economic and social disruption. We are close to a tipping point where these impacts will sharply worsen. Decarbonisation is now a must if the world is to contain the damage and build resilience in the face of such a profound challenge."*

The primary driver behind the proposed development is the need to provide additional renewable energy to offset the use of fossil fuels within the electricity generating sector. Increasing electricity generation from wind power represents the most economical renewable option to reduce emissions within the power generation sector and is the most mature technology available to achieve national targets that have been established for decarbonisation. The current proposal represents the provision of a significant wind energy proposal (as acknowledged by its classification as a Strategic Infrastructure Development under the Planning and Development Act, 2000 (as amended)) and will contribute towards Ireland satisfying its 2030 renewable energy targets.

2.2 Renewable Energy Resources

Renewable energy resources include wind, solar, water (hydropower, wave and tidal), heat (geothermal) and biomass (wood, waste) energy. These sources are constantly replenished through the cycles of nature, unlike fossil fuels, which are finite resources that are becoming increasingly scarce and expensive to extract.

Renewable energy resources offer sustainable alternatives to our dependency on fossil fuels as well as a means of reducing greenhouse gas emissions and opportunities to reduce our reliance on imported fuels. These resources are abundantly available in Ireland, yet only a fraction has been tapped so far.

A gradual shift towards increasing our use of renewable energy resources would result in:

- Reduced carbon dioxide emissions;
- Secure and stable energy for the long-term;
- Reduced reliance on fuel imports; and
- Investment and employment in our indigenous renewable energy projects; often in rural and underdeveloped areas.

Renewable energy development is recognised as a vital component of Ireland's strategy to tackle the challenges of combating climate change and ensuring a secure supply of energy. Ireland is heavily dependent on the importation of fossil fuels to meet its energy needs, with imported fossil fuels accounting for 67% of Ireland's dependency in 2018 at an estimated cost of €5 billion. This high dependency on energy imports is highly risky and Ireland is currently extremely vulnerable both in terms of meeting future energy needs and ensuring price stability.

2.3 EU Legislation

The European Union (EU) Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC) (hereafter referred to as the Renewable Energy Directive) was adopted on 23rd April 2009 and was transposed into Irish law by the European Union (Renewable Energy) Regulations 2014 (S.I. No 483 of 2014). The Directive establishes the "20-20-20" targets: a binding target of a minimum 20% reduction in greenhouse gas emissions based on 1990 levels, 20% of overall EU energy consumption to come from renewable sources by 2020, as well as a binding 10% minimum target for energy from renewable resources in the share of transportation fuels and 20% reduction in primary energy use compared with projected levels by improving energy efficiency.

The Renewable Energy Directive legally obliges each Member State to:

- Ensure that its 2020 target is met.
- Introduce "appropriate measures" and outline them in a National Renewable Energy Action Plan (NREAP). The "appropriate measures" include ensuring that grid-related measures and administrative and planning procedures are sufficient to achieve the 2020 target. The NREAP for Ireland was published in June 2010.

These targets represent an important first step towards building a low-carbon economy. They are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth (please refer to Section 2.3.2). This recognises that tackling climate and energy challenge contributes to the creation of jobs, the generation of "green" growth and a strengthening of Europe's competitiveness.

The achievement of the above '20-20-20' targets will ultimately require 'safe, secure, sustainable and affordable energy' in order to accommodate the transition to a low-carbon economy. Failure to meet EU targets on the use of energy from renewable sources could result in substantial EU sanctions.

Ireland's mandatory target under the Directive is for renewable resources to account for 16% of total energy consumption by 2020. This will be met by 40% from renewable electricity, 12% from renewable heat and 10% from the renewable transport sector.

The 2030 Climate and Energy Policy Framework (adopted by The EU Council in October 2014) marks a further development of EU renewable energy policy. The framework defines further EU wide targets and builds on the 2020 climate and energy package.

The Framework sets three key targets for the year 2030:

- A binding commitment at EU level of at least 40% domestic Greenhouse Gas reduction by 2030 compared to 1990;
- An EU wide, binding target of at least 27% renewable energy by 2030; and
- An indicative EU level target of at least 27% energy efficiency by 2030.

The European Commission published its proposal for an effort sharing regulation on the allocation of national targets for greenhouse gas emissions for the period 2021-2030 in July 2016. The proposal implements EU commitments under the Paris agreement on climate change (COP21) which is discussed in Section 2.2.3.2 and marks an important milestone in the allocation to Member States of a package of climate targets that were formally adopted as part of the 2030 Climate and Energy Framework.

On the 27th of June 2018 EU ambassadors endorsed the provisional agreement reached by the Bulgarian Presidency on the revision of the renewable energy directive. The new regulatory framework is expected to pave the way for Europe's transition towards clean energy sources such as wind, solar, hydro, tidal, geothermal, and biomass energy. The agreement sets a headline target of 32% energy from renewable sources at EU level for 2030. Other key elements of the agreement include:

- The design of support schemes will provide for a possibility of technology specific support, aligned with state aid guidelines. The opening of renewable support towards neighbouring member states will be voluntary, at an aspirational pace of at least 5% between 2023 and 2026 and 10% between 2027 and 2030. Except for certain cases, member states will be obliged to issue guarantees of origin.
- Permit granting procedures will be simplified and streamlined with a maximum of two years for regular projects and one year in case of repowering, both extendable for an additional year in case of specific circumstances and notwithstanding environmental and judicial procedures. For small-scale projects below 10.8kW simple notification procedures will apply. Each member state may choose to apply simple notification procedures also to projects up to 50kW.
- The annual increase of energy from renewable sources in heating and cooling will be 1.3 percentage points indicatively, or 1.1 percentage points if waste heat is not taken into account.
- Via obligations on fuel suppliers, renewables will reach a level of at least 14% in transport by 2030, supplemented by a set of facilitative multipliers to boost renewables in different sectors.

Based on the SEAI National Energy Projections 2019 it was expected that Ireland will fall short of its mandatory European target for an overall 16% renewable energy share by 2020, with overall achievement reaching approximately 13%.

2.3.1 Progress on Targets

The overall share of renewables in primary energy stood at 11.1% in 2018 which is up from the 2017 figure of 9.3% and 7.9% in 2016. As per the EU Renewable Energy Directive, the target for Ireland is set at 16% share of renewable energy in gross final consumption (GFC) by 2020. As per the report, the contribution from renewables in 2005 was 2.8%, which as of 2017, has risen to 10.6% of the GFC. According to the SEAI's report the share of electricity from renewable energy has increased fourfold between 2005 and 2017 – from 7.2% to 30.1% – an increase of 23 percentage points over 12 years. In absolute terms, there has been a fivefold increase in the volume of renewable electricity generated from 1,873 GWh in 2005 to 8,877 GWh in 2017. Of this, it was noted that Wind energy accounted for 84% of the renewable electricity in 2017.

The June 2018 *'Off Target Report'* published by the Climate Action Network (CAN) Europe, which ranks EU countries ambition and progress in fighting climate change, listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate and renewable energy targets and is also off course for its unambitious 2030 emissions target. The report states:

> *"Ireland has failed to prepare effective policies to align near-term climate action with EU and Paris Agreement commitments. Without new, immediate and substantive efforts to cut emissions, Ireland faces annual non-compliance costs of around €500 million."*

The Department of Climate Change, Action & Environment (DCCAE) reported in their '*Fourth Progress Report on the National Renewable Energy Action Plan'* December 2017 that Ireland will achieve 13% of its 16% RES target by 2020. SEAI in their report '*Ireland's Energy Targets – Progress, Ambition & Impacts'* (April 2016) estimates that Ireland's inability to achieve its 2020 renewable energy targets will result in fines of between €65 million and €130 million per percentage shortfall on its overall binding target after 2020 until it meets its targets.

The Climate Change Advisory Council similarly notes within their *2019 Annual Review* that while the share of renewable electricity generation, (particularly wind), is increasing in Ireland, the overall pace of the decarbonisation of the electricity generation sector is not compatible with a low-carbon transition to 2050. As such, Ireland can continue to 'comply' with EU targets by purchasing emission allowances; however, the expenditure of public funds to do so would not result in any domestic benefit, and furthermore, would result in a more difficult and expensive challenge for the county to meet its future 2030 targets and beyond. The *Review* concludes that continued and additional investment in capacity and technologies in the renewable energy sector is required to reach these said targets.

Figure 2.1 shows the latest data available for the share of renewable energies in gross final energy consumption according to the Eurostat online data and the targets that have been set for 2020. The share of renewables in gross final energy consumption stood at 18.0% % in the EU-28 in 2018. The data shows that twelve member states have reached a share equal to or above their 2020 target. This is not the case with Ireland who, as evident in Figure 2.1, are still considerably below meeting its 2020 target. Per the 2018 data Ireland were at 11.1% of its 16% target.

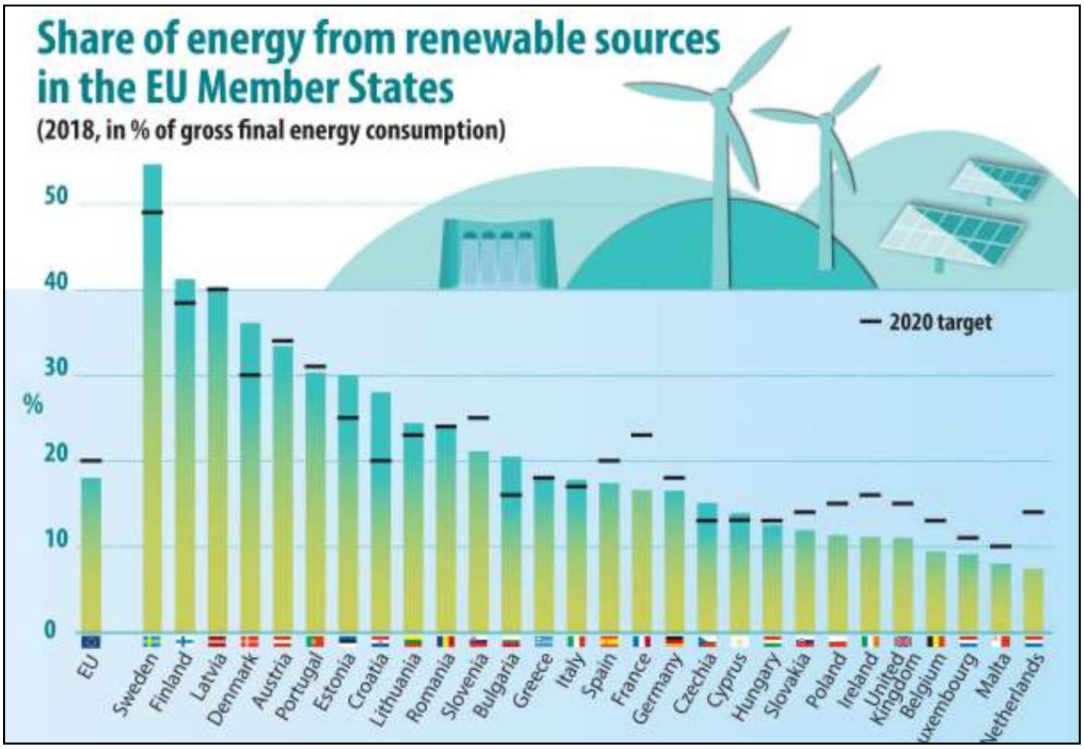


Figure 2.1 Share of energy from renewable sources, 2018

EirGrid in their 'All Island Generation Capacity Statement 2019 - 2028' (September 2019), state that, in the absence of the National Energy and Climate Plan 2021 – 2030, it is assumed that renewable targets will be achieved largely through the deployment of additional wind powered generation in Ireland. New wind farms commissioned in Ireland in 2018 brought the total wind capacity to over 3666 MW, contributing to the increase in overall RES-E percentage to 32.5%, with wind energy accounting for 27.6%. EirGrid estimates that between 3.9 – 4.4 Gigawatts (GW) of wind may be required to meet the 2020 Renewable Energy Supply - Electricity (RES-E) target of 40%. The most likely scenario for installed wind capacity in 2020 is expected to be 4200 MW which would imply an average build-out of approximately 330 MW per year until the end of 2020 to achieve targets.

It is noted by EirGrid within their 2019 – 2028 statement that, at a median demand level, Ireland does not have adequate generation capacity to meet demand from 2026 once Moneypoint closes, and should any other plant close prior to this, earlier deficits may arise. This is especially pertinent with regard to the recent announcement that the Electricity Supply Board intends to close the peat fired Shannonbridge and Lough Ree Power Stations at the end of 2020.

It is noted that the key driver for electricity demand in Ireland for the next number of years is the connection of new large energy users, such as data centres. Specifically, there is currently 1000 MVA demand capacity that is contracted to data centres and other large energy users. This statement notes that *'Large industrial connections normally do not dominate a country's energy demand forecast but this is the case for Ireland at the moment'*. EirGrid analysis shows that demand from data centres could account for 29% of all demand by 2028 in a median demand scenario (accounts for the connection of all 1400MVA of potential demand in the connection process). The median demand scenario is now higher than for last year's forecast for high demand, indicating the progression of many of the data centre projects. It should be noted that each MW of additional data centre load will add at least 1 MW of wind to the 40% RES-E 2020 target. Alternatively, 3 MW of wind could be required per MW of data centre electricity demand, if the data centre wants to commit to being powered by 100% renewable energy. Many data centres have made such commitments and have well-publicised company policies to use only renewable electricity for their power needs.

In October 2015, the Irish Wind Energy Association (IWEA) commissioned a study titled *'Data-Centre Implications for Energy Use in Ireland'* and concluded that an additional 1 GW of electricity demand may be required in Ireland by 2020 due to growth in data centres.

2.3.2 SEAI National Energy Projections 2019

The SEAI National Energy Projections 2019 were published in May 2019 and outlines there has been a significant increase in renewable energy share in Ireland over the past number of years. The report details that in 2005, 5% of Ireland's energy came from renewable sources, and in 2019, it is estimated that approximately 13% of Irelands energy will be generated by renewable sources which is below the required 16% target. The report details that there is still a significant way to go to achieving our European target of 16% and Ireland will not meet EU 2020 targets. Compared to other European countries, Ireland was 22nd out of the EU-28 for overall renewable energy share and 26th out of the EU-28 for progress towards overall 2020 renewable energy target.

- 38.9% renewable electricity by 2020 (target is 40%);
- 9.8% renewable heat by 2020 (target is 12%); and
- 10.8% renewable transport by 2020 (target is 10%).

It is assumed that the 20-20-20 renewable targets and future commitments will be achieved largely through the deployment of additional wind powered generation. Over 500 MW of wind generation was installed which resulted in wind generation accounting for 25.2% of the electricity generated. Wind generation is now the second largest source of electricity generated after natural gas.

In the context of climate change the report details that:

> *"Climate change is now recognised as the biggest threat to life on earth, and it is now urgent that we take immediate action to reduce anthropogenic emissions of greenhouse gases to limit its damaging effects."*

With regards to the production of electricity, it is noted that while Ireland has had considerable success in increasing the share of renewables in electricity generation that there is a need to continue to achieve in this sector and take full advantage of the country's abundant resources. It continues to detail that as per the latest EirGrid Generation Capacity Statement, there is a prediction of an increase of demand in the short terms with 3% to 5% per year listed.

The Renewable Energy Support scheme aims to increase the deployment rate, support up to 4,500 megawatts of additional renewable electricity by 2030 and diversify the renewable electricity portfolio. Policy measures that could help to meet the Government increased ambition include:

- Expediting the adoption of clear, and timebound, licensing and consenting procedures for offshore renewable energy development;
- Addressing technical grid challenges to incorporating very high levels of asynchronous renewables, for example via EirGrid's Delivering a Secure, Sustainable Electricity System (DS3) programme;
- Creating a clear, and timely, grid connection access and concession regime for offshore and new onshore renewable energy development, with due regard for methods by which the State can most cost effectively reduce or manage risk;
- Creating markets for grid services such as energy storage and other services supporting high levels of renewables on-grid;
- Supporting onshore wind farms reaching end of life, by providing clarity for re-powering investment decisions intertwined with new wind guidelines;
- Assisting the timely delivery of increased interconnection;
- Establishing corporate power purchase agreements mechanisms with mandated minimum renewable energy purchases or self-generation for large electricity demand users to leverage private investments in renewable electricity;
- Encouraging prosumers by consideration of communication methods, market mechanisms, market rules, frameworks and setting a price for export to the grid from point source generation, in line with the ambitions outlined in the Clean Energy Package; and
- Developing community energy and small-scale renewable generation projects to enable a shift to a more distributed generation system with demand response capabilities.

Section 9 of the report details the effort which must be made for closing the gaps to targets. It is detailed that *'given the cumulative nature of emissions, an immediate acceleration of emissions reductions is required to put Ireland on the committed long-term trajectory'*. Included as part of this is the country's commitments under the Paris Agreement. Further to this:

> *"Increased ambition and delivery targets supporting a sustainable energy transition are anticipated to be included in the upcoming All of Government Climate Action Plan being produced by DCCAE."*

In the context of the above the Climate Action Plan was published by the Department of Communications, Climate Action and Environment in August 2019. Please refer to Section 2.4.7.5 of this report.
The SEAI National Energy Projections Report notes that to achieve the level of ambition set for 2020 and 2030 the country will be dependent on:

- Increased deployment rates of sustainable energy technologies and practices across the entire economy;

- The development of a national training and skills strategy to support growth of the clean energy technology sector;
- Support for changes in business models, nascent clean energy technology supply chains and the addressing of existing market failures;
- Early resolution of planning and regulatory barriers, including continued public engagement, and the development of appropriate market structures – especially for electrification of heat and transport supported with high levels of renewable electricity;
- Significant mobilisation of private investment in renewable energy and energy efficiency – additional spend on efficiency is known to achieve multiple benefits including warmer, healthier and more cost-effective buildings;
- The acceleration of innovation and technology adoption, especially in the area of electricity demand response, grid flexibility and storage;
- The exploitation of advances in ICT and national strengths in this field to advance renewables and energy efficiency, particularly in relation to passenger mobility solutions;
- Aggressively adopting the 'avoid, shift and improve' transport energy policy principles – this involves managing mobility demand to avoid trips or a shift to the most efficient modes, plus improving the energy efficiency of vehicles as well as reducing the carbon intensity of fuels;
- Taking in the ethical cost of carbon consideration in all aspects of public and private enterprise planning, involving the enforcement of the polluter pays principle by including the negative external costs associated with emissions such as healthcare or environmental reparation costs;
- An approach to carbon neutrality in the agriculture and land-use sector, including forestry, that does not compromise capacity for sustainable food production; and
- The promotion of an environmentally aware and concerned citizen and community ideology to combat climate change, including recognition of the impact of diet and consumerism on climate change.

2.3.3 SEAI Energy in Ireland 2019 Report

In December 2019 SEAI produced the Energy in Ireland 2019 report, which provides the most up to date figures available (from 2018) in relation to energy production and consumption in Ireland. The report found that despite the increase in energy demand energy-related CO_2 emissions fell slightly mainly due to (a) a reduction in the amount of coal used for electricity generation (arising from a technical fault at Moneypoint – Irelands only coal-fired electricity generation plant) combined with (b) increased contributions from wind generation. In relation to renewable energy targets, the 2019 report found that:

- The share of electricity generated from renewable sources increased by 3.1 percentage points in 2018, to 33.2%. The 2020 target being 40%.
- The share of energy used for transport from renewable energy resources decreased from 7.4% in 2017 to 7.2% 2018. The 2020 target is 10%.
- The share of energy used for heat from renewable resources decreased from 6.7% in 2017 to 6.5% in 2018. The 2020 reduction target is 12%.

Furthermore the 2019 report also found that wind generation accounted for 28.1% (normalised) of all electricity generated. It was the second largest source of electricity generation in 2018 after natural gas. Wind energy accounted for 84% of the renewable energy generated in 2018. At the end of 2018 the installed capacity of wind generation reached 3,676MW, and during 2018 358MW of wind capacity was installed. The SEAI 2019 report also makes the following statements:

> *"EirGrid and ESB Networks note that as of 2019 there is 1,873 MW of additional wind generation planned, either with connection contracts in place or applications for connection underway. Historically, there has been a maximum of just over 500 MW installed in any one year since 2005 and on average the installation rate has been 200 MW."*

"In relation to the displacement of fossil fuels by renewable energy, it is estimated that in 2018 approximately €623 million in fossil fuel imports were avoided, of which €432 million was avoided by wind generation."

In relation to the findings of this December 2019 SEAI report it is clear that wind energy represents the strongest and most deployable renewable energy resource available to reduce dependence on fossil fuels in Ireland. While it is clear that additional deployment is on-going, it is also apparent that it is unlikely that the 2020 targets for renewable electricity generation will be met. Achieving targets becomes even more challenging in the context of increasing electricity demand.

The proposed development represents an opportunity to bring forward an additional renewable energy source which will contribute towards achieving further decarbonisation of the electricity generation sector.

2.3.4 National Policy

2.3.4.1 Introduction

This section of the EIAR provides a breakdown of national policy with regards to the proposed development. Under the national policy section the following are discussed:

- Irelands Energy Policy Framework 2007-2020,
- National Renewable Energy Action Plan,
- White Paper on Energy Policy in Ireland 2015-2020,
- Strategy for Renewable Energy 2012-2020, and,
- National Strategy for Intensifying Wind Energy Development 2000.

National policy has developed in line with European and International policies, targets and commitments, in that the importance and urgency of decarbonising the energy generation sector, the economy in general and reducing greenhouse gas emissions has become increasingly more apparent. The proposed development complies with the nationally stated need to provide a greater amount of renewable energy onto the national grid and will further reduce the national reliance on fossil fuels for electricity generation.

2.3.4.2 Ireland's Energy Policy Framework 2007-2020

The Government White Paper entitled '*Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020*' was published by the Department for Communications, Marine and Natural Resources in 2007. Currently approximately 67% of Irish energy requirements are imported, as described in Section 2.1.1 above. Combined with our peripheral location, this situation leaves Ireland vulnerable to supply disruption and imported price volatility, as stated in the White Paper. The primary objectives of the Government's energy policy are security of supply, environmental sustainability and economic competitiveness. The Framework sets out clear actions, targets and timeframes for meeting these interlinked objectives.

Ireland's energy policy priorities are framed in the context of the European Union. Directive 2009/28/EC (hereon referred to as the Renewable Energy Directive) on the Promotion of the Use of Energy from Renewable Sources sets a target for Ireland for 16% of energy consumption to come from renewable sources by 2020. The 2007 Government White Paper sets a more ambitious target of 33% for energy consumption from renewable sources by 2020. This target was further increased to 40% by the Minister for Communications, Energy and Natural Resources, in 2008 as part of the Government's strategy to make the "green economy" a core component of its economic recovery plan.

In Ireland, it is widely acknowledged that the vast majority of the renewable electricity requirement is expected to be met through the development of indigenous wind power, as Ireland has a strong wind resource potential, with one of the best onshore wind speed averages in Europe ('The Value of Wind Energy to Ireland', Pőyry, 2014). In 2015, wind energy accounted for 84% of renewable electricity generation. 2016 was less windy than 2015 and electricity generated from wind fell by 6.5% but still accounted for 82% of renewable electricity ('Energy in Ireland 1990 – 2016', Sustainable Energy Authority of Ireland, 2017). Further, the SEAI Energy In Ireland 2019 Report (December 2019) confirms that most of the growth in renewable energy has come from wind. Wind provided 84% of all renewable energy generated in 2018.

The Energy White Paper 2007 states that renewable energy will be a critical and growing component of Irish energy supply to 2020 and beyond. The Government's strategic goals for sustainable energy include addressing climate change by reducing energy-related greenhouse gas emissions and accelerating the growth of renewable energy sources. Renewable energy and enhanced efficiency in power generation are integral to the Government's strategy to deliver Ireland's climate change targets under the Kyoto Protocol. The Paper states:

> *"Renewable energy is an integral part of our climate change strategy and sustainability objectives. The additional diversity which renewables bring to Ireland's energy demand will also make a direct contribution to our goal of ensuring secure and reliable energy supplies."*

2.3.4.3 National Renewable Energy Action Plan

Article 4 of the Renewable Energy Directive on renewable energy required each Member State to adopt a national renewable energy action plan (NREAP) to be submitted to the European Commission. The NREAP sets out the Member State's national targets for the share of energy from renewable sources to be consumed in transport, electricity and heating and cooling in 2020, and demonstrates how the Member State will meet its overall national target established under the Directive.

The NREAP sets out the Government's strategic approach and planned measures to deliver on Ireland's 16% target under the Renewable Energy Directive. In relation to wind energy, the NREAP states:

> *"…, Ireland has immense potential for the development of renewable energy particularly wind energy, both on and offshore and wave energy. The development and expansion of the use of renewable energy, together with measures aimed at a reduction and more efficient use of energy are important as regards meeting our climate change objectives and priorities, both nationally and at European level. At a high level a significant increase in renewable energy and the protection of the environment are thus mutually reinforcing goals."*

2.3.4.4 White Paper on Energy Policy in Ireland 2015-2030

On 12th May 2014, 'The Green Paper on Energy Policy in Ireland' was launched, opening the way for a public consultation process on the future of energy policy in Ireland for the medium to long-term. The paper acknowledged that energy is an integral part of Ireland's economic and social landscape; and that a secure, sustainable and competitive energy sector is central to Ireland's ability to attract and retain Foreign Direct Investment and sustain Irish enterprise. The three key pillars of energy policy are to focus on security, sustainability and competitiveness.

A Government White Paper entitled 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' was published in December 2015 by the then Department of Communications, Energy and Natural Resources. This Paper provides a complete energy update and a framework to guide policy up to 2030. The Paper builds upon the White Paper published in 2007 and takes into account the changes that have taken place in the energy sector since 2007.

The policy framework was developed to guide policy and actions that the Irish Government intends to take in the energy sector up to 2030 and also reaching out to 2050 to ensure a low carbon future that maintains Ireland's competitiveness and ensures a supply of affordable energy. The Energy Vision 2050, as established in the White Paper, describes a 'radical transformation' of Ireland's energy system which will result in greenhouse gas (GHG) emissions from the energy sector reducing by between 80% and 95%, compared to 1990 levels. The paper advises that a range of policy measures will be employed to achieve this vision and will involve amongst many things, generating electricity from renewable sources of which there are plentiful indigenous supplies and increasing the use of electricity and bio energy to heat homes and fuel transport.

In this White Paper, the then DCENR confirmed that onshore wind is the cheapest form of renewable energy in Ireland, stating that it is:

> *"Onshore wind continues to be the main contributor (18.2% of total generation and 81% of RES-E in 2014). It is a proven technology and Ireland's abundant wind resource means that a wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."*

2.3.4.5 Strategy for Renewable Energy 2012-2020

The then Department of Communications, Energy and Natural Resources publication, *Strategy for Renewable Energy 2012 – 2020*, outlines the strategic goals which underpin the Government's energy and policy objectives. The Strategy articulates the key actions to be undertaken to support the development of each of the renewable energy sectors to deliver on Ireland's binding 2020 targets under the Renewable Energy Directive. It acknowledges the national importance of developing renewable energy and confirms the Government's commitment to this.

The Strategy sets out five strategic goals, the first of which is as follows:

> *"Strategic Goal 1 - Progressively more renewable electricity from onshore and offshore wind power for the domestic and export markets."*

The proposed wind farm will produce electricity for the domestic market only.

In order to achieve the above goal, the Strategy sets out a number of key actions, including the following:

- Support delivery of the 40% target for renewable electricity through the existing GATE processes. A further targeted Gate may be developed, if necessary, following a review of the take-up of Gate 3 offers, while developing a next phase plan led approach for additional onshore capacity in future;
- Review with the Department of Environment and CER the scope for further streamlining authorisation and planning processes for renewable energy projects;
- Implement REFIT 2 for onshore renewable energy and maintain a predictable; and transparent REFIT support framework for onshore wind which is cost competitive.

The Strategy highlights the economic benefits onshore wind projects can have on the Irish economy:

> *"Further strategic deployment of onshore wind projects will develop a base of indigenous and foreign companies and create employment in the short-term in wind farm construction, possible turbine component manufacturing and servicing, the opportunity to capture international supply chain opportunities and the manufacture of niche onshore renewable energy generating equipment".*

As is highlighted in Section 2.3.2 of this chapter, based on the SEAI's National Energy Projections 2019 there is still a significant way to go towards achieving the European targets and it was concluded that Ireland will not meet its EU 2020 targets.

2.3.4.6 National Strategy for Intensifying Wind Energy Development 2000

The Strategy for Intensifying Wind Energy Development was published in 2000 by the Renewable Energy Strategy Group as part of the Department of Communications, Energy and Natural Resources. The main aim of the Group was to develop a strategy for the increased contribution of onshore wind energy to electricity generation. During the initial six-month period of the preparation of the strategy, the Group examined many aspects of, and constraints to, the further development of wind energy.

The principal conclusion of the Renewable Energy Strategy Group was that three key elements: Electricity Market, Electricity Network and Spatial Planning, needed to be integrated into a plan-led approach to wind energy deployment. The recommended strategy, arising from this approach, has been designed to meet the targets set for deployment of renewable energy at least cost.

The recommended plan-led approach as described in the Strategy sees spatial planning considerations as crucial in determining suitable areas where wind farms may be accommodated. It states that these decisions should be informed by the availability of the resource (wind), the strength of the electricity networks, and landscape and other planning considerations.

2.4 Climate Change Policy and Targets

2.4.1 Introduction

This section of the EIAR presents the various policies and targets which relate to climate change. The below headings and sub-headings explore climate change in the context of EU and national policy and are broken down into the following sections:

- Impacts on Climate Change
  - Water Resource Management
  - Agriculture
  - Biodiversity and Natural Ecosystems
- International Policy
  - United Nations Framework Convention on Climate Change
- Kyoto Protocol Targets
  - Doha Amendment to the Kyoto Protocol
  - COP21 Paris Agreement
  - Progress on Targets
  - Emissions Projections
- National Policy
  - National Climate Change Adaptation Framework 2012
  - National Adaptation Framework - Planning for a Climate Resilient Ireland 2018
  - National Policy Position on Climate Action and Low Carbon Development, 2014
  - Climate Action and Low Carbon Development Act 2015
  - National Mitigation Plan
  - Report of the Joint Committee on Climate Action Climate Change: A Cross-Party Consensus for Action, March 2019
  - Climate Action Plan, 2019

International and national policy consistently identifies the need to reduce greenhouse gas (GHG) emissions and stressed the importance of reducing global warming. The context of international policy has altered over the last 30 years to being of a warning nature to the current almost universally accepted belief that we are in a climate crisis. The current proposed development, as a generator of renewable energy, will contribute to the decarbonisation of the energy sector and reduce harmful emissions. In this regard, it is in broad compliance with national and international climate change policy and targets.

2.4.2 Impacts on Climate Change

Climate change, in the context of EU and national policy, refers to the change in climate that is attributable to human activity arising from the release of greenhouse gases into the atmosphere and which is additional to natural climate variability (Department of the Environment, Heritage and Local Government, 2006). In 2008, the Environmental Protection Agency (EPA) published the results of a study entitled 'Climate Change – Refining the Impacts for Ireland', as part of the STRIVE (Science, Technology, Research and Innovation) Programme 2007 – 2013. This report stated that mean annual temperatures in Ireland have risen by 0.7 degrees Celsius (C) over the past century. Mean temperatures in Ireland relative to the 1961 to 1990 averages are likely to rise by 1.4 to 1.8ºC by the 2050's and by more than 2˚C by the end of the century due to climate change. Under a report published by the EPA titled *"Irish Climate Futures: Data for Decision-making"* (June 2019) the following is acknowledged:

> *"That the world has warmed since the 19th century is unequivocal. Evidence for warming includes changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; and sea level and atmospheric water vapour."*

The report continues to note that should business as usual continue the Earth's average temperature is likely to increase by between 2.6˚C and 4.8˚C above today's levels, for Ireland, the changes listed (extreme events and sea level rise) would probably mean more frequent wet winters, dry summers and hot summers. It is acknowledged that this would pose challenges for water and flood risk management, agriculture and tourism.

Future precipitation changes are less certain to project than temperature but constitute the most important aspect of future climate change for Ireland. The study projects that winter rainfall in Ireland by the 2050's will increase by approximately 10%, while summer rainfalls will reduce by 12 – 17%. Lengthier heatwaves, much reduced number of frost days, lengthier rainfall events in winter and more intense downpours and an increased propensity for drought in summer are also projected. The STRIVE report on climate change impacts states that Ireland can and must adapt to the challenge of climate change.

2.4.3 International Policy

2.4.3.1 United Nations Framework Convention on Climate Change

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC), was adopted as a framework for international efforts to combat the challenge posed by climate change. The UNFCCC has over 197 signatory countries and has almost universal membership from the international community. The UNFCCC seeks to limit average global temperature increases and the resulting climate change. In addition, the UNFCCC seeks to cope with impacts that are already inevitable. It recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The framework set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "protocols" or "Agreements") may be negotiated to set binding limits on greenhouse gases.

2.4.4 Kyoto Protocol Targets

Ireland is a Party to the Kyoto Protocol, an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding.

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions of 8% below 1990 levels in the period 2008 to 2012. Ireland's contribution to the EU commitment for the period 2008 – 2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

2.4.4.1 Doha Amendment to the Kyoto Protocol

In Doha, Qatar, on 8thDecember 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 5% against 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020; however, the composition of Parties in the second commitment period is different from the first.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

2.4.4.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the UNFCCC. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention, to evaluate its implementation and negotiate new commitments.

COP21 closed with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). It provides for a limitation of the global average temperature rise to well below 2˚C above pre-industrial levels and to limit the increase to 1.5˚C. It is flexible and takes into account the needs and capacities of each country.

A recent article published by the IPCC (Intergovernmental Panel on Climate Change) on the 6th October 2018 titled 'Global Warming of 1.5˚C', notes the impacts of global warming of 1.5˚C above pre-industrial levels and related global greenhouse gas emission pathways; in the context of mitigation pathways, strengthening of the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. This special report is part of an invitation contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement, and provides an update on the impact of climate change if emissions are not reduced.

The "Report of the Secretary-General on the 2019 Climate Action Summit and the Way Forward in 2020", published 11th December 2019, makes for stark reading in relation to targets, it states:

> *"...the initial national climate pledges (Nationally Determined Contributions, or NDCs) made under the Paris Agreement are inadequate. Pathways reflecting countries' current climate plans imply global warming of about 30˚C by 2100, with warming continuing afterwards. In addition, 2015-2019 has seen a continued increase in CO_2 levels and other key greenhouse*

gases (GHG) in the atmosphere to new records, with CO_2 growth rates nearly 20 percent higher than the previous five years. This trend is not estimated to begin reversing by 2030, let alone 2020."

Against this backdrop and the urgent need to scale up climate action the Secretary-General convened the Climate Action summit on 23rd September 2019 to focus global attention in the face of the worsening climate crisis and to forge new pathways ahead to support the achievement of the Paris Agreement.

The Climate Action Summit reinforced 1.5°C as the socially, economically, politically and scientifically safe limit to global warming by the end of this century, and net zero emissions by 2050 as the global long-term climate objective for all. Countries need to urgently accelerate work to define what this entails for the short-term (2020) and mid-term (2030) commitments that will be captured in their Nationally Determined Contributions and ensure the alignment of strategies to meet those commitments. The Secretary General's report stated that:

> *"The Summit reinforced on a global stage the critical need for countries to define and implement more ambitious national climate plans (NDCs) and long-term strategies (LTS) consistent with the objective of net zero emissions by 2050."*

2.4.4.3 Progress on Targets

The 'Europe 2020 Strategy' is the EU's agenda for growth and jobs. The Europe 2020 Strategy targets on climate change and energy include:

- Reducing GHG emissions by at least 20% compared with 1990 levels;
- Increasing the share of renewable energy in final energy consumption to 20%; and
- Moving towards a 20% increase in energy efficiency.

The *'Europe 2020 indicators – climate change and energy'* report provides a summary of recent statistics on climate change and energy in the EU, with reference to the progress of Member States in meeting the required targets. In 2016, EU greenhouse gas emissions, including emissions from international aviation and indirect carbon dioxide (CO_2) emissions, were down by 22.4% when compared with 1990 levels. The EU is therefore expected to exceed its Europe 2020 target of reducing GHG emissions by 20% by 2020. In 2016, renewable energy provided 17.0 % of gross final energy consumption in the EU, up from 9 % in 2005.

However, regarding the progress of individual Member States, and Ireland in particular, the Europe 2020 indicators include the following statements:

- 24 countries are on track to meet their GHG targets, except Austria, Belgium, Ireland and Luxembourg;
- Luxembourg emitted the most GHG per capita in the EU in 2014 followed by Estonia, Ireland, the Czech Republic and the Netherlands; and
- All EU countries have increased their renewable energy share between 2005 and 2014. Twelve have more than doubled their share, albeit from a low base. Nine have already met their 2020 targets. In 2014, France, the Netherlands, the United Kingdom and Ireland were farthest from reaching their national targets.

While the EU as a whole is projected to exceed it's 2020 target of reducing GHG emissions by 20%, Ireland is currently one of the countries projected to miss its national targets. The Europe 2020 report emphasises the importance of continued action on climate change:

> *"Despite the EU's shrinking share in global CO2 emissions, recent findings on the potentially catastrophic impacts of climate change confirm the ongoing importance of its climate and energy goals. EU emission cuts alone cannot halt climate change, but if it can show that a low-*

> *carbon economy is feasible, and can even increase innovation and employment, it will serve as a role model to other regions. Continuous investment in advanced low-carbon technologies can also help the EU uphold technological leadership and secure export markets. A successful transformation of the energy sector... is pivotal in this respect."*

The European Commission report *'Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions'* was published in February 2017. This report provides a comprehensive overview of renewable energy deployment in the EU and progress towards meeting the 2020 targets. The report states that the vast majority of Member States are *"well on track in terms of renewable energy deployment".* Four Member States –Ireland, Luxembourg, the Netherlands and the United Kingdom are currently projected not to meet their national binding targets. The United Kingdom's expected gap is however very short (approximately 0.2%) so it is expected that Ireland will be one of only three Member States projected to not meet their national binding 2020 targets.

While official figures have been released to date, the 2019 SEAI National Energy Projections Report, published last year (2019) acknowledges that Ireland will fall short of its 2020 targets, it states "...it is expected that Ireland will fall short of its mandatory European target for an overall 16% renewable energy share by 2020, with overall achievement approximately 13%.", The report goes on to confirm *"Compared with other European Countries Ireland was 22nd out of the EU28 for overall renewable energy share and 26th out of the EU-28 for progress towards overall 2020 renewable energy target."*

2.4.4.4 Emissions Projections

In June 2019, the EPA published an update on Ireland's Greenhouse Gas Emission Projections 2018-2040. The report provides an assessment of Irelands progress towards achieving its emission reduction targets set under the EU Effort Sharing Decision (Decision No 406/2009/EU) – i.e. to achieve a 20% reduction of non-Emission Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the 2013-2020 period.

Greenhouse gas emissions are projected to 2020 using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 are implemented. The 'With Additional Measures' scenario assumes implementation of the 'With Existing Measures' scenario in addition to further implementation of Government renewable and energy efficiency policies and measures, as set out in the NREAP and the National Energy Efficiency Action Plan (NEEAP).

The EPA Emission Projections Update notes the following key trends:

- 2019 greenhouse gas emission projections show total emission increasing from current levels by 1% and 6% by 2020 and 2030, respectively, under 'With Existing Measures' scenario. Under 'With Additional Measures', emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030, respectively;
- Under the 'With Existing Measures', emissions from Energy Industries are projected to increase by 31% between 2018 and 2030 to 15.4 Mt CO2eq. Under the 'With Additional Measures', emissions between 2018 and 2030 are predicted to decrease by 27% to 8.6 Mt CO2eq;
- Under 'With Existing Measures', approximately 41% of electricity generation is projected to come from renewable energy sources by 2030. In the 'With Additional Measures' scenario, it is estimated that renewable energy generation increases to approximately 54% of electricity consumption;
- Agriculture and transport dominate non-ETS sector emissions accounting for 75% and 80% of emissions in 2020 and 2030, respectively. In 2020, the sectors with the largest contribution of emissions are Agriculture, Transport and Energy Industries with 34%, 21%

and 20% share in total emissions, respectively, under the With Additional Measures scenario. In 2030, this is projected to change to 38%, 22% and 16% for these sectors, respectively, which reflects the growth in emissions from agriculture and reduction of emissions from power generation; and

- Ireland has exceeded its annual binding limits in 2016 and 2017. However, even using this mechanism, Ireland will still be in non-compliance according to the latest projections.

The 2019 EPA report states that *"A significant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat"*. Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by approximately 10.3 Mt CO_2 (metric tonnes of Carbon Dioxide) under the "With Existing Measures" scenario and 9.2 Mt CO_2 under the "With Additional Measures" scenario.

2.4.5 National Policy

2.4.5.1 National Climate Change Adaptation Framework 2012

Ireland's first National Climate Change Adaptation Framework (NCCAF), which was published in December 2012, aims to ensure that adaptation actions are taken across key sectors and also at local level to reduce Ireland's vulnerability to climate change. The NCCAF requires the development and implementation of sectoral and local adaptation plans which will form part of the national response to the impacts of climate change. Each relevant Government Department (or State Agency, where appropriate) are required to prepare adaptation plans for their sectors. Twelve sectors were identified in total including Transport, Flood Defence, Agriculture and Energy. The Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) puts the development of National Climate Change Adaptation Frameworks and Sectoral Adaptation Plans on a statutory basis.

The Act states that following Government approval of the first statutory National Climate Change Adaptation Framework it must be reviewed at least every 5 years after that.

2.4.5.2 National Adaptation Framework - Planning for a Climate Resilient Ireland 2018

Ireland's first statutory National Adaptation Framework (NAF) was published on 19 January 2018. The NAF sets out the national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. The NAF was developed under the Climate Action and Low Carbon Development Act 2015. The NAF builds on the work already carried out under the National Climate Change Adaptation Framework (NCCAF, 2012). It is detailed that under the NAF *'a number of Government Departments will be required to prepare sectoral adaptation plans in relation to a priority area that they are responsible for'*. The NAF can be broken down as follows:

Chapter 1 provides a summary of observed and projected global climate change and the international and European policy drivers for adaptation to climate change. It also contains a summary of observed and projected climate change impacts in Ireland. The following are detailed under the NAF:

- Warming of the global climate system is unequivocal and it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
- Observations show that global average temperatures have increased by 0.85°C (in the range 0.65 to 1.06°C) since 1850.
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans.
- Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts.

- Uncertainties exist in relation to the extent and rate of future climate change. Addressing uncertainties is a challenge but should not be read as an excuse for inaction as there is overall agreement on the robustness of trends and projections.
- The impacts and risks of climate change can be reduced and managed through mitigation and adaptation actions.
- Adaptation actions must be risk based, informed by the vulnerabilities of exposed societies and systems and an understanding of projected climate change.
- Changes in Ireland's climate are in line with global trends. Temperatures have increased by about 0.8˚C since 1900, an average of about 0.07˚C per decade over that period, and changes in precipitation regimes, sea level rise and extreme events (storms, flooding, sea surges and flash floods) are also being observed.
- Climate change will have diverse and wide-ranging impacts on Ireland's environment, society, economic development, including managed and natural ecosystems, water resources, agriculture and food security, human health and coastal infrastructures and zones.
- The overall trend in Ireland is consistent with global patterns of change, with a high degree of climate variability and associated uncertainties in relation to extreme events.
- Sufficient robust information exists nationally to further progress the process of implementing adaptation actions and increasing social, economic and environmental resilience to climate change.

The Framework continues to detail that as per the Intergovernmental Panel on Climate Change (IPCC, 2013) it was concluded with 95% probability that the global warming of the last 50 years is a result of human activities, with the main contribution to this warming coming from the burning of fossil fuels. With regards to climate impacts for 2050 and beyond

Chapter 2 sets out the progress to date on climate change adaptation planning in Ireland, including work undertaken at sectoral and local government level and initiatives involving civil society and the research community.

Chapter 3 provides a number of guiding principles for adaptation at national level. It includes steps for creating an enabling environment for adaptation planning. It sets out the sectors for which adaptation plans under the NAF are to be prepared, along with proposals for local authority or regional level adaptation strategies. Regardless of how successful efforts to mitigate GHG emissions prove to be, the impact of climate change will continue over the coming decades because of the delayed impacts of past and current emissions. There is no choice, therefore, but to take adaptation measures to deal with the unavoidable impacts of climate change and associated economic, environmental and social costs. This is recognised at International, European Union and National level. It is detailed that:

> *"Adaptation not only depends on action by all levels of government but also on the active and sustained engagement of all stakeholders, including sectoral interests, the private sector, communities and individuals. Everybody has a role to play in making sure Ireland is taking appropriate adaptation action to achieve a climate resilient future. This is a joint responsibility where "climate proofing" our country is an undertaking for which all of society is responsible and everyone has a role to play."*

Chapter 4 outlines how the Framework will be implemented with revised Governance and reporting arrangements as well as actions and supporting objectives that are to be progressed.

2.4.5.3 National Policy Position on Climate Action and Low Carbon Development, 2014

The National Policy Position on Climate Action and Low Carbon Development, published by the Department of Environment, Community and Local Government in April 2014, provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to move to a low-carbon economy by 2050. The position paper acknowledges that the evolution of climate policy in Ireland will be an iterative process, based on the adoption by Government of a series of national plans over the period to 2050. Statutory authority for the plans is set out in the Climate Action and Low Carbon Development Act 2015.

2.4.5.4 Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was signed into law on 10th December 2015. The Act provides for the establishment of a national framework with the aim of achieving a low carbon, climate resilient, and environmentally sustainable economy by 2050, referred to in the Act as the "national transition objective".

The Act provides the tools and structures to transition towards a low carbon economy and it anticipates that it will be achieved through a combination of:

- A National Mitigation Plan (to lower Ireland's greenhouse gas emissions levels);
- A National Adaptation Framework (to provide for responses to changes caused by climate change);
- Tailored sectoral plans (to specify the adaptation measures to be taken by each Government ministry); and
- Establishment of the Climate Change Advisory Council to advise Ministers and the Government on climate change matters.

2.4.5.5 National Mitigation Plan

Ireland's first statutory National Mitigation Plan (NMP), published in July 2017, (as required under section 4 of the Climate Action and Low Carbon Development Act 2015) represents a landmark national milestone in the evolution of climate change policy in Ireland and provides for the statutory basis for the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050.

The NMP reaffirms Ireland's commitment to concerted and multilateral action to tackle climate change following the adoption of the legally binding Paris Agreement of which Ireland is a co-signatory. Under the Paris Agreement and as noted previously, the EU is committed to reducing greenhouse gas emissions by at least 40% by 2030, compared with 1990 levels. The Paris Agreement represents a landmark accord in tackling climate change, which is recognised by all parties as the defining global issue of this generation.

The NMP outlines a range of measures to lay the foundations for transitioning Ireland to a low-carbon, climate-resilient and environmentally sustainable economy by 2050. The Plan reaffirms Ireland's commitment to action on climate change following the adoption of the legally binding Paris Agreement.

The NMP reiterates that the objective of a low-carbon future will involve radically changing our behaviour as citizens, industry and Government and becoming significantly more energy-efficient. In this regard, the NMP has made it clear that Ireland has abundant, diverse and indigenous renewable energy resources, which will be critical to decarbonising our energy system, including electricity generation. Onshore wind has, to date, been the most cost-competitive renewable electricity technology in Ireland, accounting for 22.8% of overall electricity generation in 2015.

The NMP addresses the role of local authorities in facilitating the transition towards a low-carbon economy and recognises that this requires engagement from all levels of Government and that a bottom-up approach is also essential to promote awareness and engagement within individual communities across Ireland.

The NMP further states that *there "is also recognition within the Local Authority sector of the need for the sector to assume a leadership role within their local communities to encourage appropriate behavioural change".* Moreover, the Plan emphasises that local authorities also have a key role to play *"in addressing climate change mitigation action and are well placed to assess, exploit and support opportunities within their administrative areas, in cooperation with each other and with national bodies, and through the involvement and support of local communities".*

In specific relation to wind energy and meeting targets, the National Mitigation Plan notes the following:

> *"To date, wind energy has been the largest driver of growth in renewable electricity. The total amount of renewable generation connected to the grid at December 2016 was 3,120MW, of which wind generation was approximately 2,796MW, hydro was 238MW and biomass was 86MW. EirGrid estimates that a total of between 3,900MW and 4,300MW of onshore renewable generation capacity will be required to allow Ireland to achieve 40% renewable electricity by 2020. This leaves a further requirement of between 780MW and 1,180MW to be installed by 2020 if the 2020 electricity target is to be reached, requiring an increased rate of installation."*

2.4.5.6 Report of the Joint Committee on Climate Action Climate Change: A Cross-Party Consensus for Action, March 2019

In March 2019, the Joint Committee on Climate Action Change released a report detailing a cross party consensus for action. The report in its introduction notes that *"Irelands performance in meeting international obligations has to date been poor".* The Committee places concern that predictions of emissions indicate that the state is off track in meeting its 2020 and 2030 targets under the Kyoto protocol and the EU Directives.

The committee recommended that new climate change legislation be enacted by the Oireachtas in 2019. The following recommendations have been listed:

1. *A target of net zero economy wide GHG emissions by 2050.*
2. *A provision for a 2030 target, consistent with the GHG emissions reduction pathway to 2050 to be set by 2020 by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council.*
3. *Provision for five-yearly carbon budgets, consistent with the emissions reduction pathway to 2030 and 2050 targets, to be set by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council.*
4. *A target for the renewable share of electricity generation of 70% by 2030.*

Further to this the committee acknowledge that the measures which are currently in place along with the measures suggested within the report will not be sufficient in meeting Ireland's targets.

Chapter 7 of the report outlines the committee's recommendations for developing Ireland's capacity in renewable energies and renewable electricity in particular. It is noted that the transformation of Ireland's energy system will be required for the country to meet its GHG emission targets. To reach net zero emissions by 2050 the report recognises that the country will be required to fully decarbonize electricity generation. Section 7.5 relates to onshore renewable energy generation, it is acknowledged that onshore wind energy is currently the primary source of renewable electricity within Ireland, accounting for 84% of renewable power generated in 2017, it is also detailed that, 'onshore wind alone will not supply Ireland with sufficient electricity to become self-sufficient, it is evident that it must be used alongside other sources of renewable energy'.

Under its recommendations, the Committee encourages the upgrading of existing onshore wind turbines where this will yield additional potential. While acknowledging that there are challenges in relation to securing additional on-shore wind generated renewable energy the Report fully supports the increased provision of on-shore wind farm development at appropriate locations (such as that of the current proposal) and acknowledges that on-shore wind has a pivotal role to play in achieving climate action targets.

2.4.5.7 Climate Action Plan 2019

The Climate Action Plan 2019 (CAP) was published on the 1st August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Irelands environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption.

Chapter 1 of the CAP sets out the nature of the challenge which Ireland faces over the coming years. The CAP notes that the evidence for warming of our climate system is beyond dispute with observations showing that global average temperatures having increased by more than 1°C since pre-industrial times. These changes will cause extensive direct and indirect harm to Ireland and its people, as well as to other countries more exposed and less able than we are to withstand the associated impacts, which are predicted to include:

- Rising sea-levels threatening habitable land and particularly coastal infrastructure,
- Extreme weather, including more intense storms and rainfall affecting our land, coastline and seas,
- Further pressure on our water resources and food production systems with associated impacts on fluvial and coastal ecosystems,
- Increased chance and scale of river and coastal flooding,
- Greater political and security instability,
- Displacement of population and climate refugees,
- Heightened risk of the arrival of new pests and diseases,
- Poorer water quality,
- Changes in the distribution and time of lifecycle events of plant and animal species on land and in the oceans, and
- It is also recognised within the Plan that in addition to the above many of the pollutants associated with climate change are also damaging to human health.

It is the ambition of the CAP to deliver a step-change in our emissions performance over the coming decade, so that we will not only meet our EU targets for 2030 but will also be well placed to meet our mid-century decarbonisation objectives.

Figure 2.2 below depicts Irelands decarbonisation pathway up to the year 2030. The below will be used to manage Irelands decarbonisation pathway and details the path for the various sectors:

	Technology	NDP 2030	Uptake to meet 2030 targets (Based on MACC analysis) 2025	Uptake to meet 2030 targets (Based on MACC analysis) 2030
Electricity	**Total RES in Generation mix⁴, %**	**55**	**52**	**70**
	• Onshore wind, GW	~7	~6.5	~8.2
	• Offshore wind, GW	1.8	~1.0	~3.5
	• Solar PV, GW	1.5	~0.2	~0.4
Transport	**Electric Vehicles, #**	**498,000**	**181,500**	**936,000**
	• Passenger EVs, #	355,000	57,000	550,000
	• Passenger PHEVs, #	118,000	94,000	290,000
	• Electric delivery vans, #	19,000	30,000	61,000
	• Electric trucks, #	n.a	0	34,000
	• Electric buses, #	1,250	500-600	1,000-1,200
	Bioethanol blend, Volume	**E10**	**E10**	**E10**
	Biodiesel blend, Volume	**B12**	**B12**	**B12**
Built Environment	**Retrofitted homes[1], cumulative 2021-30, #**	**450,000**	**300,000**	**500,000**
	Electric heating sources, total residential, #	**370,000**	**350,000**	**600,000**
	• New buildings, #	200,000	50,000	200,000
	• Existing buildings, #	170,000	300,000	400,000
	Electric heating sources, total commercial, #	**15,000[3]**	**15,000**	**25,000**
Enterprise	**Emissions, $MtCO_2eq.$**	**9**	**8**	**8**
	• Alternative fuels in cement fuel mix, %	N/A	65%	80%
	• CO2-neutral heat generation in food industry[2], %	N/A	~70%	~80%
Agriculture	**Emissions, $MtCO_2eq.$**	**21**	**19**	**18**
	• Fertilizers CAN replacement, %	N/A	40%	50%
	• Trailing-shoe slurry spreading, %	N/A	30%	50%
Other (e.g. waste)	**Emissions, $MtCO_2eq.$**	**3.2**	**3.2**	**3.2**

"Solar PV, some electrification of buses, and biofuel blending are identified in 2030 the NDP scenario but are not showing as cost-effective in MACC. Despite MACC analysis these technologies may remain in plan given other factors (e.g., exchequer cost, ease of implementation, need for public sector leadership)

1 Retrofit to B2 BER fabric equivalent
2 Includes biomass and electricity
3 Not specified in NDP, estimated based on residential ratio
4 RESS competitive auction determines the final mix

Figure 2.2 Irelands Decarbonisation Pathway Dashboard to 2030

Chapter 7 of the CAP details the views surrounding electricity. The CAP notes that as of 2017 electricity accounted for 19.3% of Ireland's greenhouse gases which was down from the 2016 figure of 20.4%. With regards to electricity the following is detailed:

"It is important that we decarbonise the electricity that we consume by harnessing our significant renewable energy resources. By doing this we will also become less dependent on imported fossil fuels."

In Ireland, in 2017 a total of 30.1% of electricity produced came from renewable sources, the target to be achieved by 2020 is set at 40%. The CAP goes on to note that *'given our 40% target is based on a percentage of total energy demand, this rising demand makes meeting our 2020 target even more challenging and latest forecasts indicate we may miss this target by 3 to 4 percentage points'*. Further to this while decarbonising electricity is a key aspect of the strategy it is noted that this is against the background of rapid projected growth in electricity demand. The CAP notes that it is expected that demand for electricity is forecast to increase by 50% above existing capacity in the next decade. The CAP recognises that:

> *"Ensuring we build renewable, rather than fossil fuel, generation capacity to help meet this demand is essential."*

The CAP goes on to note that policy measures to date will not achieve the level of decarbonisation required in the electricity sector to meet the 2030 emissions reduction targets, as such it is listed that *'we must 'reduce our electricity sector emissions to 4-5 Mt in 2030'*. In relation to emissions the following is noted:

"In 2017, emissions from electricity were 12 Mt and in 2030, despite implementation of Project Ireland 2040 measures, emissions are projected to be 8 Mt. This clearly demonstrates the need for a significant step-up in ambition over existing policy, not only to meet our 2030 targets, but to set us on course to deliver substantive decarbonisation of our economy and society by 2050."

In the electricity sector, reaching a 70% share of renewable electricity would require 50-55% emissions reduction by 2030. Under Section 7.2 of the CAP, the following targets have been set out:

- Reduce CO2 eq. emissions from the sector by 50–55% relative to 2030 Pre-National Development Plan (NDP) projections.
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation.
- Increase electricity generated from renewable sources to 70%, indicatively comprising:
    - at least 3.5 GW of offshore renewable energy;
    - up to 1.5 GW of grid-scale solar energy; and
    - up to 8.2 GW total of increased onshore wind capacity.
- Meet 15% of electricity demand by renewable sources contracted under Corporate PPAs.

Achieving 70% renewable electricity by 2030 will involve phasing out coal- and peat-fired electricity generation plants, increasing our renewable electricity, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries) and putting systems in place to manage intermittent sources of power, especially from wind.

Section 7.2 of the CAP notes the 'Measures to deliver targets' in which efforts to meet the 2030 ambitions which includes increased harnessing of renewable energy. As seen in Figure 2.3 below, CAP identifies a need for 8.2GW of onshore wind generation and states that in 2017 there was 3.3GW in place, therefore Ireland needs to more than double its installed capacity of wind generation. Accordingly, the 2019 CAP presents clear and unequivocal support for the provision of additional renewable energy generation and presents yet further policy support for increased onshore wind energy.

Key Metrics	2017	2025 Based on MACC	2030 Based on NDP	2030 Based on MACC
Share of Renewable Electricity, %	~30%[20]	52%	55%	70%
Onshore Wind Capacity, GW	~3.3	6.5	N/A	8.2
Offshore Wind Capacity, GW	NA	1.0	N/A	3.5
Solar PV Capacity, GW	NA	0.2	N/A	0.4
CCGT Capacity, GW	~3.6	5.1	N/A	4.7

Figure 2.3 Potential Metrics to Deliver Abatement in Electricity

2.4.5.8 Introduction

This section of the EIAR Provides the strategic planning context of the proposed development. As is examined below, the proposed development is in line with national, regional and local policies, frameworks, guidelines and plans. This section has been broken down to the following sections:

- National Planning Framework 2018,
    - Key Sustainability Elements of National Planning Framework
- Draft Renewable Electricity Policy and Development Framework, 2016
- Regional Policy
    - Eastern and Midland Regional Assembly - Regional Spatial and& Economic Strategy
- Local Policy
    - Offaly County Development Plan 2014-2020
    - Offaly County Council Wind Energy Strategy
- Other Relevant Guidelines

- Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017
- DoEHLG Wind Energy Guidelines 2006
- Department Circular PL5/2017
- Draft Revised Wind Energy Development Guidelines 2019
- IWEA Best Practice Guidelines for the Irish Wind Energy Industry 2012
- IWEA Best Practice Principles in Community Engagement and Community Commitment 2013
- Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement 2016
- IWEA Community Engagement Strategy 2018
- Commission for Regulation of Utilities: Grid Connection Policy
- Renewable Energy Support Scheme (RESS)
- Forest Service Guidelines

As a renewable energy project the current proposal is broadly consistent with the overall national policy objectives to increase penetration and deployment of renewable energy resources and has been designed in the context of the relevant wind energy and other guidelines. The specific compliance with the County Development Plan provisions are dealt with in detail in the County Development Plan section below.

2.4.5.9 National Planning Framework, 2018

The National Planning Framework (NPF), published in February of 2018, aims to shape and guide the future growth and development of Ireland up to 2040. The NPF will supersede the National Spatial Strategy 2002-2020 (NSS) and will include a focus on economic development and investment in housing, water services, transport, communications, energy, health and education infrastructure. The new framework sets out five strategic actions:

- Developing a new region-focused strategy for managing growth;
- Linking this to a new 10-year investment plan, the Project Ireland 2040 National Development Plan 2018-2027;
- Using state lands for certain strategic purposes;
- Supporting this with strengthened, more environmentally focused planning at local level; and
- Backing the framework up in law with an Independent Office of the Planning Regulator.

The NPF forms the top tier of the national planning policy structure, accordingly, establishing the policy context for the Regional Spatial and Economic Strategies and local level development plans. In an effort to move away from developer led development to one informed by the needs and requirements of society, a number of objectives and policies have been put in place in order for the country to grow and develop in a sustainable manner.

The NPF notes that the population of Ireland is projected to increase by approximately 1 million people by 2040 which will result in a population of roughly 5.7 million. This population growth will place further demand on both the built and natural environment. In order to strengthen and facilitate more environmentally focused planning at the local level, the NPF states that future planning and development will need to

> "*Tackle Ireland's higher than average carbon-intensity per capita and enable a national transition to a competitive low carbon, climate resilient and environmentally sustainable economy by 2050, through harnessing our country's prodigious renewable energy potential.*"

The Framework notes that while the overall quality of the country's environment is good, it is not without challenges. The NPF notes the manner in which we plan is important for the sustainability of our environment and states the following.

> *"While the overall quality of our environment is good, this masks some of the threats we now face. Key national environmental challenges include the need to accelerate action on climate change, health risks to drinking water, treating urban waste water, protecting important and vulnerable habitats as well as diminishing wild countryside and dealing with air quality problems in urban areas. It is also important to make space for nature into the future, as our population increases."*

The NPF seeks to achieve ten strategic priorities surrounding:

1. *Compact Growth*
2. *Enhanced Regional Accessibility*
3. *Strengthened Rural Economies and Communities*
4. *Sustainable Mobility*
5. *A Strong Economy, supported by Enterprise, Innovation and Skills*
6. *High-Quality International Connectivity*
7. *Enhanced Amenity and Heritage*
8. *Transition to a Low Carbon and Climate Resilient Society*
9. *Sustainable Management of Water and other Environmental Resources*
10. *Access to Quality Childcare, Education and Health Services*

Relevant to the proposed development, the **National Strategic Outcome 8** (Transition to Sustainable Energy), notes that in creating Ireland's future energy landscape, new energy systems and transmission grids will be necessary to enable a more distributed energy generation which connects established and emerging energy sources, i.e. renewables, to the major sources of demand. Ireland's national energy policy under **Objective 55** aims to *'promote renewable energy use and generation at appropriate locations within the built and natural environment to meet national objectives towards achieving a low carbon economy by 2050'.* Through this, it is noted that there are three pillars of focus which must be considered:

1. *Sustainability;*
2. *Security of supply;*
3. *Competitiveness.*

The NPF highlights the important role which the regions will have in promoting a sustainable renewable energy supply and have been noted as a key future planning and development priority. It notes that *'harnessing the potential of the regions in renewable energy terms across the technology spectrum from wind and solar to biomass and where applicable, wave energy, focusing in particular on the extensive tracts of publicly owned peat extraction areas in order to enable a managed transition of the local economies of such areas in gaining the economic benefits of greener energy'.* The government recognise that they must reduce greenhouse gas emissions which come from the energy sector by at least 80% by 2050 when compared to 1990 levels while ensuring a secure supply of energy.

A key aspect of the NPF surrounds the long-term sustainability of the environment, it aims to ensure that decisions that are made today meet our future needs in a sustainable manner.

> *"The manner in which we plan is important for the sustainability of our environment. Our planning system has influence across a wide range of sectors, both directly and indirectly and interacts with many common issues related to effective environmental management, including water services, landscape, flood risk planning, protection of designated sites and species, coastal and marine management, climate mitigation and adaptation, and land use change."*

The Government will address environmental and climate challenges through the following overarching aims as listed under 'Resource Efficiency and Transition to a Low Carbon Economy':

- Sustainable Land Management and Resource Efficiency;
- Low Carbon Economy;

- Renewable Energy; and
- Managing Waste.

In order to meet legally binding targets agreed at EU level, it is a national objective for Ireland to make a transition and become a competitive low carbon, economy by the year 2050. To aid in meeting these targets the NPF notes that the Government will aim to support the following objectives:

- Integrating climate considerations into statutory plans and guidelines. In order to reduce vulnerability to negative effects and avoid inappropriate forms of development in vulnerable areas.
- More energy efficient development through the location of housing and employment along public transport corridors, where people can choose to use less energy intensive public transport, rather than being dependent on the car.

Accordingly, it is envisioned that the national strategy will be supported, implemented and translated through the planning hierarchy by the local development plans and regional strategies.

2.4.5.9.1 *Key Sustainability Elements of National Planning Framework*

A key focus running throughout the NPF is the fostering of a transition toward a low carbon, climate-resilient society. In this regard, one of the stated key elements of the NPF is an Ireland which has a secure and sustainable renewable energy supply and facilitates the ability to diversify and adapt to new energy technologies.

The NPF further references the National Climate Policy Position which established the fundamental national objective of achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050.

In relation to energy production, the NPF emphasises that rural areas have a strong role to play in securing a sustainable renewable energy supply for the country and acknowledges that *"rural areas have significantly contributed to the energy needs of the country and continue to do so"*. In this regard, the NPF states:

> *"In meeting the challenge of transitioning to a low carbon economy, the location of future national renewable energy generation will, for the most part, need to be accommodated on large tracts of land that are located in a rural setting, while also continuing to protect the integrity of the environment".*

Section 9 of the NPF addresses the theme of *"Realising Our Sustainable Future"* and sets out a number of National Policy Objectives under this subject, with a key focus on resource efficiency and the transition towards a low carbon economy. In relation to climate action and planning, the NPF reiterates the commitment of the Government to a long-term climate policy based on the adoption of a series of national plans over the period to 2050, informed by UN and EU policy, and progressed through the National Mitigation Plan and the National Climate Change Adaptation Framework.

Key features identified in the NPF to facilitate the transition towards a low carbon energy future include:

- A shift from predominantly fossil fuels to predominantly renewable energy sources.
- Increasing efficiency and upgrades to appliances, buildings and systems.
- Decisions around development and deployment of new technologies relating to areas such as wind, smart grids, electric vehicles, buildings, ocean energy and bio energy.
- Legal and regulatory frameworks to meet demands and challenges in transitioning to a low carbon society.

The NPF reiterates that the *"transition to a low carbon economy from renewable sources of energy is an integral part of Ireland's climate change strategy and renewable energies are a means for reducing our reliance on fossil fuels"*. This position is cemented in National Policy Objective 55 of the NPF which seeks to:

> *"Promote renewable energy generation at appropriate locations within the built and natural environment to meet objectives towards a low carbon economy by 2050".*

Section 10 of the NPF sets out a series of desired National Strategic Outcomes, underpinned by the national planning objectives set out in the NPF in combination with governance arrangements and aligned with capital investment. The transition towards a low carbon and climate resilient society is identified as one of the national strategic outcomes to guide the implementation of the NPF.

The NPF further emphasises that new energy systems and transmission grids will be necessary for a more distributed, more renewables focused energy generation system to harness the considerable on-shore and off-shore potential from energy sources such as wind, wave and solar and *"connecting the richest sources of that energy to the major sources of demand"*. The NPF recognises that the development of on-shore and off-shore renewable energy is critically dependent on the development of enabling infrastructure including grid facilities to connect to major sources of energy demand.

In achieving this desired National Strategic Outcome of a transition to sustainable energy, the NPF re-emphasises the following national policy target of delivering *"40% of our electricity needs from renewable sources by 2020 with a strategic aim of in excess of 50% by 2030 and more by 2040 and beyond using wind, wave, solar, biomass and hydro sources".*

2.4.5.10 Draft Renewable Electricity Policy and Development Framework, 2016

The Renewable Electricity Policy and Development Framework has been formulated to ensure Ireland meets its future needs for renewable electricity in a sustainable manner compatible with environmental and cultural heritage, landscape and amenity considerations.

The Framework will contribute toward meeting Ireland's future energy needs, particularly up to 2030 and beyond, as informed by national and European policy, and be reviewed at five-yearly intervals. The Policy and Development Framework will be primarily for the guidance of An Bord Pleanála, planning authorities, other statutory authorities, the general public and persons seeking development consent in relation to large scale projects for the generation of renewable electricity on land. It will set out policy in respect of environmental considerations, community engagement and in relation to potential, future export of renewable electricity. It will seek to broadly identify suitable areas in the State, where large-scale renewable electricity projects can be developed in a sustainable manner. The existing system for planning permission applications to local authorities or An Bord Pleanála will remain unchanged in respect of renewable electricity projects. These will still require planning permission, including environmental impact assessment where appropriate. It is proposed that the Policy and Development Framework will be focused on providing for renewable electricity projects of large scale. It is considered that a threshold of 50 MW and upwards would be appropriate, having regard to the provisions of the strategic infrastructure development legislation.

In July 2018 tenders for the provision of consultancy services for Strategic Environmental Assessment (SEA), Appropriate Assessment (AA) and related services including spatial planning, landscape and visual assessment in relation to the framework were requested. The tender documentation circulated has indicated that the updated REPDF will have the following objectives:

- To maximise the sustainable use of renewable electricity resources in order to develop progressively more renewable electricity for the domestic and potentially, for future export markets.

- To assist in the achievement of targets for renewable energy, enhance security of supply and foster economic growth and employment opportunities. It will identify appropriate parts of the country for large renewable electricity projects and will assess the environmental impact of renewable electricity projects at various scales at a national level.
- To identify strategic areas on land for large scale renewable energy generation and this analysis will include a spatial component.
- In addition, the amended scope will include renewable electricity projects below this threshold (including wind and solar PV) at a national level.

The updated scope will also include an assessment of available grid capacity in relation to the location of large and medium-scale renewable electricity generation plants. This analysis will support the strategic planning and location decision making process for Data Centres in Ireland.

2.4.6 Regional Policy

2.4.6.1 Eastern and Midland Regional Assembly - Regional Spatial and Economic Strategy

The Midlands Regional Area was amalgamated within the Eastern and Midland Regional Assembly (EMRA) as of January 2015. The Region covers nine counties containing twelve Local Authorities namely – Longford, Westmeath, Offaly, Laois, Louth, Meath, Kildare, Wicklow, Fingal, South Dublin and Dún Laoghaire-Rathdown County Councils and Dublin City Council. One of the principal functions of the Assembly is to deliver a Regional, Spatial and Economic Strategy (RSES) which considers both spatial and economic factors within the regional planning framework. The principal statutory purpose of the RSES for the Eastern and Midland Region is to support the implementation of the Ireland 2040 NPF / NDP and the economic policies and objectives of the Government. Specifically, the RSES will provide a range of plans and strategies relevant to the Ireland 2040 NPF / NDP.

The RSES sets out a Vision Statement which is underpinned by three key cross-cutting principles which best reflect the challenges and opportunities of the Region: healthy placemaking; climate action; and economic opportunity.

> *"To create a sustainable and competitive Region that supports the health and wellbeing of our people and places, from urban to rural, with access to quality housing, travel and employment opportunities for all."*

Climate action is described as the need to enhance climate resilience and to accelerate a transition to a low carbon society recognising the role of natural capital and ecosystem services in achieving this. Chapter 7 of the RSES covers the regions plans for the Environment and Climate, and under section 7.9, the RSES sets out the theme of climate change within the region. Under this the RSES is noted:

> "*Climate change is a global challenge which requires a strong and coherent response at national, regional and local level. Observations show that Ireland's climate is changing in terms of sea level rise, higher average temperatures, changes in precipitation patterns, more frequent weather extremes, the spread of invasive alien species and increased risk of wild fires, for example upland gorse fires. These changes are projected to continue over the coming decades. Climate change will have diverse and wide-ranging impacts on the Eastern and Midland Region's environment, society and economic development, including managed and natural ecosystems, water resources, agriculture, food security and bioeconomy, human health and coastal zones.*"

It is recognised that climate change is impacting and will continue to impact many of the policies and objectives contained in the RSES, and as such, informs policies including those in relation to flood risk management and surface water drainage, settlement strategy, transport, waste management, water services, energy, natural heritage, and green and blue infrastructure.

With regards to the current situation, the RSES notes an overall increase in greenhouse gas emissions from most sectors. The main emissions sources which are relevant to the EMRA Region include electricity, built environment, the transport sector and agriculture. To support transition to a low carbon, circular & climate resilient region, the Eastern and Midland Regional Assembly is committed to the Region becoming a low-carbon and circular region. This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent. The priority is to minimise energy demand and waste, and then address how energy will be supplied and renewable technologies incorporated. In order to address this, it is necessary to reduce the effects of climate change through settlement and travel patterns, energy use, waste and protection of green infrastructure. The following Regional Policy Objectives (RPO's) have been proposed:

- **RPO 7.31**: Within 1 year of carrying out a regional emissions assessment, EMRA shall compile and publish an emissions inventory and, in collaboration with the relevant departments and agencies, agree emissions reductions targets in accordance with agreed national sectoral plans and to support an aggregate 40% reduction in greenhouse gas emissions by 2030 in line with the EU 2030 Framework.
- **RPO 7.32**: With the assistance and support of the Climate Action Regional Offices, local authorities shall develop, adopt and implement local climate adaptation and mitigation strategies which shall address issues including local vulnerability to climate risks and identify and prioritise actions, in accordance with the Guiding Principles of the National Adaptation Framework, National Mitigation Plan.

According to the RSES, the Dublin and Eastern Regions are a major load centre on the Irish electricity transmission system; specifically, approximately one third of total electricity demand is located in these regions. Having regard to projected population and economic growth in the eastern region, the RSES notes that the increasing demand for electricity in the region must be addressed in a way which balances the need for a significant shift towards renewable energy and enabling resources to be harnessed in a manner consistent with the principles of proper planning and sustainable development.

- Facilitating the provision of appropriate renewable energy infrastructure and enabling technologies;
- Expansion and upgrading of the grid with the aim of increasing the share of variable renewable electricity;
- Onshore wind, bioenergy, solar and offshore energy;
- Moving from carbon intense fossil fuel generation to lower emissions fuels such as natural gas; and
- The need to ensure sufficient electricity to meet increased demand.

The RSES supports an increase in the amount of new renewable energy sources in the Region, including provisions for wind energy (both onshore and offshore), biomass, and solar photovoltaics and solar thermal, both on buildings and at a larger scale on appropriate sites in accordance with National policy and the Regional Policy Objectives outlined in this Strategy. The proposed renewable energy development would contribute to increasing the levels of renewable energy supply in a manner consistent with the proper planning and sustainable development of the area/region. Therefore, the proposed development is consistent with the provisions of the RSES.

The following RPO's have also been listed within the RSES:

- **RPO 7.35**: EMRA shall, in conjunction with local authorities in the Region, identify Strategic Energy Zones as areas suitable for larger energy generating projects, the role of community and micro energy production in urban and rural settings and the potential for renewable energy within industrial areas. The Strategic Energy Zones for the Region will ensure all environmental constraints are addressed in the analysis. A regional landscape strategy could be developed to support delivery of projects within the Strategic Energy Zones.

- **RPO 7.36**: Planning policy at local authority level shall reflect and adhere to the principles and planning guidance set out in Department of Housing, Planning and Local Government publications relating to 'Wind Energy Development' and the DCCAE Code of Practice for Wind Energy Development in Ireland on Guidelines for Community Engagement and any other relevant guidance which may be issued in relation to sustainable energy provisions.

The key drivers for the development and implementation of new infrastructure within the region are climate action and environmental sustainability. In this context, the RSES notes the following on the theme of infrastructure:

> *"The sustainable growth of the Region requires the provision of services and infrastructure in a plan led manner to ensure that there is adequate capacity to support future development. High-quality infrastructure is an important element of a modern society and economy, it provides essential functions and services that support societal, economic and environmental systems at local, regional and national levels."*

As noted above, a 'secure and resilient' supply of energy is critical to a well-functioning region. As population projections are set to increase into the future for the EMRA, the demand for energy and associated infrastructure is set to increase. To meet the State's energy targets, in addition to regional demand, the RSES states that the region will need to better leverage natural resources to increase our share of renewable energy. Relevant to the proposed development, there is an established tradition of energy production in the Midland counties by state agencies; however, key planning, environmental and commercial issues are dictating the wind down of traditional fossil fuel powered stations, such as peat fired power plants (Shannonbridge and Lough Ree Power Stations) in these counties. The subsequent diversification of energy production within the region towards green energy, such as wind, solar and biomass, will require the progressive and strategic development of a different form of energy grid. The RSES also emphasises that it will also be necessary to ensure more geographically focused renewables investment to minimise the amount of additional grid investment required, for example through co-location of renewables and associated grid connections.

The RSES has identified a number of key RPOs which have been designed to ensure the development of the energy networks in a safe and secure way to meet projected demand levels, to meet Government Policy, to ensure a long-term, sustainable and competitive energy future for Ireland to transition to a low carbon economy by 2050:

- **RPO 10.20**: Support and facilitate the development of enhanced electricity and gas supplies, and associated networks, to serve the existing and future needs of the Region and facilitate new transmission infrastructure projects that might be brought forward in the lifetime of this Strategy. Including the delivery of the necessary integration of transmission network requirements to facilitate linkages of renewable energy proposals to the electricity and gas transmission grid in a sustainable and timely manner subject to appropriate environmental assessment and the planning process.
- **RPO 10.22**: Support the reinforcement and strengthening of the electricity transmission and distribution network to facilitate planned growth and transmission/ distribution of a renewable energy focused generation across the major demand centres to support an island population of 8 million people, including:
    - Facilitate the delivery of the necessary integration of transmission network requirements to allow linkages of renewable energy proposals to the electricity transmission grid in a sustainable and timely manner

2.4.7 Local Policy

2.4.7.1 Offaly County Development Plan 2014-2020

The Offaly County Development Plan 2014-2020 (CDP) is the principal instrument that is used to manage change in land use in the County. The Plan sets out the Council's strategic land use objectives and policies for the overall development of the County up to the year 2020 and beyond. The plan recognises that Offaly has had a long history of energy production, predominantly related to the commercial exploitation of peatlands. It has been identified that the energy market is changing and moving to a greater reliance on various forms of renewable energy. It is highlighted that there *'must be a renewed emphasis on energy efficiency to reduce the influence of the markets for carbon based fuel on our economic prosperity'*. A core strategy of the plan surrounds the need for adapting to climate change, it is stated that:

"To ensure that development promoted, supported or facilitated by the Development Plan provides for the adaptation to climate change and the promotion of renewable energy where possible including the increased risk of flooding."

The Plan, through its inclusion of an Energy Strategy, acknowledges the importance of energy to the local economy ensuring that the County is positioned in order to compete for future investment in generation capacity. The main developments in the energy industry over the lifetime of the Offaly County Development Plan 2014-2020 will be in generation, in particular the plan finds this will involve the migration from non-renewables to renewables.

The Council recognises the importance which cutaway bogs may have in relation to the provision of renewable energy within the county; they are described as a major natural and archaeological resource that are also have a critical role in employment provision in the county. Of Offaly's estimated land extent of 493,985 acres the plan states that approximately one fifth of the county comprises peatlands. The CDP highlights that *'the reuse of cutaway bog will present significant opportunities in the energy sector'*. In terms of their potential use the council state that:

> *"Cutaway bogs have potential land uses that can enhance both the employment and tourism sectors of the county as well as providing a potential habitat as much of the area will return to wilderness and contribute to the green infrastructure network."*

Section's 2.3.2 and 2.4.5 of the County Development Plan recognise that there is the potential for peatlands to accommodate large scale energy developments including in the form of wind farms. The County Development Plan 2014-2020 sets a number of objectives in relation to energy/ renewable energy which include the following:

- RDP–08: It is Council policy to support the development of renewable energy in rural areas, where it is considered appropriate i.e. where it is demonstrated that such development will not result in significant environmental effects. Such development will be assessed on a case-by-case basis.
- RDP–09: It is Council policy to encourage and facilitate the development of local and community based renewable energy projects in the county, notwithstanding their suitability and additional considerations such as location, nature of use, compliance with relevant guidelines and scale, where it can be demonstrated that such proposals are feasible.
- RDP–11: It is Council policy to encourage expansion and employment in industries such as agriculture, horticulture, forestry, peatlands, food, crafts, tourism and energy.

The proposed development which constitutes the provision of a renewable energy project on cutover bog is broadly compliant with the overall objectives of the County Development Plan. Furthermore the proposal has been designed to minimise environmental impacts and accordingly is in accordance with the proper planning and sustainable development of the area.

Section 3.5 of the County Development Plan 2014-2020 details the council's strategic plans surrounding the development of wind energy throughout its lifetime. In recent years, through the further improvement of wind energy technology and the development of larger turbines (which have the ability to take advantage of lower wind speeds) it opens the opportunity for the development of renewable wind energy production. It makes the development of wind energy in Offaly where wind speeds are as low as 7m/s at 100m fully possible.

The Wind Energy Strategy for the county provides designations in an effort to guide the development of Wind Farms to appropriate locations. Figure 2.2.6.1 of the Wind Energy Strategy shows the areas which are considered to be *'areas suitable for wind farm development'*. In all other areas, the plan states that Wind Energy Developments shall not normally be permitted except as provided under exemption provisions and as described in Section 5.4 of the Wind Energy Strategy referring to single turbines. The Wind Energy Strategy is discussed in further detail below.

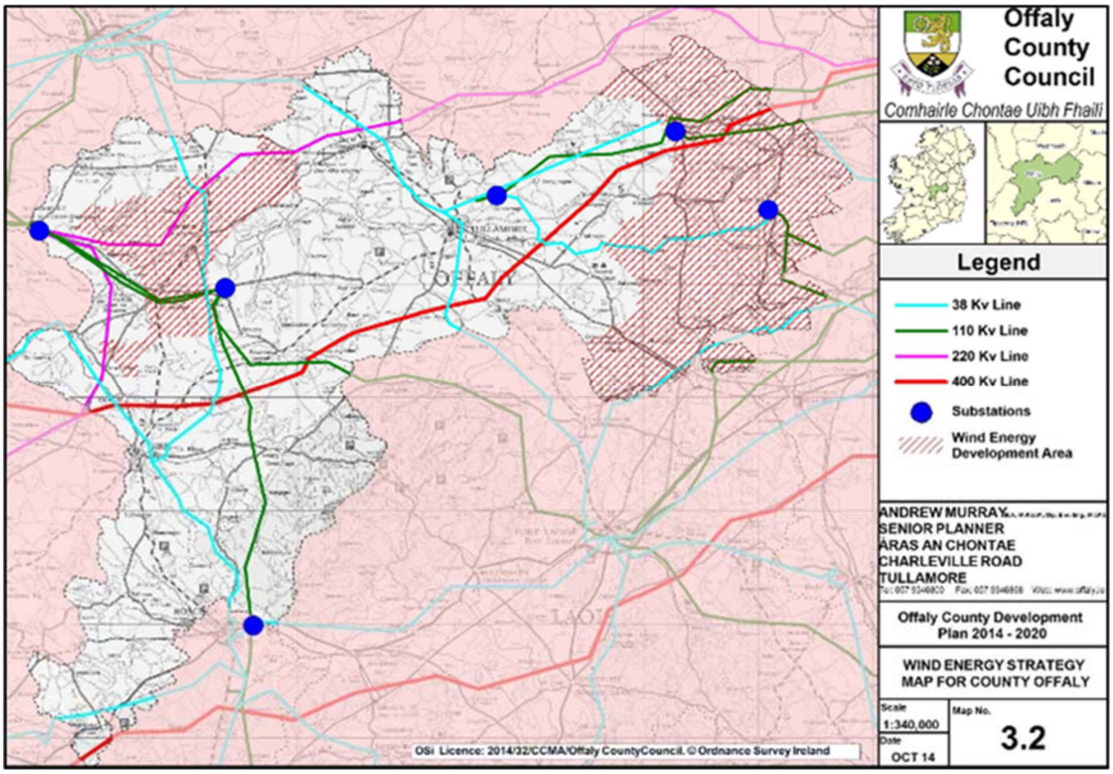


Figure 2.4 Offaly Wind Energy Strategy

In relation to energy the following objectives have been set to aid the plan in meeting its goals during the duration of the development plan:

- **EP–01**: It is Council policy to support national and international initiatives for limiting emissions of greenhouse gases and to encourage the development of renewable energy sources.
- **EP–02**: It is Council policy to facilitate the continual development of renewable energy sources having regard to the proper planning and sustainable development of the area concerned, the protection of amenities, landscape sensitivities, European Sites, biodiversity, natural heritage, and built heritage, and where such proposals comply with policy contained in the County Development Plan, in the interests of proper planning and sustainable development.
- **EP–03**: It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for

consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out.
  - The Area around Corracullin Bog, (Area 4 in Wind Energy Strategy), is omitted from the Wind Energy Development Area.
- **EP–05**: It is Council policy that applications for wind energy development outside of the wind energy development areas open for consideration identified in Map 3.2 will not normally be permitted except when it can be demonstrated that the proposal falls into the following category:
  - Category A: Single Turbines that are sited close to and specifically relate to the operations of an industrial/commercial premises or a school, hospital or other community-related premises. Supporting evidence must be provided detailing that the development will only facilitate and is only related to the operation of the business or community facility.
  - Each proposal within this category will be open for consideration outside of the wind energy development areas and subject to site specific assessment in accordance with relevant guidance.
- **EO–01**: It is an objective of the Council to achieve a reasonable balance between responding to government policy on renewable energy and in enabling the wind energy resources of the county to be harnessed in an environmentally sustainable manner. This will be implemented having regard to the Council's Wind Energy Strategy as follows:
  - In Areas open for consideration for Wind Energy Development, as identified in Map 3.2;
  - In all other areas, Wind Energy Developments shall not normally be permitted except as provided for under exemption provisions and as specifically described in Section 5.4 of the Wind Energy Strategy and Policy EP–05.

The Offaly County Development Plan lists cutaway bogs as areas of moderate landscape sensitivity. The characteristics of this landscape type are described in the Plan as follows:

> *"Cutaway bogs cover a large part of the landscape of Offaly and in their entirety, are approximately 42,000 hectares. There are a number of land uses for cutaway bog, which include wilderness, grassland, forestry and recreation. Some cutaway bog landscapes are more robust and may be considered for other uses."*

The Plan states that some areas of cutaway bog may be appropriate for other sensitively designed and located developments, including renewable energy (wind farms, biomass crops), and/or industrial use.

The County Development Plan identifies Areas of High Amenity, to protect and enhance areas of scenic and amenity value in County Offaly which are worthy of special protection in order to preserve their uniqueness and amenity value. Drinagh Bog is designated as High Landscape Sensitivity and is also an area of High Amenity and part of the Lough Boora Parklands. Clongawny is designated as an area of Moderate Landscape Sensitivity. The amenity value and landscape sensitivity are assessed in Chapter 12, Landscape and Visual Impact.

2.4.7.2 Offaly County Council Wind Energy Strategy

The Wind Energy Strategy (WES) for Offaly County Council was adopted as part of the Offaly County Development Plan 2014-2020. The objective of the strategy is to evaluate and analyses the potential for wind energy development with the County. Development of alternative energy sources is a priority at National and European level for both environmental and energy policy reasons.

The WES identifies 'Areas Suitable for Wind Energy Development', where the development of wind farms and smaller wind energy projects are open for consideration. It aims to capitalise on the potential for wind energy development in the County, while protecting the landscape, environmental considerations and residential amenity, and to give a broad indication of where potential appropriate wind energy development could take place within the lifetime of the County Development Plan 2014 – 2020. The WES identifies 'Areas Suitable for Wind Energy Development', where the development of wind farms and smaller wind energy projects are open for consideration.

The WES states that these areas are likely to be suitable for all scales of wind energy on account of a combination of factors that include:

- Available access to suitable grid connections (within 10.0 kilometres);
- The absence of compelling environmental constraints;
- Low densities of adjacent residential development;
- Areas of cut-over bog, and
- Low densities of adjacent residential development.

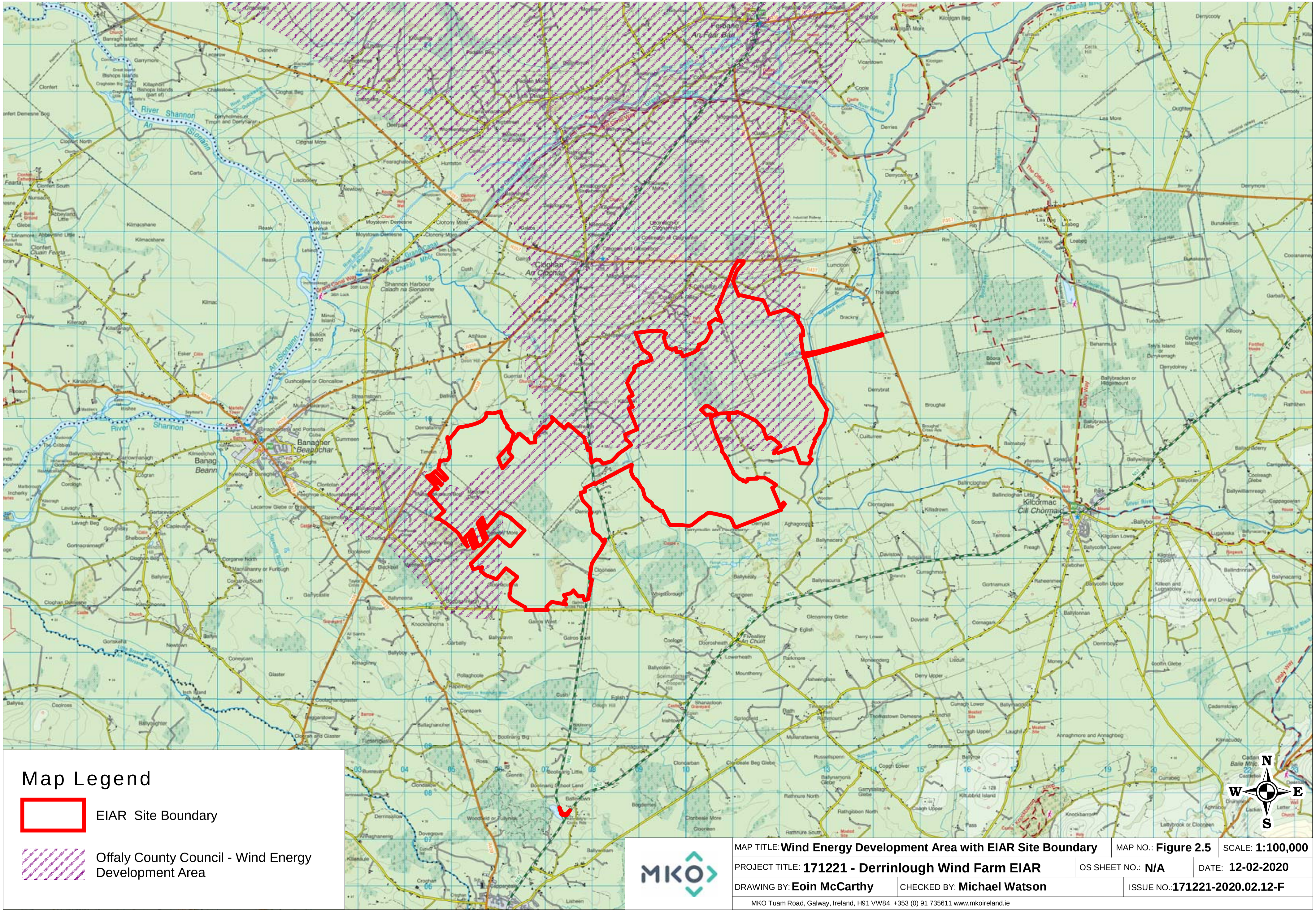
Justification of the Site in context of the Wind Energy Strategy provisions

A portion of the proposed development site is located within the Wind Development Area (WDA) which has been designated as being appropriate for the provision of wind turbines within the Wind Energy Strategy and is shown in Figure 2.5 below. The areas of the proposed development site that are located outside of the WDA share the same characteristics as the portion within and also conform to the suitability factors listed previously above. The Strategy states that applications for wind turbines in the Suitable Areas are acceptable in principle, subject to conformance with all other requirements of the County Development Plan, including objectives relating to landscape protection and the protection of residential amenity. The rationale behind this is to minimise the impacts of large-scale developments on the environment of Co. Offaly as a whole, while maximising the potential for optimal and efficient grid connection.

The Offaly WES also identifies six main areas within the County for potential wind farm development. A portion of the proposed development site is located in Area 7: Area South of Cloghan. The Strategy found that this area is suitable for large-scale wind farm development, as follows:

> *"7. Area South of Cloghan: Having regard to low levels of adjacent dwellings, reasonable access to grid, proximity to access and areas of cut-over bog this area is suitable for windfarms."*

As can be seen from the above while the majority of the proposed development site is located within the area designated as being suitable for wind farm development there are areas that lie outside this designation and in which it is intended to place wind turbines. Policy EP–05 of the County Development Plan deals with the development of lands for wind farms outside of the designated wind energy development areas and states that *"applications for wind energy development outside of the wind energy development areas open for consideration identified in Map 3.2 will not normally be permitted"*. The plan further notes that the exception to 'normal circumstances' indicated above has been specified as relating to single turbines, sited close to and operated by an industrial/commercial premises or a school, hospital or other community-related premises.



MAP TITLE: Wind Energy Development Area with EIAR Site Boundary		MAP NO.: Figure 2.5	SCALE: 1:100,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR		OS SHEET NO.: N/A	DATE: 12-02-2020
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 171221-2020.02.12-F	

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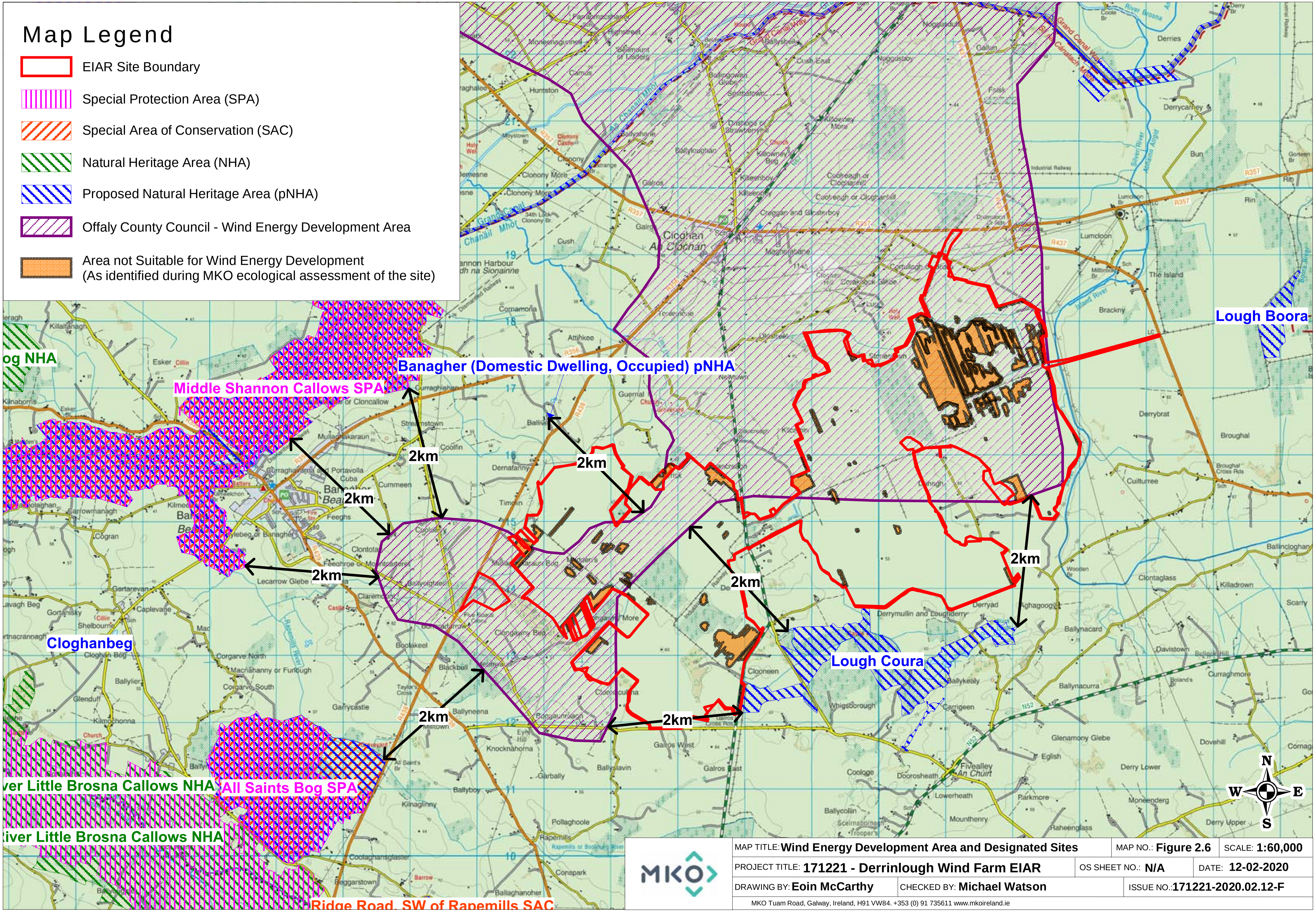
Notwithstanding the current designations in the WES it is evident (from any site inspection and considering the strategy's methodology) that the entirety of the proposed development site benefits from the same characteristics and meets the five key criteria, as outlined in the WES (and above), for land suitable for wind energy development. The subject site which comprises a mixture of active and cut away bogs are surrounded primarily by a mixture of agricultural land and forestry and comprise low densities of adjacent residential development. The grid infrastructure in the area includes a 400kV line from Moneypoint to Woodland Station near Dublin which runs approximately 3 kilometres to the south of the site. There are also two 220 kV lines within the vicinity, one running south from Shannonbridge to the west of Clongawny bog and another running east from Shannonbridge approximately 7 kilometres to the north of the site. There are four 110 kV lines in the area with two running to the north of Clongawny and Drinagh, one to the west of Clongawny bog and one to the east of Drinagh bog.

In relation to ecological sensitivities, the nearest Special Protection Area (SPA), is the Middle Shannon Callows SPA, which is located approximately 2.3 kilometres north and west of the subject site at its nearest point. The nearest SAC is All Saints Bog and Esker SAC, the boundary of which is located approximately 2.5 kilometres southwest of the site. The Lough Coura pNHA lies adjacent to the south of the site while Lough Boora NHA is 3.1 kilometres to the east. A Bat roost has also been identified as shown in Figure 2.6 below.

By necessity the WES for Offaly is a strategic document and the areas designated as being appropriate for wind farm development have arisen from applying a strategic "sieve" to the County. First discounting areas of particular sensitivity and then incorporating strategic nominal buffers. On review of the Offaly WES it is apparent that ecological designations, landscape sensitivities as well as proximity to settlements and other technical considerations all informed the identification of areas suitable for wind energy development in Offaly. While the entirety of the EIAR study area shares common characteristics, a portion of the subject site is situated outside of the Wind Energy Development Area.

Figure 2.6 above identifies the locations of the various sensitivities giving rise to the boundary of the Wind Energy Development Area surrounding the proposed development. The EIA study area is shown in red and surrounding sensitivities have also been indicated (NHAs, SACs, and bat roost). The WES is a strategic document and at that level and in order to ensure impacts are minimised it is appropriate and necessary to apply standardised buffers from designated areas and as the WES is a county-wide strategy it is not practical, feasible or appropriate for the local authority to carry out a finer grain review . The preparation of this EIAR has involved carrying out a range of focused and detailed environmental reports and assessments, including a full range of site-specific ecological, hydrological and landscape studies which have facilitated a greater level of understanding of the site and its surroundings than could be achieved in any strategic county-wide assessment.

The studies and assessments that have been carried out have demonstrated that there are areas within the study area that have been identified as "Wind Development Area" (WDA), that are not appropriate for the provision of wind turbines. The north-western zone of the EIA study area (hatched orange in Figure 2.6) refers in this regard. This area is under the ownership of the applicant, however, following detailed ecological review of this area, carried out as part of the EIAR process, it has been identified as the most biodiverse location in the vicinity which offers good habitats for a range of flora and fauna, however, is not subject to any specific environmental or ecological designation. Accordingly, in designing the proposed development, this area has been avoided in order to ensure the diverse range of habitats and fauna can be preserved. In this regard while it would be consistent with the provisions of the WES to provide turbines at this location, the finer grain analysis facilitated in the preparation of this EIAR highlights that biodiversity, environmental enhancement and general amenities would be better served by excluding wind turbines from this area. Accordingly, wind turbines will not be provided in this area which has been designated as WDA by the Wind Energy Strategy.



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Further to the finer grain studies that have been facilitated in the preparation of this EIAR other areas have been identified within the landholding (but outside the WDA designation) that can accommodate wind turbines, while minimising environmental impact and ensuring the sensitive receptors identified in the WES remain unaffected. Prior to proposing turbines at these locations, it was necessary to ensure that the particular sensitivities identified in the WES (and which informed the boundaries of the WDA at this location) were not adversely impacted. In this regard, the following is of note (and illustrated in Figure 2.6).

- The reason for the southern portion of the EIA study area being excluded from the WDA is the presence of the Lough Coura proposed Natural Heritage Area (pNHA) and it's WES designated standard 2km exclusion/buffer zone. Lough Coura pNHA is a small in-filled lake, which has a long history of botanical recording and has been identified as a pNHA for the occurrence of Fen habitat. As a fen habitat, the most important consideration in terms of potential for impacts to arise relate to hydrology and hydrological connection between the proposed development and Lough Coura. In this regard, Lough Coura is located upstream of the proposed development and therefore no water or runoff from the site will flow in the direction of the pNHA. The ecological surveying and monitoring that has been carried out also highlights that there will be no other impacts arising on the pNHA from the proposed development. Accordingly, the provision of turbines within the southern portion of the subject site (on lands outside the WDA) can be provided while protecting the relevant sensitive receptor identified in the WES in the vicinity.
- In relation to the provision of turbines in the north-western portion of the site this area also lies outside the WDA designated area. Again, the WDA boundary at this location is dictated by the presence of a pNHA and its associated WES generated generic buffer zone – set back. The pNHA in question is a privately-owned dwelling house referred to as "Banagher (Domestic Dwelling, Occupied)" and it has been designated as a pNHA for being a roost of the Brown Long-eared Bat. (approximately 60 bats have been recorded in the attic in 1987). This pNHA is located over 700m from the proposed project boundary and outside the 200m survey buffer of the site, and the project has been designed to minimise any potential impacts on bats, with appropriate mitigation measures being applied throughout. Accordingly, the proposed development will not have an adverse impact on this pNHA and therefore maintain integrity of this sensitive feature identified within the WES.
- In relation to the SACs and SPAs in the wider vicinity the NIS and range of ecological studies carried out demonstrate that the proposed development will not give rise to adverse impacts on these Natura sites.

It should be noted that pNHA sites do not have any legal designations or protections under the Wildlife Act 2000, and therefore the application of arbitrary setbacks and exclusion areas from these non-designated areas, is not a mandatory or legislative requirement. The setbacks have been imposed by the methodology adopted in the WES and are not based on any guidelines or best practice. The requirement for and scale of setbacks should typically be established as part of project specific site constraints mapping or studies. It is acknowledged that the generic setbacks used within the WES can inform strategic decision making at a macro level, the protection of sensitive features (which is the fundamental principle driving the WES setbacks) can also be assured by site specific project design and mitigation once a greater understanding of any site, its surroundings and conditions is achieved. This greater site-specific understanding has been facilitated in the current instance through the EIA process. . The detailed and site specific studies carried out to inform this EIAR has allowed a more detailed and finer-grain analysis of the relevant issues to be carried out and the details set out in the relevant sections of this EIAR confirm that the design of the proposed wind farm can be accommodated as proposed without adverse impact on the sensitive features identified in the WES. In fact the analysis carried out goes further and acknowledges that a portion of land within the applicants holding (the eastern portion of the study area) which has been designated as being within the WDA is not in fact an optimum location for the provision of wind turbines due to the quality and range of the habitats that are present at that location. These lands are not designated and are within the WDA, but turbines are not being proposed at this location arising from the various studies that have been carried out.

The identification of the southern portion of the subject site as being unsuitable for wind energy would appear to be contrary to the stated underlying rationale of the WES to maximise wind energy developments in suitable areas. In addition to this it is noted that the Offaly County Development Plan specifically references cutaway bogs, such as the subject site, as having characteristics that *"appear to be particularly suitable for wind energy development"*, and reference is made to the characteristics including large, interconnected landholdings which have sparse residential populations, which is very much the situation with the current proposed development.

It is evident that there is a clear conflict between the recognition of cut away bogs as being suitable for wind energy development and the current WES designation for the subject site, however, the findings and conclusions of this EIAR clearly point to the proposed development not only being suitable as proposed but also being in line with the requirements of proper planning and sustainable development in that the site can clearly accommodate a development as proposed without significant adverse impact on the environment in the vicinity.

The subject development has been confirmed as a Strategic Infrastructure Development by An Bord Pleanála, thereby requiring an application directly to An Bord Pleanála under the provisions of Section 37E of the Act. Section 37G of the Act states that;

> *"(1) When making a decision in respect of a proposed development for which an application is made under section 37E, the Board may consider any relevant information before it or any other matter to which, by virtue of this Act, it can have regard."*

Section 37G Subsection (2)(c) states that "Without prejudice to the generality of subsection (1), the Board shall consider .... the provisions of the development plan or plans for the area" however subsection 6, notes that the Board may;

> *"decide to grant a permission for development, or any part of a development, under this section even if the proposed development, or part thereof, contravenes materially the development plan relating to any area in which it is proposed to situate the development."*

Accordingly, An Bord Pleanála are not bound by the provisions of the development plan in determining SID applications and can grant permission for the development of wind turbines outside of the area deemed appropriate for wind farm developments. However, having regard to the dual provisions of the County Development Plan, which on the one hand supports the provision of renewable energy and specifically recognises cutover bogs as being an appropriate location for such infrastructure, while on the other the entirety of the proposed site is not within the WDA designated within the WES, it can be argued that the proposed development does not contravene the development plan provisions, particularly as the sensitive features for which buffers have been applied in the WES (to create the WDA) remain protected from potential impacts from the proposed development through the design process and the range of mitigation measures associated.

2.4.8 Other Relevant Guidelines

2.4.8.1 Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017

In July 2017, the Department of Housing, Planning, Community and Local Government (DoHPCLG) published '*Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change*' under Section 28 of the Planning and Development Act 2000. Planning authorities are obliged to have regard to guidelines issued pursuant to Section 28 in the performance of their functions under the Planning and Development Act 2000 (as amended).

The guidelines state that it is a specific planning policy requirement under Section 28(1C) of the Act, that in making a development plan with policies or objectives that relate to wind energy developments that a Planning Authority must:

1. *"Ensure that overall national policy on renewable energy as contained in documents such as the Government's 'White Paper on Energy Policy - Ireland's Transition to a Low Carbon Future', as well as the 'National Renewable Energy Action Plan', the 'Strategy for Renewable Energy' and the 'National Mitigation Plan', is acknowledged and documented in the relevant development plan or local area plan;*
2. *Indicate how the implementation of the relevant development plan or local area plan over its effective period will contribute to realising overall national targets on renewable energy and climate change mitigation, and in particular wind energy production and the potential wind energy resource (in megawatts); and*
3. *Demonstrate detailed compliance with item number (2) above in any proposal by them to introduce or vary a mandatory setback distance or distances for wind turbines from specified land uses or classes of land use into their development plan or local area plan. Such a proposal shall be subject to environmental assessment requirements, for example under the SEA and Habitats Directives. It shall also be a material consideration in SEA, when taking into account likely significant effects on climatic factors, in addition to other factors such as landscape and air, if a mandatory setback or variation to a mandatory setback proposed by a planning authority in a development plan or local area plan would create a significant limitation or constraint on renewable energy projects, including wind turbines, within the administrative area of the plan."*

2.4.8.2 DoEHLG Wind Energy Guidelines 2006

In June 2006, the then Department of Environment, Heritage and Local Government (DoEHLG) published 'Wind Energy Development Guidelines for Planning Authorities' (the Guidelines) under Section 28 of the Planning and Development Act, 2000. The aim of these guidelines was to assist the proper planning of wind power projects in appropriate locations around Ireland. The Guidelines highlight general considerations in the assessment of all planning applications for wind energy. They set out advice to planning authorities on planning for wind energy through the development plan process and in determining applications for planning permission. They contain guidelines to ensure consistency of approach throughout the country in the identification of suitable locations for wind energy development.

It is the case that each wind project has its own characteristics and defining features, and it is therefore impossible to write specifications for universal use. Guidelines should be applied practically and do not replace existing national energy, environmental and planning policy. The Department of the Environment, Community and Local Government published proposed revisions to the guidelines in December 2013 as part of a targeted review relating to Noise, Proximity and Shadow Flicker for discussion. The Department has since issued the Draft Revised Wind Energy Development Guidelines in December 2019. At the time of lodgement the consultation period for the Draft Guidelines still remained open, the consultation period closes on the 19th of February 2020. The proposed development has been designed in accordance with the current wind farm guidelines and has also been fully informed by the provisions of the Draft Wind Energy Guidelines 2019.

2.4.8.3 Department Circular PL5/2017

On the 3rd of August 2017, the Department of Housing, Planning and Local Government issued Circular PL5/2017 to provide an update on the review of the wind energy and renewable policies in development plans, and the advice contained within a previous Departmental Circular PL20-13. Circular PL20-13 advised that local authorities should defer amending their existing Development Plan policies in relation to wind energy and renewable energy generally as part of either the normal cyclical six-yearly review or plan variation processes and should instead operate their existing development plan policies and objectives until the completion of a focused review of the Wind Energy Development

Guidelines 2006. The new circular (PL05/2017) reconfirms that this continues to be the advice of the Department.

The Department circular also sets out the four key aspects of the preferred draft approach being developed to address the key aspects of the review of the 2006 Wind Energy guidelines as follows:

- The application of a more stringent noise limit, consistent with World Health Organisation noise standards, in tandem with a new robust noise monitoring regime, to ensure compliance with noise standards;
- A visual amenity setback of 4 times the turbine height between a wind turbine and the nearest residential property, subject to a mandatory minimum distance of 500 metres between a wind turbine and the nearest residential property;
- The elimination of shadow flicker; and
- The introduction of new obligations in relation to engagement with local communities by wind farm developers along with the provision of community benefit measures.

The release of Circular Letter PL05/2017 and the Interim Guidelines coincide with the publication of Irelands first statutory National Mitigation Plan (previously discussed above).

2.4.8.4 Draft Revised Wind Energy Development Guidelines 2019

The Department of Housing, Planning and Local Government published the Draft Wind Energy Guidelines (referred to as the Draft Revised Guidelines) in December 2019 and these Draft Guidelines are under public consultation (until 19th February 2020). Following the previous 2013 consultation and subsequent detailed engagement between the relevant Government Departments, a "preferred draft approach" to inform and advance the conclusion of the review of the 2006 guidelines was announced in June 2017 and informed the design approach of the current proposed development. The current guidelines in force remain the 2006 guidelines, however it is acknowledged that the draft guidelines may be adopted prior to a decision issuing in relation to the current proposal, and accordingly in so far as is practicable the provisions of the Draft Guidelines have informed the design process for the current proposal.

The Draft Revised Guidelines recognise that the proper planning and sustainable development of areas and regions must be taken into account when local authorities prepare their development plans and assess planning applications, irrespective of the significant role renewable energy has to play in tackling climate change. The Draft guidelines also acknowledge that *"In broad terms, Ireland must double the level of output from the wind energy sector to meet its targets, which can be achieved, on-land through a combination of both upgrading existing wind energy development sites with newer more efficient turbines and developing new projects."*

The Draft Revised Guidelines note that potential impacts of wind energy development proposals on the landscape, including the natural and built environment, must be considered along with the legitimate concerns of local communities. With this in regard, and in line with the previously stated "preferred draft approach", the 2019 Draft Guidelines primarily focus on addressing a number of key aspects including, but not limited to:

- Acceptable noise thresholds and monitoring frameworks;
- Visual amenity setback and spacing;
- Control of shadow flicker;
- Compliance with Community consultation and dividend requirements, as included within the obligatory Community Report; and
- Consideration of the siting, route and design of the proposed grid connection as part of the whole project.

The design of the proposed development has taken account of the "preferred draft approach" as articulated by the Department in June 2017, and accordingly, has been developed with the provisions of the current Draft Revised Guidelines in mind. In relation to the design parameters of the draft revised guidelines, shadow flicker as an entirely controllable phenomenon can be controlled by the proposed wind farms control systems and the Project will adhere to the shadow flicker standards of the draft guidelines. Extensive community consultations have also been carried out as advised in the draft. The project will also provide a community dividend and the community gain proposal has set out in Chapter 4.5 of this EIAR. The noise section of this EIAR demonstrates that the proposed development will not have an adverse impact on sensitive properties. The layout of the project has been designed to accommodate the visual amenity setback set out in the Draft Guidelines (Section 6.18 of the Draft Guidelines refer). In this regard, the Draft Guidelines state that *"…. Planning authorities and An Bord Pleanála (where relevant) shall … ensure that a setback distance for visual amenity purposes of 4 times the tip height of the relevant wind turbine shall apply between each wind turbine and the nearest point of the curtilage of any residential property in the vicinity…. subject to a mandatory minimum set back of 500 metres from the residential property.*" The proposed development has been designed to ensure that no turbine is located within 4 times tip height of any residential dwelling.

2.4.8.5 IWEA Best Practice Guidelines for the Irish Wind Energy Industry 2012

The Irish Wind Energy Association (IWEA) published updated Wind Energy Best Practice Guidelines for the Irish Wind Industry in 2012. The guidelines aim to encourage and define best practice development in the wind energy industry, acting as a reference document and guide to the main issues relating to wind energy developments. The purpose of the guidelines is to encourage responsible and sensitive wind farm development, which takes into consideration the concerns of local communities, planners, and other interested groups. The guidelines outline the main aspects of wind energy development with emphasis on responsible and sustainable design and environmental practices, on aspects of development which affect external stakeholders, and on good community engagement practices. In approaching the development of IWEA's guidelines the aim was to be complementary to the Department of the Environment Heritage and Local Government's 'Wind Energy Development Guidelines' (2006).

2.4.8.6 IWEA Best Practice Principles in Community Engagement and Community Commitment 2013

Following on from the IWEA published Best Practice Guidelines in March 2012, the Association extended its guidance with the publication of this Best Practice in Community Engagement and Community Commitment. IWEA and its members support the provision of financial contributions by wind farm operators to local communities and have sought to formulate best practice principles for the provision of a community commitment. The document sets out IWEA's best practice principles for delivering extended benefits to local communities for wind farm developments of 5 Megawatts (MW) or above. Best Practice Principles of community engagement when planning the engagement strategy and preparing associated literature are also outlined in the document. The aim of these guidelines is to ensure that the views of local communities are taken into account at all stages of a development and that local communities can share in the benefits.

Further details on the community engagement that has been undertaken as part of the proposed development are presented below.

2.4.8.7 Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement 2016

In December 2016, the Department of Communications, Climate Action and Environment (DCCAE) issued a Code of Practice for wind energy development in relation to community engagement. The Code of Good Practice is intended to ensure that wind energy development in Ireland is undertaken in adherence with the best industry practices, and with the full engagement of local communities.

Community engagement is required through the different stages of a project, from the initial scoping, feasibility and concept stages, right through construction to the operational phase. The methods of engagement should reflect the nature of the project and the potential level of impact that it could have on a community. The guidelines advise that ignoring or poorly managing community concerns can have long-term negative impacts on a community's economic, environmental or social situation. Not involving communities in the project development process has the potential to impose costly time and financial delays for projects or prevent the realisation of projects in their entirety. Community engagement in relation to the proposed development is discussed in full below.

2.4.8.8 IWEA Community Engagement Strategy 2018

The IWEA Community Engagement Strategy was launched in March 2018 in line with their plan to 'step change' in how members will engage with communities neighbouring wind farm projects. There are a number of commitments listed under this strategy which are summarized as follows:

Pre-planning

With the long-term timelines associated with wind farm developments it is noted that there is considerable uncertainty in the early stages. When all necessary land rights are secured IWEA members commit to:

- Create a project website at an early stage of the project development. This webpage will include project milestones and timelines, as they become known;
- Appoint a Community Liaison Officer (CLO) for the project and provide contact details to the community. The CLO will be the point of contact for the community and all requests/concerns will be acknowledged within 48 hours and resolved, where possible within one week; and
- Call to the door of all residents within one kilometre of the nearest proposed turbine to provide information –in the form of a project leaflet –which explains the proposed project and provides contact details for the CLO.

Pre-Construction/Construction

It is noted that it typically takes approximately 12 months to construct a wind farm and is detailed that during periods there will inevitably be disruption locally. The role of the CLO will become more proactive, during this phase, to make sure the local community are kept up to date with developments and any issues are dealt with. The following IWEA commitments are listed:

- Provide information on the construction schedule to all stakeholders identified in the pre-planning process and on the project website;
- Facilitate public meetings, as necessary, to inform the public about the project and its status;
- The CLO acknowledging all requests/ concerns made to him / her within 48 hours and working with the project promoter / construction contractor to resolve any issues that arise. Issues raised generally to be 'closed out' within one week; and
- Produce an annual report detailing events / issues that arose and how they were dealt with. This report to be submitted to the local authority.

Post Construction/Operation

Following the completion of the construction and commissioning phase, activity on the site will dramatically reduce. During this phase the IWEA commitments are as follows:

- Maintain the project website with updated information about the project;
- CLO continuing to acknowledge all requests/ concerns made to him / her within 48 hours and work with the project promoter / owner to resolve any issues that arise/ Produce an

annual report detailing events / issues that arose and how they were dealt with. This report to be submitted to the local authority; and
- Compile a report measuring the economic impacts of the project

Existing projects:

There are over 200 windfarms in operation in Ireland today of varying sizes and at varying stages of their operational life. The Strategy details that of the operational wind farms IWEA's members make up 70% of the installed wind capacity. The following commitments are listed:

- Nominate Community Liaison Officer (CLO) to each wind farm;
- Host a project website with CLO details, or where no dedicated website for the project is in existence, IWEA members commit to providing CLO details to a windfarm database hosted on the IWEA website;
- Acknowledge all requests / concerns within 48 hours of being made;
- Ensure all instances of any planned disruption, traffic restrictions etc. are highlighted and clearly communicated to the community in advance; and
- Prepare an annual report documenting engagement with the local community. This report to be submitted to the local authority.

Community Benefit and Community Ownership

Benefit - It is noted that IWEA members should be seeking to provide support to local communities. Members are committed to providing resources for Community Benefit Funds, tailored to each particular project and the needs of each particular community, with each community defining for themselves how the funding should be allocated. To ensure that IWEA's members are aligned with the best practice proposed in RESS, IWEA members are committing to provide €2/MWh to Community Benefit Funds for all future wind farm projects (RESS supported or not) over the first 15 years of operation.

Ownership - In some cases, local communities aspire to forms of community ownership or community investment in windfarms. IWEA supports this, but also recognises that there are important aspects of how this might best work in practice, that require further working through between the different stakeholders.

Bord na Móna have fully adopted the above commitments and have engaged fully with the community; full details are included in Section 2.7.4 below.

2.4.8.9 Commission for Regulation of Utilities: Grid Connection Policy

The Commission for Regulation of Utilities (CRU) (previously the Commission for Energy Regulation (CER)) launched a new grid connection policy in March 2018 for renewable and other generators, known as ECP-1, which will seek to allow "shovel ready" projects that already have a valid planning permission, connect to the electricity networks. The principal objective which guides this decision is to allow those projects which are 'shovel ready' to have an opportunity to connect to the network, along with laying the foundations for future, more regular batches for connection. In August 2018, the applicants for new connection capacity under ECP-1 were published. The CRU is expected to launch the second round of grid connection offers knows an ECP-2 in 2020.

The enduring connection policy regime replaces the previous 'Gate' system of grid connection applications. The grid connection application window under ECP-1 is the first time since 2007 that certain renewable energy projects including wind farms have an opportunity to secure a new grid connection offer.

2.4.8.10 Renewable Energy Support Scheme (RESS)

On the 24th July 2018, the Department of Communications, Climate Action and Environment announced Government approval for the new Renewable Energy Support Scheme (RESS). It is intended that the new RESS will incentivise the introduction of sufficient renewable electricity generation to deliver Ireland's contribution towards the EU wide 32% RES target, out to 2030 and will be the key policy measure that will drive the delivery of Irelands 70% RES-E target, attracting significant international investment in the renewable sector in Ireland and driving down consumer costs. Projects will be eligible for RESS support from 1st of July 2021 until 31st of December 2037 (16.5 years max.).

This new scheme replaces the previous support mechanism for renewable electricity known as the Renewable Energy Feed-in Tariff (REFIT) and marks a shift from guaranteed fixed prices for renewable generators to a more market-oriented mechanism i.e. auction based scheme where the cost of support will be determined by competitive bidding between renewable energy generators. A Community-led category and community capacity building measures within the scheme will provide opportunities for communities to play their part in Ireland's renewable energy transition. As detailed in the Climate Action Plan (June 2019), the first RESS auction was expected to open for applications by the end of 2019. More recently it has been confirmed that the RESS auction will open at the end of Q1 2020.

2.4.8.11 Forest Service Guidelines

The Forest Service is responsible for ensuring the development of Forestry within Ireland in a manner and to a scale that maximises its contribution to national socio-economic well-being on a sustainable basis that is compatible with the protection of the environment. The forestry works (felling/planting) associated with the proposed development will carried out under the relevant guidance from the Forestry Service.

2.5 Planning History

This Section of the EIAR sets out the relevant planning history of the proposed wind farm site, planning applications in the vicinity of the site and other wind energy applications within the wider area.

2.5.1 Applications Within the Proposed Wind Farm Site

A review of Offaly County Council Planning Register shows that there were a number of planning applications lodged in relation to works carried out by Bord na Móna and Telecommunication operators. The following applications were identified within the site boundary:

- **Pl. Ref. 88/274** - Application made by Bord na Móna for new weighbridge and weighbridge office. The planning Authority granted conditional permission on the 23rd of November 1998.
- **Pl. Ref. 01/132** - Application made by Eircell for a telecommunications support structure, antennae and equipment shelter. The planning Authority granted conditional permission on the 23rd of May 2002.
- **Pl. Ref. 07/1235** - Application made by Vodafone Ireland Ltd. for retention of an existing 30m high telecommunications support structure, antennas, equipment container and associated equipment within a fenced compound and access track. The development forms part of Vodafone Ireland Limited's existing gsm and broadband telecommunications network. The planning Authority granted conditional permission on the 10th of June 2014.
- **Pl. Ref. 13/69** - Application made by Vodafone Ireland Ltd. for retention of an existing 30m high telecommunications support structure with antennas, equipment container and associated equipment within a fenced compound and access track. the development forms part of Vodafone Ireland Limited's existing gsm and 3g broadband

telecommunications network. The planning Authority granted conditional permission on the 4th of August 2013.

- **Pl. Ref. 14/251** - Application made by Bord na Móna PLC for the construction of a new workshop building, measuring approximately 190 m^2. this building will be used to carry out minor maintenance works on peat haulage stock including locomotives and wagons. external works are to include a concrete paved yard area, with surface water run-off draining through an oil-interceptor. an on-site treatment system is to be constructed to cater for foul water run-off. External fencing and public lighting are proposed immediately outside the proposed building. Access to the site will be by the existing access to the briquette factory, off the N62 Cloghan-birr road. This application relates to a development which comprises or is for the purposes of an activity requiring an integrated pollution prevention and control licence (Boora Group EPA IPC Licence no. P0500-01). The planning Authority granted conditional permission on the 4th of August 2013.
- **Pl. Ref. 17/155** - Application made by Bord na Móna Powergen Ltd. for erection of a guyed wind monitoring mast, with instruments, up to 100m in height. the purpose of the proposed mast is to assess the suitability of the company's adjacent lands for wind farm development. The planning Authority granted conditional permission on the 4th of August 2013.

2.5.2 Applications in the Vicinity of the Proposed Wind Farm Site

The majority of planning applications in the immediate vicinity of the proposed wind farm site are related to the provision and/or alteration of one-off housing and agricultural developments, where relevant these have been considered in the design of the project and are considered within the relevant sections of this EIAR. The relevant housing and agricultural developments from the Planning Register in the vicinity of the proposed development site includes those listed Table 2.1 below.

Table 2.1 Housing and Agricultural Developments included on the Planning Register

Pl. Ref:	Description	Decision
Pl Ref. 82/615	Erection of saw shed/office facilities and septic tank.	Grant; 21.04.1983
Pl Ref.94/119	Bungalow and septic tank	Grant; 27.06.1994
Pl Ref. 95/358	Dwelling house and septic tank	Grant; 22.07.1996
Pl Ref. 97/394	Dwelling house and septic tank	Grant; 15.10.1997
Pl Ref. 97/704	Single storey dwelling and septic tank	Grant; 10.03.1998
Pl Ref. 98/325	Dwelling house and septic tank	Grant; 05.08.1998
Pl Ref. 98/591	Extension to dwelling house and separate garage and fuel store	Grant; 06.10.1998
Pl Ref. 99/255	Dwelling house and effluent treatment system	Grant; 08.10.1999
Pl Ref. 99/386	Bungalow and septic tank.	Grant; 13.07.1999
Pl Ref. 00/389	Dwelling house and septic tank	Grant; 27.09.2000
Pl Ref. 00/711	2 no. dwelling house and 2 No septic tank	Grant; 11.01.2001
Pl.Ref.00/965	Dwelling house, garage and septic tank	Grant; 17.11.2000
Pl Ref. 01/442-	Bungalow and garage	Refused; 16.08.2001
Pl Ref.01/990	Dwelling house and septic tank	Grant; 21.12.2001
Pl Ref. 01/1231	Dwelling house, garage and septic tank	Grant; 31.05.2002
Pl Ref. 01/1255	Dwelling house, septic tank/effluent treatment system	Grant; 24.06.2002
Pl Ref. 02/605	Dwelling house, garage/fuel store septic tank, percolation area and entrance	Grant; 19.09.2002
Pl Ref. 03/169	Dwelling house, domestic garage, effluent treatment system and entrance	Refused; 15.04.2003

Pl. Ref:	Description	Decision
Pl Ref. 03/712	Build addition and alteration to existing dwelling house	Grant; 09.10.2003
Pl Ref. 03/945	Dwelling house and construction of septic tank	Grant; 22.01.2004
Pl Ref.03/1295	Dormer dwelling and septic tank (dwelling to include solar panels in roof)	Grant; 22.04.2004
Pl Ref. 04/81	Dwelling house, detached garage, septic tank and wastewater treatment system	Grant; 26.05.2004
Pl Ref. 04/170	Two storey dwelling house, effluent treatment system, entrance and ancillary site works	Grant; 06.07.2004
Pl Ref. 04/775	Dwelling house, domestic garage, effluent treatment system and entrance	Grant; 25.11.2004
Pl Ref. 04/1066	Dwelling house, garage and effluent treatment unit	Grant; 23.11.2004
Pl Ref. 05/931	Dormer bungalow, septic tank, sewage treatment system and percolation area	Grant; 01.12.2005
Pl Ref. 06/186	Construction of dormer bungalow, effluent treatment system and domestic garage	Grant; 27.06.2006
Pl Ref. 06/319	Demolition of existing house and shed and construction of new dwelling house complete with effluent treatment system	Grant; 27.06.2011
Pl Ref. 06/991	Construction of a 42 bedroom (50 bed) single storey nursing home, effluent treatment system, entrance, car parking, landscaping and all ancillary services	Grant; 22.01.2007
Pl Ref. 06/1267	Construction of a dormer dwelling with domestic garage and effluent treatment system	Grant; 23.03.2007
Pl Ref. 06/1331	Construction of livestock cattleshed with slatted slurry tank and storage area and all associated site works	Grant; 09.01.2007
Pl Ref. 06/1686	Construction of extension to existing cubicle shed and associated concrete works	Grant; 21.03.2007
Pl Ref. 07/289	Construction of dormer dwelling with domestic garage and effluent treatment system	Grant; 23.05.2007
Pl Ref. 07/316	Construction of construction of a two-storey dwelling house with attached garage and associated site works with effluent treatment system and new separate entrance.	Grant; 27.08.2007
Pl Ref. 07/609	Construction of a plant room building housing electrical substation stores and all ancillary services on a site with permission for a 50-bed nursing home	Grant; 20.07.2007
Pl Ref. 07/645	Construction of bedded area extension to existing slatted shed and all associated concrete area	Grant; 19.07.2007
Pl Ref. 07/1192	Construction of a dwelling house, domestic garage and treatment system with percolation area	Refused; 17.09.2007
Pl Ref. 07/1226	Construction of a dwelling house, domestic garage and treatment system with percolation area	Refused; 19.09.2007
Pl Ref. 07/1450	Retention of existing garage and permission for conversion of existing attic to accommodate bedrooms and toilets, provide sunroom to southern aspect gable	Grant; 04.03.2008
Pl Ref. 07/1466	Construction of agricultural slatted shed for housing pigs. The Planning Authority granted conditional permission on the 4th of January 2008.	Grant; 04.01.2008
Pl Ref. 07/1547	Construction of a bungalow type dwelling, domestic garage, advanced effluent treatment system and all associated site works	Granted by Planning Authority; Refused

Pl. Ref:	Description	Decision
		by An Bord Pleanála 29.10.2008
Pl Ref. 07/1594	Construction of new dwelling house, domestic garage/fuel shed and install effluent treatment unit with percolation area	Grant; 02.04.2008
Pl Ref. 08/170	Construction of dwelling house, garage and effluent treatment unit.	Grant; 02.07.2008
Pl Ref. 08/429	Construction of a part 2 storey part single storey dwelling house with effluent treatment system and sundry associated works.	Grant; 11.08.2008
Pl Ref. 08/576	Installation of effluent treatment system and percolation area to existing dwelling house with all associated site works.	Grant; 04.09.2008
Pl Ref. 09/126	Extension and alterations to an existing dwelling and the retention of an existing domestic shed and permission for completion of an extension and alterations to an existing dwelling.	Grant; 22.12.2009
Pl Ref. 09/265	Dwelling house with first floor accommodation, envirocare sewage treatment system and percolation area to EPA recommendations, domestic garage and all ancillary site works.	Grant; 15.10.2009
Pl Ref. 14/48	Erection of a dwelling, entrance / driveway and wastewater treatment system, including associated site works.	Grant; 03.07.2014
Pl Ref. 17/65	Dwelling house, septic tank and percolation area, and adjacent domestic garage.	Grant; 16.05.2017

There are a number of commercial and utility developments in the wider area that have been granted planning permission which include the following applications made by Lumcloon Energy to the North of the development site:

<u>Lumcloon Energy Applications:</u>

- **19.PA0015**: Permission granted by An Bord Pleanála to Lumcloon Energy Ltd. for a gas fired electricity generating station capable of producing up to a maximum of 350MW approximately under the provisions of the Strategic Infrastructure Development (SID) process. Site is located 5.5 kilometres east of Cloghan. An Bord Pleanála granted permission on the 12th of March 2010.
- **Pl Ref. 17/194**: Planning application made by Lumcloon Energy Limited for the development of an energy storage facility designed to provide 100MW of system support services to the electricity grid The Planning Authority granted conditional permission for the proposed development on the 25th of July 2017. This permission was subsequently superseded by **Pl. Ref. 19/55** in an application by the same applicant for alterations to development of an energy storage facility designed to provide 100mw of system support services to the electricity grid at Lumcloon, Cloghan, Co. Offaly in lieu of that granted under planning permission 17/194. The Planning Authority granted conditional permission for the development on the 7th of August 2019.

There are a number of commercial and utility developments in the wider area that have been granted planning permission which include the following:

- **Pl Ref. 06/295**: Planning application made by Nordale Enterprises Ltd. for the construction of new single storey building (1,285sqm) in existing yard behind existing building. The Planning Authority granted conditional permission for the development on the 17th of August 2006.

- **Pl Ref. 09/399**: Planning application made by McGill Environmental Systems (Ireland) Ltd. for the construction of a compost manufacturing facility, office building, biocycle treatment unit and all associated site works. The Planning Authority refused permission on the 21st of May 2010 and was subsequently refused again on appeal by An Bord Pleanála on the 9th of December 2010.
- **Pl Ref. 12/65**: Planning application made by Galetech Energy Developments Ltd for the erection of an anemometer mast. The Planning Authority granted permission for the development on the 22nd of June 2012.
- **Pl Ref. 18/230**: Planning application made by Galetech Energy Developments Cloghan Limited for the installation of approximately 12.5km of 38 kV electricity transmission line from the permitted (wind farm) substation (Offaly County Council Pl Ref. 14/188 and An Bord Pleanála Ref. PL l19.244053) in the townland of Stonestown, County Offaly to the existing electricity substation in the townland of Clondallow, County Offaly. The Planning Authority refused permission on the 27th of February 2019, and the application is currently on appeal with An Bord Pleanála under 304056-19.
- **Pl. Ref.19/555** - Planning application made by Galetech Energy Developments Cloghan Limited for the installation of approximately 8 kilometres of underground electricity line with a capacity of up to 38kv from the permitted (wind farm) substation (Offaly county council planning register reference 14/188 and An Bord Pleanála reference Pl 19.244053 and Offaly county council planning register reference 19/22 -permission granted for technical amendments to substation) in the townland of Stonestown, to the permitted Derrycarney electricity substation in the townland of Lumcloon, County Offaly. This is a current planning application which is due to be decided on the 25th of January 2020

2.5.3 Other Wind Farm Sites

Within the wider area, there have been a number of planning applications for wind farm developments (comprising two or more turbines) lodged within a 20-kilometre radius of the EIAR study area. These wind farms applications are based on a review of the Offaly County Council and Tipperary County Council Planning Register and include those listed below. This record lists the main relevant renewable energy applications in the wider vicinity of the proposed development that could be considered to reasonably give rise to potential cumulative effects. It is not intended to be exhaustive and list every application associated with the sites.

2.5.4 County Offaly

- **PL. Ref. 02/734**: Planning application made by New Energy Technologies Ltd. for the erection of five wind turbine generators, a meteorological mast, associated access roads and control building. The Planning Authority granted conditional permission on the 30th of October 2002.
- **Pl. Ref. 07/1595**: Planning application made by Gaelectric Developments Ltd. for the construction of a windfarm of 3 no. turbines (hub height not exceeding 85m, blade diameter not exceeding 80m), and all associated works. The Planning Authority refused permission for the proposed development on the 30th of October 2008.
- **Pl Ref. 10/130**: Planning application made by Gaelectric Developments Ltd. for the construction of a wind farm consisting of 2 no. wind turbines (hub height not exceeding 85m, blade diameter not exceeding 82.4m), and all associated works. The Planning Authority granted conditional permission on the 2nd of July 2010.
- **Pl Ref. 12/293**: Planning application made by Galetech Energy Developments Ltd. for the erection of 10 no. wind turbines each with a hub height of up to 110m and a rotor diameter of up to 120m, with an overall maximum tip height of up to 170m and all associated site development works. The Planning Authority granted conditional

permission where subsequently An Bord Pleanála refused permission on the 23rd of December 2013.

- **Pl Ref. 14/188**: Planning application made by Galetech Energy Developments Cloghan Ltd. for permission for a period of 10 years for the erection of 9 no. wind turbines each with a hub height of up to 100m, a typical rotor diameter of 103m (overall maximum tip height of up to 150m) and all associated site development works. The Planning Authority granted conditional permission with An Bord Pleanála granting conditional permission on the 27th of November 2016.
- **Pl Ref. 15/44**: Planning application made by Meenwaun Wind Farm Ltd. for a wind farm comprising up to 5 no. turbines with a maximum tip height of up to 169m and associated works The Planning Authority granted conditional permission on the 22nd of April 2015 with An Bord Pleanála granting conditional permission on the 21st of October 2015.
- **19/404** – Current Planning Application made by Galetech Energy Developments Cloghan Ltd. for amendments to the development permitted (above) (Pl Ref. 14/188) including an increase in overall turbine height from 150m to 169m, re-siting of turbines and realignment of access roads and electrical lines. This application is currently under the consideration of the Planning Authority (further information response submitted December 2019), at time of writing this application remains under the consideration of the Planning Authority.

2.5.5 County Tipperary

- **Pl Ref. 5123496**: Planning application made by T. and G Armitage for 3 no. wind turbines, service roadways and control house. The Planning Authority granted conditional permission on the 24th of June 2001.
- **Pl Ref. 5123495**: Planning application made by N. and R. Alexander for 5 no. wind turbines, service roadways and control house. The Planning Authority granted conditional permission on the 25th of May 2001. Figure 2.7 Other Wind Farms

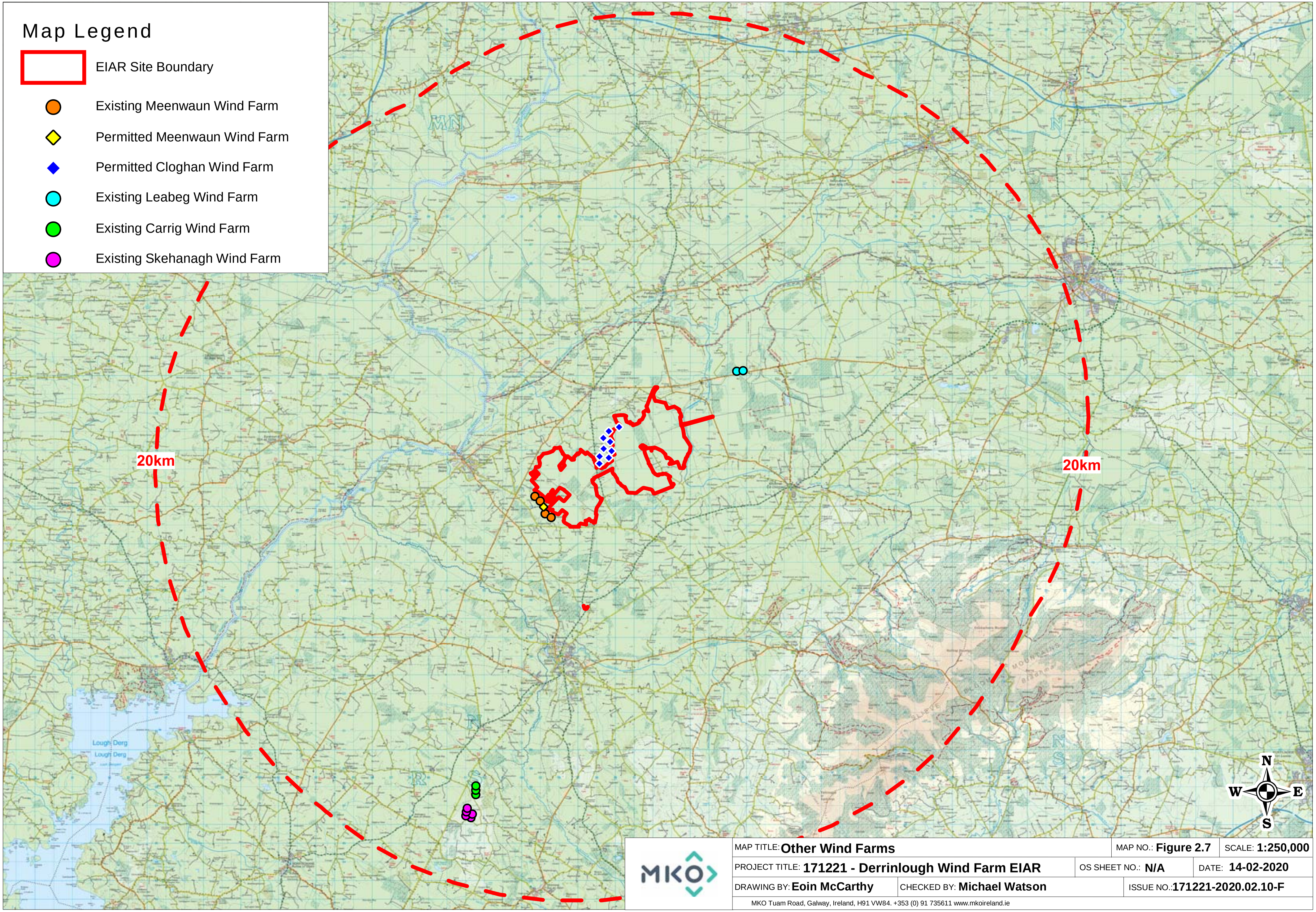
2.6 Scoping and Consultation

2.6.1 Scoping

Scoping is the process of determining the content, depth and extent of topics to be covered in the environmental information to be submitted to a competent authority for projects that are subject to an Environmental Impact Assessment (EIA). This process is conducted by contacting the relevant authorities and Non-Governmental Organisations (NGOs) with interest in the specific aspects of the environment with the potential to be affected by the proposal. These organisations are invited to submit comments on the scope of the EIAR and the specific standards of information they require. Comprehensive and timely scoping helps ensure that the EIAR refers to all relevant aspects of the proposed development and its potential effects on the environment and provides initial feedback in the early stages of the project, when alterations are still easily incorporated into the design. In this way scoping not only informs the content and scope of the EIAR, it also provides a feedback mechanism for the proposal design itself.

A scoping report, providing details of the application site and the proposed development, was prepared by MKO and circulated in June 2018. MKO requested the comments of the relevant personnel/bodies in their respective capacities as consultees with regards to the EIA process.

Once determined, the final proposed turbine layout was circulated to all consultees in November and December 2019. Mko, again, requested the comments of all consultees with regards to the assessment of the proposed turbine layout as part of the EIA process.



MAP TITLE: Other Wind Farms		MAP NO.: Figure 2.7	SCALE: 1:250,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR		OS SHEET NO.: N/A	DATE: 14-02-2020
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 171221-2020.02.10-F	

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2.6.2 Scoping Responses

Table 2.2 lists the consultees to which the scoping document and final turbine layout design was circulated. Copies of the scoping responses received as of 31st January 2020 are included in Appendix 2-1 of this EIAR. Table 2.3 presents a summary of the key points from the scoping responses and notes where they have been addressed in this EIAR (where applicable). The responses received were fully considered and issues raised where follow up through contact with the respondent where clarification was necessary and addressed throughout the EIAR.

Table 2.2 Scoping List of Consultees

No.	Consultee	Response Date
1	Airspeed	No response as of 31st January 2020
2	An Taisce	No response as of 31st January 2020
3	(BAI) Broadcasting Authority of Ireland	08.11.2019
4	Bat Conservation Ireland	No response as of 31st January 2020
5	BirdWatch Ireland	8.11.2019
6	BT Communications Ireland	14.06.2018
7	Commission for Communications Regulation	No response as of 31st January 2020
8	Commission for Regulation of Utilities Water and Energy	No response as of 31st January 2020
9	Department of Agriculture, Food and the Marine	23.07.2018
10	Department of Communications, Climate Action and the Environment	No response as of 31st January 2020
11	Department of Defence	17.12.019
12	Department of Transport, Tourism and Sport	No response as of 31st January 2020
13	Department of Culture, Heritage and the Gaeltacht	19.07.2018
14	Eir	02.07.2018; 17.12.2019
15	Eirgrid	No response as of 31st January 2020
16	EMR Integrated Solutions	13.03.2018
17	Environmental Protection Agency	No response as of 31st January 2020
18	ESB Telecoms	No response as of 31st January 2020
19	Fáilte Ireland	25.06.2018
20	Forest Service	No response as of 31st January 2020

21	Geological Survey of Ireland	27.11.2019
22	Health Service Executive	25.06.2018; 09.01.2020
23	Imagine Group	08.03.2018; 11.09.2019
24	Inland Fisheries Ireland	No response as of 31st January 2020
25	Irish Aviation Authority	25.06.2018
26	Irish Peatland Conservation Council	14.11.2019
27	Irish Red Grouse Association	No response as of 31st January 2020
28	Irish Raptor Study Group	No response as of 31st January 2020
29	Irish Sports Council	No response as of 31st January 2020
30	Irish Water	No response as of 31st January 2020
31	Irish Wildlife Trust	No response as of 31st January 2020
32	Office of Public Works	No response as of 31st January 2020
33	Offaly County Council – Planning Department	05.07.2018
34	Offaly County Council – Environment Department	05.07.2018
35	Offaly County Council – Roads Department	05.07.2018
36	Offaly County Council – Heritage Officer	05.07.2018
37	Ripplecom	No response as of 31st January 2020
38	2rn (RTÉ Transmission Network Ltd)	12.03.2018; 19.12.2019
39	Sustainable Energy Authority of Ireland	No response as of 31st January 2020
40	Tetra Ireland Communications Ltd.	13.11.2019
41	The Heritage Council	No response as of 31st January 2020
42	Three Ireland	17.04.2018; 11.112019
43	Towercom	20.03.18
44	Transport Infrastructure Ireland	18.12. 2019
45	Viatel Ireland Ltd.	09.03.2018
46	Virgin Ireland Ltd.	11.11.2019
47	Netshare (Formerly Vodafone)	12.06.2018
48	Waterways Ireland	No response as of 31st January 2020

Table 2.3 Review of Scoping Responses Received to date

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
1	Broadcasting Authority of Ireland (BAI)	"*Not aware of any issues*" Proposed Development *"is not close to existing or planned FM transmission sites."*	N/A	Chapter 14: Material Assets
2	BirdWatch Ireland (BWI)	Scoping letter received by BWI and forwarded on to Policy Officer.	N/A	N/A
3	BT Communications Ireland	"*the planned development will have no impact on the BT Ireland microwave radio network*"	N/A	Chapter 14: Material Assets
4	Department of Agriculture, Food and the Marine	Felling Licence required if tree felling will be undertaken	No felling will be undertaken	N/A
5	Department of Defence	Obstruction lights should be incandescent ore of a type visible to Night Vision Equipment. Obstruction lighting must emit light at the near Infra-Red range (specifically at or near 850nm wavelength). Light intensity to be that of or similar to visible spectrum.	Incorporated into development design	Chapter 14: Material Assets
6	Department of Culture, Heritage and the Gaeltacht	Archaeology Assessment to be carried out by a suitably qualified archaeologist and by licence provided by DCHG All previous surveys of the bog should be examined	Archaeology assessment undertaken as per DCHG recommendations	Chapter 13: Cultural Heritage and Archaeology

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
		A new survey of the bog should be undertaken including cleaning the drains and walking the bog Buffer zones to be implemented where necessary	Buffer zones implemented where necessary	
7	Eir (Formerly Meteor Ireland)	Four Microwave links need to be considered. Minimum separation distance to be greater than 30m horizontal separation.	Buffer zones implemented	Chapter 14: Material Assets
8	EMR Integrated Solutions	No links within 5km of the development site and are unaffected	N/A	Chapter 14: Material Assets
9	ESB Telecoms	1 Microwave link and multiple point to multi point links which could be impacted- buffer zones provided	Buffer zones implemented	Chapter 14: Material Assets
10	Fáilte Ireland	Consider Fáilte Ireland's Guidelines for the treatment of tourism in the EIAR.	Details included in relevant chapters	Chapter 5: Population and Human Health
11	Geological Survey Ireland	Derrinlough Mushroom Rock County Geological Site located within the development boundary- typically afforded county protection Consult GSI Map Viewer for locating Natural Mineral Resources on site and Aquifer and Recharge points	Derrinlough Mushroom Rock County Geological Site avoided in design GSI Map Viewer consulted Geohazards considered	Chapter 8: Land, Soils and Geology Chapter 9: Hydrology and Hydrogeology

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
		Geohazards to be taken into consideration		
12	Health Service Executive	Details of Public Consultation	Details included in relevant chapter	Chapter 2: Background of the Proposed Development
		Surface and ground water details	Details included in relevant chapter	Chapter 9: Hydrology and Hydrogeology
		Noise and Shadow Flicker	Assessed in relevant chapters	Chapter 5: Population and Human Health Chapter 11: Noise and Vibration Chapter 14: Material Assets
		Dust Minimisation Plan	Dust Minimisation Measures will be undertaken	Chapter 10 Air and Climate Appendix 4.3 Construction Environment Management Plan (CEMP)
		Cumulative Impacts	Assessed in relevant chapters	Chapters 5–14
		Potable water supply and sanitary accommodation details	Details included in relevant chapters	Chapter 4: Description of the Proposed Development Appendix 4.3 CEMP
		Proposals for Decommissioning	Details included in relevant report	Appendix 4.3 CEMP

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
13	Imagine Group	1 No. existing link close to the Development siteThis link is located approximately 200 metres from the nearest proposed turbine location. This was not highlighted as an issue by Imagine Group.		Chapter 14: Material Assets
14	Irish Aviation Authority	Agree an aeronautical obstacle warning light scheme Provide as constructed coordinates in WGS84 format and ground and tip height elevations for each turbine Notify the Authority of intention to commence crane operations within a minimum of 30 days prior of their erection	Incorporated into design	Chapter 14: Material Assets
15	Irish Peatland Conservation Council	Requested a Bord na Móna Rehabilitation Plan	Rehabilitation Plan undertaken	Appendix 6.8: Clongawny and Drinagh Rehabilitation Plans
16	2rn (RTÉ Transmission Network Ltd)	No impact upon fixed microwave links Moderate risk to DTT viewers south and east of the site. Protocol to be signed between 2rn and Developer	Protocol to be signed between 2rn and Developer prior to commsioning of the propoised development.	Chapter 14: Material Assets
17	Tetra Ireland Communications Ltd.	Anticipate no impact from the development at the proposed turbine locations	N/A	Chapter 14: Material Assets

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
18	Three Ireland	No objection to development, nearest link to the site will not be retained.	N/A	Chapter 14: Material Assets
19	Towercom	The proposed development does not appear have a significant impact on Towercom's sites.	N/A	Chapter 14: Material Assets
20	Transport Infrastructure Ireland	Avoid creating new access points onto a national road as its contra to policy Follow Spatial Planning and National Roads Guidelines in relation to road works, maintenance, cable laying, haul routes Consider Noise Impacts and how it will affect future action plans by the relevant authority. Noise barriers may need to be considered. Ensure consultations with LPAs are undertaken. Consider visual impact of the construction and operational period of the development on N62 and its users	National and County Development Plans and Policies considered Consultations with LPAs undertaken Visual impact on N62 considered	Chapter 14: Material Assets Chapter 11: Noise and Vibration Chapter 12: Landscape and Visual
21	Viatel Ireland Ltd.	Ensure blades are not in direct beam/centre line. Links will not be impacted from the proposed development	Blades are not in direct beam/centre line.	Chapter 14: Material Assets

No.	Consultee	Response	Action Required	Discussed within EIAR (where applicable)
22	Virgin Ireland Ltd.	No links within the area. To be updated if the site layout changes	N/A	Chapter 14: Material Assets
23	Netshare (Formerly Vodafone)	30m perpendicular buffer between turbine rotor edge and maximum diameter of the first Fresnel zone of the point to point microwave provided.	Buffer zone implemented	Chapter 14: Material Assets

2.6.3 Pre-Planning Meetings

2.6.3.1 Offaly County Council

Two pre-planning meetings were held with the Planning Department of Offaly County Council in relation to the proposed development prior to the submission of the planning application. The meetings were held on 29th of August 2018 and the 6th of March 2019. These meetings were attended by representatives of the Planning Department, MKO and Bord na Móna.

Items discussed at the meetings included an overview of the proposal, the site selection process, County Development Plan provisions, planning application approach (Strategic Infrastructure Development process), EIAR scoping, Public consultation, Wind farm design process, and Environmental Assessments and the progress of the project design.

2.6.3.2 SID Meeting

Pre-application consultations also took place with An Bord Pleanála as part of the Strategic Infrastructure Development process. This matter was considered by the Board under their reference ABP-303157-18. The consultation process commenced on the 3rd of December 2018 when the applicants requested to enter into pre-application consultations under the provisions of Section 37B of the Planning and Development Act, 2000 (as amended).

As part of this process a pre-application consultation meeting was held on the 12th of March 2019. Attendee's at the meeting included the applicant representatives, J. Green and M. Watson of MKO, A.M. O'Connor, P. Calleary, J. Hayes, and F. Kilmurray on behalf of An Bord Pleanála and S. Creedon and C. Carter on behalf of Bord na Móna. At this meeting the Board set out their relevant procedures, and the design team made a presentation setting out the location, nature and character of the proposed development. The discussions included consideration of the Development Plan policy, noting that some of the site lies outside of the area shown on the Wind Energy Strategy Map, the boards representatives stressed that robust justification should be provided in relation to areas which fall outside of the designated areas. This has been provided above. Other issues discussed included residential amenity, Visual Impact/Landscape, Access, Appropriate Assessment, EIAR, engagement with the National Parks and Wildlife Service, and the existing and upcoming Wind Energy Guidelines. In relation to the Draft Wind Energy Guidelines which were yet to be published at the time of the meeting the Board acknowledged that any new guidelines would be relevant when they were enacted (not issued in draft form). It was acknowledged by the Board that should any issue of potential conflict arise due to guidelines being finalised/enacted while the current proposal was under consideration that an opportunity would be provided to the applicant to provide clarification.

Following the meeting the Board issued a record of the proceedings and the applicants moved to close out the pre-application process. The Board by letter dated 25th November 2019 confirmed that the proposed development falls within the scope of paragraphs 37A(2)(a) and (b) of the Act. Accordingly, the Board have confirmed that the proposed development would be strategic infrastructure within the meaning of Section 37A of the Planning and Development Act, 2000 (as amended), and that any application for permission must therefore be made directly to the Board. A copy of this correspondence is included as Appendix 2.2.

2.6.4 Community Consultation

2.6.4.1 Public Consultation

Overview

Engagement with the public, adjacent residents and local public representatives took place in many forms during the project design and preparation of the EIAR, as follows:

- Two 'Community Information Sessions' were held in April 2018 and November 2018, respectively.
- Briefing Sessions for public representatives were held on two occasions, namely on the evening before each of the two 'Community Information Sessions'.
- A dedicated Community Liaison Officer (CLO) was appointed for the project in April 2018.
- Eight 'one to one' house visits were requested and facilitated by the project team during the period from April 2018 to November 2019.
- Approximately 40 queries received via email, post, phone and the CLO were responded to by the project team.

Summary information on all of the above is provided in the following sections. A detailed 'Community Report' is attached in Appendix 2.3.

Community Information Sessions

Community Information Session 1

The first Community Information Sessions were held between 24th and 26th April 2018, from 3 – 9 pm on each day. The sessions were held in the following venues:

- 24th April 2018: Saint Mary's Parish Hall, Cloghan;
- 25th April 2018: Drumcullen GAA Club, Rath; and
- 26th April 2018: Banagher Community Centre.

In advance of the sessions, approx. 600 households within 2 km of the proposed development site were visited by the Community Liaison Officer (CLO) to provide them with information. The information distributed to each household included a map of the proposed development site location and details of the Community Information Sessions.

Details of the Community Information Sessions were broadcast on local radio - Midlands 103 - three times daily from the 19th-24th April 2018 to inform the local community of the dates, times and venues of the sessions. In addition, adverts were placed in three local papers, namely the Offaly Independent, Offaly Express and Midland Tribune for two weeks prior to the sessions and an advertisement was also circulated to the Parish Priests for Banagher and Cloghan for inclusion in the weekly mass newsletter.

Over the three days approx. 100 people attended the sessions. A series of information panels were presented at the sessions which contained details on the following:

- Proposed Location of the Development;
- The Necessity of Wind Energy Development in the Context of National Policy;
- The Suitability of Bord na Móna Peatlands for Wind Energy;
- Criteria for Site Selection;
- Preferred Draft Approach to Wind Energy Development in Ireland;
- Strategic Infrastructure Development Planning Process;
- Environmental Impact Assessment Report;

- Visual Impact Assessment;
- Project Benefits;
- Complementary Uses of Cutaway Peatlands;
- Potential Wind Farm Recreational Facilities;
- Indicative Project Timeline; and
- Community Engagement.

In addition, attendees were provided with an A3 map of the location of the proposed development and an information booklet.

The main queries raised and recorded by the project team at the sessions, were:

1. Proximity to houses;
2. Community Gain Scheme;
3. Number of Turbines;
4. Near Neighbour Scheme;
5. Noise;
6. Height of turbines;
7. Visual Impact; and
8. Wind Farm Amenities.

Following the first round of Community Information Sessions, the CLO revisited all of the approx. 600 homes within the 2 km area and provided them with a copy of the A3 map and Information Booklet that was available at the sessions.

Community Information Session 2

The second Community Information Sessions were held between, 27th and 29th November 2018, from 3 – 9 pm each day. The sessions were held in the same three venues as the first sessions as follows:

- 27th November 2018: Saint Mary's Parish Hall, Cloghan;
- 28th November 2018: Drumcullen GAA Club, Rath; and
- 29th November 2018: Banagher Community Centre.

In advance of the sessions, the CLO circulated letters to all homes within 2 km of the proposed development site to inform them of the dates, times and venues of the Community Information Sessions.

Details of the Community Information Sessions were broadcast on local radio - Midlands 103 - three times daily on the 23rd, 24th, 25th and 26th of November 2018 to inform the local community of the dates, times and venues of the sessions. In addition, adverts were placed in two local papers, namely the Offaly Independent and Midland Tribune for one week prior to the sessions and an advertisement was also circulated to the Parish Priests for Banagher and Cloghan for inclusion in the weekly mass newsletter.

Over the three days approx. 100 people attended the sessions. A series of information panels were presented at the sessions which contained details on the following:

- Proposed Location of the Development;
- The Necessity of Wind Energy Development in the context of National Policy;
- Preferred Draft Approach to Wind Energy Development in Ireland;
- Site Layout Design;
- Proposed Development;
- Proposed Turbine locations;
- Setback Distance from Properties;
- Strategic Infrastructure Development Planning Process;
- Environmental Impact Assessment Report;

- Photomontages of the Proposed Development;
- Local Benefits of the Project; and
- Potential Wind Farm Recreational Facilities.

In addition, attendees were provided with an Information Brochure and an A2, double-sided map of the proposed development depicting the locations of the proposed turbines and distance bands to sensitive receptors out to 2 km to enable members of the community identify the proximity of the nearest turbine to their residential property.

The main queries raised and recorded by the project team at the sessions, were:

1. Near Neighbour Scheme;
2. Proximity of turbines to Houses;
3. Number of turbines;
4. Height of Turbines;
5. Wind Farm amenities;
6. Noise;
7. Visual Impact;
8. Community Gain Scheme; and
9. Roads/Local infrastructure.

Following the second round of Community Information Sessions, the CLO circulated a copy of the information brochure and map, that was available at the sessions, to all homes within 2 km of a proposed turbine.

Information Sessions for Public Representatives

In advance of both 'Community Information Sessions' Bord na Móna Powergen Ltd. held briefing sessions for Offaly County Councillors for the Municipal District of Birr.

Councillors were invited by way of written communication to the briefing sessions which were held on 23rd April and 26th November 2018, respectively in the County Arms Hotel in Birr.

The purpose of the first briefing session was to inform them about the proposed development. The second briefing session presented more information on the proposed development, namely the turbine layout design. Further, in November 2019, by way of written communication, Councillors for the Municipal District of Birr were issued a copy of the revised layout for the proposed development.

In addition, all TDs representing the Dáil Éireann Constituency of Offaly were issued a briefing note in April 2018, November 2018 and November 2019 on the proposed development.

Community Liaison Officer

A dedicated Community Liaison Officer (CLO) was appointed for the project in April 2018. The CLO was a direct contact between the project team and the local community/interested parties, providing information on the project as required and facilitating one-on one house visits as required.

In addition, as part of their duties the CLO carried out door to door visits to homes (as outlined above) providing information as follows:

- A letter of invitation to the first Community Information Session - April 2018.
- Location Map and Information Brochure (as presented at the Community Information Session) – May 2018.
- A letter of invitation to the second Community Information Session – November 2018.
- Location Map and Information Brochure (as presented at the Community Information Session) – January 2019.
- Revised Turbine Layout and Infrastructure Layout – November 2019.

Influence of Public Consultation on the Proposed Development

Number of turbines/Setback distance

Following the second series of Community Information Sessions in November 2018, the draft layout of the proposed development was revised from 28 to 24 turbines. This decrease in the number of turbines arose from a combination of factors, including feedback from the project team on site investigations and baseline assessments in addition to feedback received at the Community Information Sessions.

At the second Community Information Session, the project team received feedback that a number of sensitive receptors did not appear to be included on the sensitive receptor database. This was investigated by the project team after the consultation event and it transpired that during the initial design phase these properties had been identified as uninhabited dwellings given their location and relative inaccessibility from the local road. Following a site visit by the Community Liaison Officer/Stakeholder Manager, accompanied by the property owners it was determined that the buildings, should be included on the sensitive receptor database. Following this decision, a full review of all buildings within 2 km of the proposed development was conducted to ensure that all sensitive receptors were included on the database for the final turbine layout design.

As discussed in Chapter 3 (Section 3.3.5) following the lodgement of a planning application for proposed amendments to Cloghan Wind Farm in August 2019 the layout was further revised to a 21-turbine layout as the proposed amendments (which comprised an increase in turbine tip height and the micro-siting of 6 No. turbines) impacted on turbine location in an upwind and downwind direction.

Amenity Pathways and Carparks

During both the first and second Community Information Sessions members of the local community expressed an interest in having amenity access to the proposed development site once the wind farm was operational. Consequently, approximately 20km of the internal road network will be opened up to the public once the wind farm becomes operational.

A number of local residents and local community groups expressed a desire for a connection between any proposed amenity pathways provided as part of the proposed development and Lough Boora Parklands. On this basis, the proposed development will include a link eastwards from Drinagh to the eastern extent of Derrybrat bog (where it meets the R437). This will facilitate potential future connectivity to Lough Boora Parklands.

Further, three additional amenity links will be provided, two to access points from the adjacent road network namely the R438 in West Clongawny and the L7005 in Drinagh and a link to provide potential future connectivity to the proposed Whigsborough Amenity Walk in south-west Drinagh.

2.7 Cumulative Impact Assessment

The EIA Directive and associated guidance documents state that as well as considering any indirect, secondary, transboundary, short-, medium-, and long-term, permanent and temporary, positive and negative effects of the project (all of which are considered in the various chapters of this EIAR), the description of likely significant effects should include an assessment of cumulative impacts that may arise. The factors to be considered in relation to cumulative effects include population and human health, biodiversity, land, soil, water, air, climate, material assets, landscape, and cultural heritage as well as the interactions between these factors.

2.7.1 Methodology for the Cumulative Assessment of Projects

To gather a comprehensive view of cumulative impacts on the above environmental considerations and to inform the EIA process being undertaken by the consenting authority, each relevant chapter within the EIAR addresses the potential for cumulative effects to arise.

The potential cumulative impact of the proposed development (which includes the proposed means of grid connection) and other relevant developments has been carried out with the purpose of identifying what likely significant effect the proposed development will have on the surrounding environment when considered cumulatively and in combination with relevant permitted, proposed and constructed projects in the vicinity of the proposed site.

The cumulative impact assessment of projects has three principle aims:

- To establish the range and nature of existing projects within the cumulative impact study area of the proposed development.
- To summarise the relevant projects which have a potential to create cumulative impacts.
- To identify the projects that hold the potential for cumulative interaction within the context of the proposed development and discard projects that will neither directly or indirectly contribute to cumulative impacts.

Assessment material for this cumulative impact assessment was compiled on the relevant developments within the vicinity of the proposed development. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIAR documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental impacts.

2.7.2 Projects Considered in Cumulative Assessment

The projects considered in relation to the potential for cumulative impacts arising from construction, operational and decommissioning phases of the proposed development and for which all relevant data was reviewed include those listed below.

Peat Extraction/Peat Briquette Manufacturing

Peat harvesting and Peat Briquette manufacturing is projected to continue in the wider area however peat harvesting has ceased currently within the study area.

Forestry

The proposed development site is partially used for commercial forestry. This land-use will continue in conjunction with the proposed wind farm. The potential for cumulative effects during the construction, operational and decommissioning phases of the proposed wind farm have therefore been assessed.

Other Wind Turbines

There is a number of wind farms located within a 20-kilometre radius of the proposed development site, as identified previously in this Chapter. Any cumulative affects arising are considered in the relevant chapters of this EIAR.

Other Developments/Landuses

The review of the Offaly County Council planning register documents relevant general development planning applications in the vicinity of the proposed site of the wind farm and all its associated works, most of which relate to the provision and/or alteration of one-off rural housing and agriculture-related structures, as described previously above. These applications (which include those listed previously above in Section 2.6) have also been taken account in describing the baseline environment and in the relevant assessments.

Furthermore, the cumulative impact assessments carried out in each of the subsequent chapters of this EIAR consider all potential significant cumulative effects arising from all land uses in the vicinity of the proposed development. These include ongoing agricultural practices, and drainage/maintenance works/programmes. Overall the proposed development has been designed to mitigate impacts on the environment and particularly water, and a suite of mitigation measures is set out within the EIAR. The mitigation measures set out in this EIAR have been developed to ensure that significant cumulative affects do not arise during construction, operational or decommissioning phases of the proposed development. Additional detail in relation to the potential significant cumulative effects arising and, where appropriate, the specific suite of relevant mitigation measures proposed are set out within each of the relevant chapters of this EIAR.

3. CONSIDERATION OF REASONABLE ALTERNATIVES

3.1 Introduction

Article IV of the EIA Directive as amended by Directive 2014/52/EU states that the information provided in an Environmental Impact Assessment Report (EIAR) should include a description of the reasonable alternatives studied by the developer which are relevant to the project and its specific characteristics and an indication of the main reasons for the option chosen, taking into account the environmental effects. The consideration of alternatives typically refers to alternative design, technology, location, size and scale.

This section of the EIAR contains a description of the reasonable alternatives that were considered for the proposed wind farm development in terms of site selection, other land-use options for the site as well as site layout and transport route options to the site. This section also outlines the design considerations in relation to the wind farm, including the associated substation, construction compound and borrow pits and indicates the main reasons for selecting the chosen option with regards to its environmental impacts.

The consideration of alternatives is an effective means of avoiding environmental impacts. As set out in the '*Draft Guidelines on The Information to be Contained in Environmental Impact Assessment Reports' (Environmental Protection Agency, 2017),* the presentation and consideration of reasonable alternatives investigated is an important part of the overall EIA process.

It is important to acknowledge that although the consideration of alternatives is an effective means of avoiding environmental impacts, there are the existence of difficulties and limitations when considering alternatives. These include hierarchy, non-environmental factors and site-specific issues as outlined below.

Hierarchy

EIA is concerned with projects. The Environmental Protection Agency's draft guidelines (EPA, 2017) state that in some instances neither the applicant nor the competent authority can be realistically expected to examine options that have already been previously determined by a higher authority, such as a national plan or regional programme for infrastructure which are examined by means of a Strategic Environmental Assessment (SEA), the higher tier form of environmental assessment.

Non-environmental Factors

EIA is confined to the potential significant environmental effects that influence consideration of alternatives. However, other non-environmental factors may have equal or overriding importance to the developer of a project, for example project economics, land availability, engineering feasibility or planning considerations.

Site-specific Issues

The EPA guidelines state that the consideration of alternatives also needs to be set within the parameters of the availability of the land, i.e. the site may be the only suitable land available to the developer, or the need for the project to accommodate demands or opportunities that are site-specific. Such considerations should be on the basis of alternatives within a site, for example design and layout.

3.2 Methodology

The EU Guidance Document (EU, 2017) on the preparation of EIAR outlines the requirements of the EIA Directive and states that, in order to address the assessment of reasonable alternatives, the Developer needs to provide the following:

- A description of the reasonable alternatives studied; and
- An indication of the main reasons for selecting the chosen option with regards to their environmental impacts.

There is limited European and National guidance on what constitutes a 'reasonable alternative' however the EU Guidance Document (EU, 2017) states that reasonable alternatives "*must be relevant to the proposed project and its specific characteristics, and resources should only be spent assessing these alternatives*".

The guidance also acknowledges that "*the selection of alternatives is limited in terms of feasibility. On the one hand, an alternative should not be ruled out simply because it would cause inconvenience or cost to the Developer. At the same time, if an alternative is very expensive or technically or legally difficult, it would be unreasonable to consider it to be a feasible alternative*".

The current Draft EPA Guidelines (EPA, 2017) state that "*It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account is deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required.*"

Consequently, taking consideration of the legislative and guidance requirements into account, this chapter addresses alternatives under the following headings:

- 'Do Nothing' Alternative;
- Alternative Locations;
- Alternative Layouts;
- Alternative Designs; and
- Alternative Mitigation Measures.

Each of these is addressed in the following sections.

When considering a wind farm development, given the intrinsic link between layout and design, the two will be considered together in this chapter.

3.3 Consideration of Alternatives

3.3.1 'Do-Nothing' Option

Article IV, Part 3 of the EIA Directive states that the description of reasonable alternatives studied by the developer should include "an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge." This is referred to as the "do nothing" alternative. EU guidance (EU, 2017) states that this should involve the assessment of "an outline of what is likely to happen to the environment should the Project not be implemented – the so-called 'do-nothing' scenario."

An alternative land-use option to the development of a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to existing land-use practices. If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

In implementing the 'Do-Nothing' alternative, however, the opportunity to capture a significant part of County Offaly's renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, a development contribution, rates and investment would also be lost. Also, the proposed amenity access points and associated carpark would not be constructed as part of the rehabilitation and therefore this recreational opportunity would be lost as well as the potential connectivity with Lough Boora Parklands. On the basis of the positive environmental effects arising from the project, the do–nothing scenario was not the chosen option.

3.3.2 Alternative Locations

Bord na Móna owns circa 80,000 hectares of land, primarily in the midlands of Ireland. An assessment of potential future uses of this landbank was published by Bord na Móna in 2011 in a document entitled 'Strategic Framework for the Future Use of Peatlands'. This report clearly identified the potential for the development of renewable energy (in particular Wind Energy) and other developments on Bord na Móna lands.

The Project Ireland 2040 National Planning Framework identifies a range of Key future planning and development and place-making policy priorities for the Eastern and Midland Region that includes:

> *"Harnessing the potential of the region in renewable energy terms across the technological spectrum from wind and solar to biomass and, where applicable, wave energy, focusing in particular on the extensive tracts of publicly owned peat extraction areas in order to enable a managed transition of the local economies of such areas in gaining the economic benefits of greener energy."*

Consequently, when considering suitable locations for the proposed development, the assessment was confined to lands within the Bord na Móna landholding only as these lands have been identified in a national and regional context as being suitable for this type of development. An examination of sites outside of the landholding was not included as part of the process.

The assessment carried out for the determination of a suitable location for the proposed development was a two-stage process. The first stage comprised the identification of a number of candidate sites while the second phase comprised a site-specific assessment. Each of these stages are described in the following sections.

3.3.2.1 Selection of Candidate Sites

In order to identify candidate sites i.e. sites considered suitable for wind energy development, Bord na Móna conducted a technical review of lands which are either cut away or will be cut away before 2030. This involved desk studies and on-site surveys of the landbank. Known constraints were then applied across the landbank. The constraints applied were derived from various industry and regulatory guidelines, available Geographical Information Systems (GIS) datasets and on-site surveys (carried out as part of the peat extraction activity), and included the following:

- Planning Policy Context;
- Proximity to Sensitive Receptors;
- Peat Depths;
- Consistent suitable wind speeds;
- Proximity to the national electricity grid; and
- Proximity to Designated sites/Environmental Sensitivities.

This methodology was used to generate a list of potential sites for further consideration. Fifteen sites were identified as having a higher potential for wind energy development and were then brought forward for the site-specific assessment, as detailed overleaf.

A review of the Offer Process Application Information that is provided on the publicly available EirGrid website indicates a total of 18 Bord na Móna sites that were in the application process for grid connection under the Gate 3 mechanism. These sites are outlined in Table 3.1 below:

Table 3.1: Bord na Móna Grid Connection Applications (January 2016)

Bord na Móna Grid Connection Applications (Gate 3)	
Derryadd Note 1	Clorhane 1
Derryarogue Note 1	Clorhane 2
Clongawny	Coolnamona
Drinagh	Leamonoghan
Littleton	Derryarkin
Ballydermot 1	Garryhinch
Ballydermot 2	Timahoe 1 Note 1
Ballydermot 3	Timahoe 2
Lisclogher	Ballybeg

Note 1: At the time of the assessment the Derryadd and Derryarogue sites and the Timahoe 1 site had already been selected for development, Derryadd Wind Farm and Timahoe North Solar Farm, respectively. Therefore, these sites were not considered as part of the assessment for the proposed development.

3.3.2.2 Site Specific Assessments

The site-specific assessments were conducted by the Bord na Móna Powergen wind energy development team with input from other in-house experts where required e.g. the Bord na Móna Works Management, Central Engineering, Construction, Ecology and Land and Property teams. The aim of the site-specific assessments was to gauge the sites with the best potential to deliver a successful wind farm project by the early to mid-part of the next decade, i.e. 2020 - 2025. The ultimate end goal was to select a project to bring forward, for which preliminary engineering designs and a planning application could be prepared.

The site-specific assessment of the candidate sites was guided by the 2013 '*Methodology for Local Authority Renewable Energy Strategies*' report from the Sustainable Energy Authority of Ireland (SEAI). For the site-specific assessment of candidate sites, a number of criteria were chosen which not only covered the broad range of issues which can arise in wind farm development but also allowed for direct comparison of the candidate sites to each other to determine their relative suitability for wind farm development.

The site-specific selection criteria and an outline of the basis for assessment for each criterion are listed in Table 3.2. The criteria can be regarded as either a constraint to the proposed development or a facilitator for the proposed development. For example, the level of flooding at the site may reduce the available 'buildable 'area or the lack of flooding may highlight the suitability of the site. The environmental effect of significant flooding may arise due to a requirement for deeper and more extensive drainage leading to potential downstream surface water impacts. In the case of Bord na Móna lands the existing onsite drainage is a facilitator to the project as surface water is already managed in accordance with the EPA administrated IPC licence.

Following selection of the criteria an assessment of each site was carried out under each criterion. Greater emphasis was given to key criteria such as environmental sensitivity, grid access/capacity, County Development Plans/zoning and proximity to houses. Following the assessment, the most suitable site (within the short list of suitable sites) was selected for the proposed wind energy development.

3.3.2.3 Site Selection Results

The findings of the site-specific assessment process, which included a comparison of the site selection criteria and potential environmental effects is provided in Table 3.3.

Of these sites, Derrinlough (Clongawny/Drinagh) was selected as a site with low potential for environmental effects similar to a number of the other sites on the list that met the relevant criteria. Due to the close proximity of potential grid connection (and resulting environmental and project viability benefits), it was deemed that Derrinlough should be progressed for detailed assessment and planning consideration.

It is noteworthy that the process described in the preceding paragraphs is not a one-off assessment of the entire Bord na Móna landholding in terms of its suitability for renewable energy developments. The site selection process is revisited in its entirety for each individual project and the criteria updated to suit the technology type proposed and to take account of any changes that have occurred (i.e. policy, legislative, environmental etc.) since the previous site selection process was conducted.

Table 3.2: Site-specific Selection Criteria and Basis for Assessment

Criterion	Basis for Assessment	Potential Environmental Effect
Grid Access/ Capacity	Grid Access/Capacity means potential of the National Grid to accommodate future projects on the network. The proximity of the project to suitable grid nodes (i.e. those with spare capacity) should facilitate the selection of a project for a viable grid connection offer.	**Direct:** Land, Soil and Geology, Hydrology and Hydrogeology, Biodiversity. **Indirect:** Noise and Vibration, Population and Human Health.
Wind Resource Assessment	The available wind resource (i.e. wind speed) directly translates into how much electrical output is available from the site.	**Direct:** Air Quality and Climate. **Indirect:** Air Quality and Climate.
County Development Plans (CDP) and Zoning	County Development Plans typically indicate the areas of a county which are deemed preferred, open to consideration and not suitable for wind farm development.	**Direct:** Landscape and Visual, Cultural Heritage, Biodiversity.
Proximity to Houses	Proximity to houses refers to how close the wind turbines are to residences.	**Direct:** Population and Human Health, Noise and Vibration, Shadow Flicker. **Indirect:** Landscape and Visual.
Environmental Sensitivity	Environmental Sensitivity is the ecological sensitivity of the site based on proximity to sensitive areas within or around the site.	**Direct:** Biodiversity. **Indirect:** Hydrology and Hydrogeology.
Landscape Capacity/ Cumulative Impact	This refers to the landscape's capacity to absorb wind farm developments.	**Direct:** Landscape and Visual. **Indirect:** Cultural Heritage.
Aviation	Airspace control and use to be considered. For the assessment, the criterion examines proximity of the site to local and regional airports (including Casement Aerodrome),	**Direct:** Telecommunications, Aviation and Electromagnetic Frequency.

Criterion	Basis for Assessment	Potential Environmental Effect
	proximity to National Motorway network, parachute zone, Military Operating Areas etc.	
Land Use	Internal Bord na Móna consideration relating to the residual peat depth on-site, peat harvesting plans and alternative uses for each bog.	**Direct:** Cultural Heritage, Land, Soils and Geology, Hydrology and Hydrogeology, Biodiversity.
Communications Infrastructure	Telecoms masts and signals in the vicinity and across the sites to be considered.	**Direct:** Telecommunications, Aviation and Electromagnetic Frequency.
Flood Plain Analysis	Flood Plain Analysis assesses the wind farm's location in terms of historical flooding data. It also considers if the site is pumped or gravity drained.	**Direct:** Hydrology and Hydrogeology. **Indirect:** Traffic and Transportation.
Supporting Infrastructure	Proximity to national and regional road network Sites with better road access require less modifications or upgrade to the local infrastructure to facilitate construction or delivery of turbine components to site.	**Direct:** Traffic and Transportation. **Indirect:** Noise and Vibration, Air Quality and Climate.

Table 3.3: Site-specific Selection Criteria and associated potential effects

Candidate Sites	Grid Access/ Capacity	Wind Resource Assessment	CDP and Zoning	Proximity to Houses	Environmental Sensitivity	Landscape Capacity/ Cumulative Impact	Aviation	Land Use	Communications Infrastructure	Flood Plain Analysis	Supporting Infrastructure
Proposed Derrinlough Wind Farm Site (Clongawny and Drinagh Bogs)	Site is in close proximity to existing grid infrastructure with available grid capacity. A number of 110kV lines run close to the site.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Partially within an area open for consideration	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas within the site, significant number of Natura sites in the wider area, mixture of low, medium and high value habitat within the site (large wetland in Drinagh East)	There are five windfarm sites (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports as well as the main motorway network.	Significant areas (>75%) of the site have low levels of peat. There is a low level of commercial forestry at the site and also a large area of biodiversity.	There is a mast on adjacent lands.	The site is pumped. It has no recognised flood point in the local area.	The site has direct access to the N62 and R357.
Littleton	110 kV network runs to the west of the site but there is a lack of available capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	In an area, open for consideration	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas within the site, Low to medium number of Natura sites in the wider area, mixture of low, medium and high value habitat within the site	There are nine windfarm sites (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports. It is located in proximity to the main motorway network.	Significant areas (>75%) of the site have low levels of peat. There is a low level of commercial forestry at the site.	There are a number of masts on the mountains to the east	The site is pumped. It has no recognised flood point in the local area.	The site has restricted access to the regional roads but is on close proximity to the M8.
Ballydermot 1,2,3	110kV network runs to the west and south of Ballydermot bog. Potential available capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Offaly section in area open for consideration, Kildare sections in medium risk areas	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas within the site, low level of Natura sites in the vicinity, mixture of low, medium and high value habitats within the site	There are four windfarm sites (either constructed or consented) within 20km of the site.	The eastern part of the site is in relatively close proximity to Casement Aerodrome.	Significant areas (>75%) of the site have low levels of peat. There is a low level of commercial forestry at the site.	There are a maximum of 5 links crossing the site.	The site is pumped. It has no recognised flood point in the local area.	The site has limited access to the regional and national road network.
Lisclogher (Ballivor)	110kV network runs through centre of Ballivor bog group. Potential available capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Site within High risk area (Landscape) County Development specifies cutaway peatland for this type of development	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas within the site, low level of Natura sites in the vicinity, mixture of low, medium and high value habitats within the site (excluding Lisclogher west)	There is one windfarm site (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports as well as the main motorway network.	Significant areas (>75%) of the site have low levels of peat. There are some areas dedicated to Biodiversity on the site.	There are 7 links that pass through the site that include a main regional telecoms link.	The site is not pumped. It has no recognised flood point in the local area	The site has access to the R159 regional road.

Candidate Sites	Grid Access/ Capacity	Wind Resource Assessment	CDP and Zoning	Proximity to Houses	Environmental Sensitivity	Landscape Capacity/ Cumulative Impact	Aviation	Land Use	Communications Infrastructure	Flood Plain Analysis	Supporting Infrastructure
Clorhane 1,2 (Blackwater)	Site is in close proximity to existing grid infrastructure at Shannonbridge with good available grid capacity. A number of 110kV lines run close to the site.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Partially in preferred area, partially within buffered area from Clonmacnoise	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas within the site, high density of Natura sites in the local area, close proximity to the River Shannon, large areas of high value habitat within the site.	There are three windfarm sites (either constructed or consented) within 20km of the site. This site is also located near Clonmacnoise.	The site is at a significant distance from local and regional airports as well as the main motorway network.	Significant areas (>75%) of the site have low levels of peat. There is a low level of commercial forestry at the site and also some areas of biodiversity.	There are a number of masts located in Shannonbridge.	The site is pumped. It has 7 recognised flood points in the local area.	The site has access to the R357 and R444 regional roads.
Coolnamona	110kV network runs to the north of Coolnamona bog but there is poor available capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Completely within preferred area	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura sites within the site, medium level of Natura sites in the wider area (reasonable proximity to Slieve Bloom SPA). Mainly low with some medium value habitat within the site.	There are two windfarm sites (consented) within 20km of the site.	The site is at a significant distance from local and regional airports. It is located in close proximity to the M7.	Large areas of the site have medium to high levels of peat. There are no other significant uses at the site.	There are two masts adjacent to the site.	The site is not pumped It has no recognised flood point in the local area	The site has access to the regional road R445 and is adjacent to the M7.
Leamonoghan	Site is within reasonable proximity to existing grid infrastructure at Shannonbridge with good available grid capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Mainly within area open for consideration	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas in the site, low number of Natura sites in the wider area, Mainly low value habitat on the site	There are three windfarm sites (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports as well as the main motorway network.	A significant portion of the site has medium levels of peat. There are no other significant uses at the site.	There is a mast at Corr Hill with potential links through the site.	The site is pumped. It has 3 recognised flood points in the local area.	The site has direct access to the N62
Derryarkin	Site is within reasonable proximity to existing 110 kV grid infrastructure with potential available grid capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Within High risk for Westmeath, low risk area for Offaly.	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas in the site, low to medium number of Natura sites in the wider area, Mixture of low, moderate and high value habitat on the site	There are four windfarm sites (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports. It is located in close proximity to the M6.	Significant areas (>75%) of the site have low levels of peat. There is a low level of commercial forestry at the site and also some areas of quarrying.	There is a mast in Derrygreenagh works with 5 identified links through the site.	The site is not pumped. It has no recognised flood point in the local area	The site has access to the R400 and is adjacent to the M6.
Garryhinch	Site is within reasonable proximity to existing 110 kV grid infrastructure	The Irish Wind Atlas outlines that wind speeds in midlands bog	Within area open for consideration	This criterion is neutral with respect to the outlined environmental effects	No Natura areas in the site, low number of Natura sites in the wider area, Mixture of	There are three wind farm sites (constructed) within 20km of the site.	The site is at a significant distance from local and	Significant areas (>75%) of the site have low levels of peat. There are no	There is a major telecoms hub on the Sliabh Blooms and two masts adjacent to	The site is pumped. It has no recognised	The site has limited access to the regional and

Candidate Sites	Grid Access/ Capacity	Wind Resource Assessment	CDP and Zoning	Proximity to Houses	Environmental Sensitivity	Landscape Capacity/ Cumulative Impact	Aviation	Land Use	Communications Infrastructure	Flood Plain Analysis	Supporting Infrastructure
	with potential available grid capacity.	groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.		as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	low to moderate value habitat on the site		regional airports as well as the main motorway network	other significant uses at the site.	the site with multiple links.	flood point in the local area.	national road network.
Timahoe 2 (Timahoe South)	110kV network runs to the north of Timahoe South bog (i.e. through Timahoe North bog) with potential available capacity	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	In medium risk area	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura areas in the site, low number of Natura sites in the wider area, Mixture of low, moderate and high value habitat on the site	There are two wind farm sites (either constructed or consented) within 20km of the site.	This site is also close to Casement Aerodrome. It is located proximate to the M4.	Large areas of the site have low levels of peat. The site is also used for waste processing and as an engineered landfill.	There are some links on the northern boundary.	The site is pumped. It has no recognised flood point in the local area.	The site has direct access to the R415
Ballybeg	110 kV grid infrastructure runs to south of Ballybeg with potential available grid capacity.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups is typically between 7 – 8 m/s. Therefore, this criterion is neutral across all sites.	Partially in preferred, partially with scenic buffer zone (Croghan Hill)	This criterion is neutral with respect to the outlined environmental effects as BnM wind farms are generally designed for turbine setback distance of 750m or greater.	No Natura sites within the boundary, Low number of Natura sites in the wider area, mixture of low and high value habitats within the site.	There are four wind farm sites (either constructed or consented) within 20km of the site.	The site is at a significant distance from local and regional airports. It is located in relative proximity to the M6.	Significant areas (>75%) of the site have low levels of peat. There are no other significant uses at the site.	It has 5 links that cross the site.	The site is pumped. It has no recognised flood point in the local area.	The site has access to the R400.

3.3.3 Alternative Renewable Electricity Technologies

Alternative sources of renewable electricity generation considered for this site, given its scale, is solar energy. To achieve the same energy output from solar energy, the site would require a significantly larger development footprint. In addition, a solar development would have a higher potential environmental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity (habitat loss) at the site. Chapter 2 of this EIAR also sets out the need and benefits of the proposed development. For this reason, wind energy is considered the most suitable renewable electricity generation option for the site.

3.3.4 Alternative Turbine Numbers and Model

The proposed wind turbines will have a potential power output in the 3-5 megawatt (MW) range. It is proposed to install 21 turbines at the site which could achieve approximately 88.2 MW output. Such a wind farm could also be achieved on the proposed site by using smaller turbines (for example 2.5 MW machines). However, this would necessitate the installation of over 35 turbines to achieve a similar output. Furthermore, the use of smaller turbines would not make efficient use of the wind resource available having regard to the nature of the site. A larger number of smaller turbines would result in the wind farm occupying a greater footprint within the site, with a larger amount of supporting infrastructure being required (i.e. roads etc.) and increasing the potential for negative environmental impacts to occur on biodiversity, hydrology and traffic and transportation. The proposed number of turbines takes account of all site constraints and the distances to be maintained between turbines and features such as roads and houses, while maximising the wind energy potential of the site. The 21-turbine layout selected for the site has the smallest development footprint of the other alternatives considered, while still achieving the optimum output at a more consistent level than would be achievable using different turbines.

The turbine model to be installed on the site will be the subject of a competitive tendering process. The maximum height of the turbines that will be selected for construction on the site will not exceed 185 metres when measured from top of foundation level to blade tip. For the purposes of this EIAR a range of turbines within this size envelope has been assessed (e.g. tallest turbine within defined range has been assessed for visual impact, widest rotor diameter within the defined range has been assessed for shadow flicker etc.). The EIAR therefore provides a robust assessment of the turbines that could be considered within the overall development description. The use of alternative smaller turbines at this site would not be appropriate as they would fail to make the most efficient use of the wind resource passing over the site. Furthermore, the increased use of materials, excavation and movement of peat and increase in visual impact associated with a larger number of smaller turbines would result in a higher level of negative environmental effects than the chosen option.

3.3.5 Alternative Turbine Layout and Design

The design of the proposed development has been an informed and collaborative process from the outset, involving the designers, developers, engineers, landowners, environmental, hydrological and geotechnical, archaeological specialists and traffic consultants.

Throughout the preparation of the EIAR, the layout of the proposed development has been revised and refined to take account of the findings of all site investigations and baseline assessments, which have brought the design from its first initial layout to the current proposed layout. The design process has also taken account of the recommendations and comments of the relevant statutory and non-statutory organisations, the local community and local authorities as detailed in Section 2.5 of Chapter 2.

3.3.5.1 Constraints Mapping

The design and layout of the proposed wind energy development follows the recommendations and guidelines set out in the *'Wind Energy Development Guidelines'* (Department of the Environment, Heritage and Local Government (DoEHLG), 2006) and the *'Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2008). The '*Wind Energy Development Guidelines'* (DoEHLG, 2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the document *'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review'* (2013), the '*Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach'* (June 2017), and the Draft Revised Wind Energy Development Guidelines, December 2019.

The constraints mapping process involves the placing of buffers around different types of constraints so as to identify clearly the areas within which no development works will take place. The size of the buffer zone for each constraint has been assigned using a combination of desktop assessments, baseline information and guidance presented in the 'Wind Energy Development Guidelines' (DoEHLG, 2006). As it is considered likely that that the new guidelines will be adopted during the application process timeframe, current proposed changes have been incorporated into the design.

The constraints map for the site, as shown in Figure3.1, encompasses the following constraints and associated buffers:

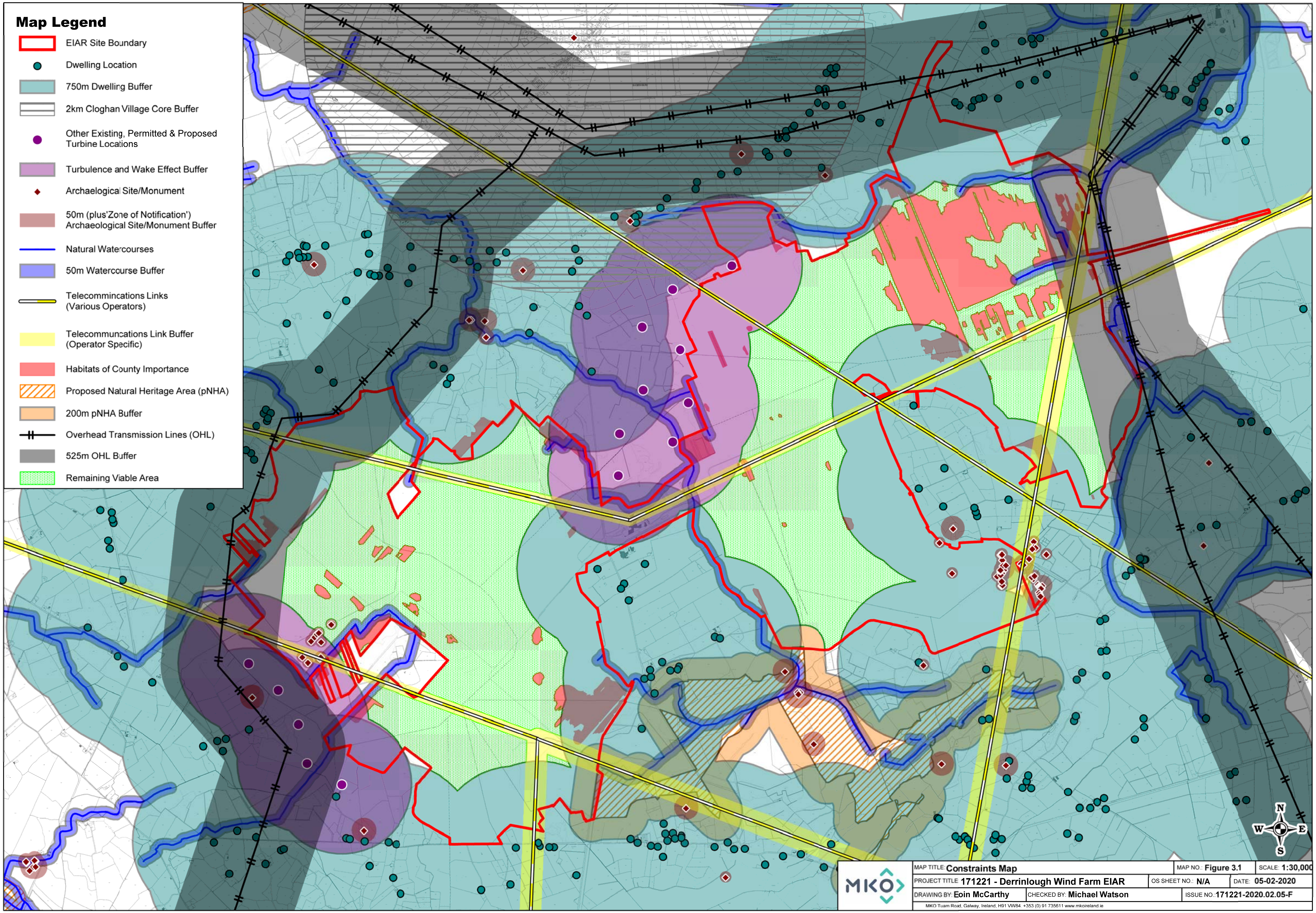
- Residential dwellings plus a minimum 750-metre buffer (exceeding the proposed requirement for a 4 times tip height separation distance from the curtilage of properties in line with the new draft guidelines);
- 2km setback from Cloghan Village Core as per the Offaly County Development Plan;
- Natura 2000 and Designated sites plus 200-metre buffer;
- Habitats of County Importance (see Chapter 6: Biodiversity);
- Telecommunication Links plus operator specific buffer;
- Overhead transmission lines plus 3.5 times proposed rotor diameter buffer (as required by EirGrid);
- Design distances from adjacent wind farms (constructed and consented) to take account of turbulence and wake effects in accordance with relevant guidance requirements.
- Watercourses plus 50-metre buffer; and
- Archaeological Sites or Monuments, 50-metre buffer, plus 'Zone of Notification' as required by the National Monuments Service (ROI).

Facilitators at the site build on the existing advantages and include the following:

- Lands are available for development;
- No Natura 2000 or Designated sites located within the proposed development site;
- Proximity to existing 110kV transmission lines for grid connection;
- Absence of recognised flood points on site; and
- Accessibility of site via National/Regional Roads;
- Existing site access points/entrances.

The inclusion of the constraints on a map of the study area allows for a viable area to be identified. An initial turbine layout is then developed to take account of all the constraints mentioned above and their associated buffer zones and the separation distance required between the turbines.

Following the mapping of all known constraints, detailed site investigations were carried out. These investigations included habitat mapping and ecological surveying of the site and also hydrological and geotechnical investigations of the site of the proposed development.



Map Legend
EIAR Site Boundary
Dwelling Location
750m Dwelling Buffer
2km Cloghan Village Core Buffer
Other Existing, Permitted & Proposed Turbine Locations
Turbulence and Wake Effect Buffer
Archaeological Site/Monument
50m (plus 'Zone of Notification') Archaeological Site/Monument Buffer
Natural Watercourses
50m Watercourse Buffer
Telecommincations Links (Various Operators)
Telecommuncations Link Buffer (Operator Specific)
Habitats of County Importance
Proposed Natural Heritage Area (pNHA)
200m pNHA Buffer
Overhead Transmission Lines (OHL)
525m OHL Buffer
Remaining Viable Area
N
W
E
S
MKO
MAP TITLE: Constraints Map
MAP NO.: Figure 3.1
SCALE: 1:30,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
DATE: 05-02-2020
DRAWING BY: Eoin McCarthy
CHECKED BY: Michael Watson
ISSUE NO.: 171221-2020.02.05-F
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Following the initial constraints mapping, where specific areas were deemed to be sensitive to the proposed development for any reason the project design/layout was further amended and circulated to all members of the project team so that the final design has been reviewed in full and potential impacts assessed.

3.3.5.2 Turbine Layout

There were several reviews carried out as part of optimisation of the turbine layout on site (refer to Figure 3.2). As information regarding the site of the proposed development was compiled and assessed, the number of turbines and the proposed layout was revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas which were not favourable for turbine location, as well as cumulative impacts. The selection of turbine number and layout has also had regard to wind-take, noise and shadow flicker impacts and the separation distance to be maintained between turbines. The baseline environmental assessment of the site and wind farm design was an iterative process, where findings at each stage of the assessment were used to further refine the design, always with the intention of minimising the potential for environmental impacts.

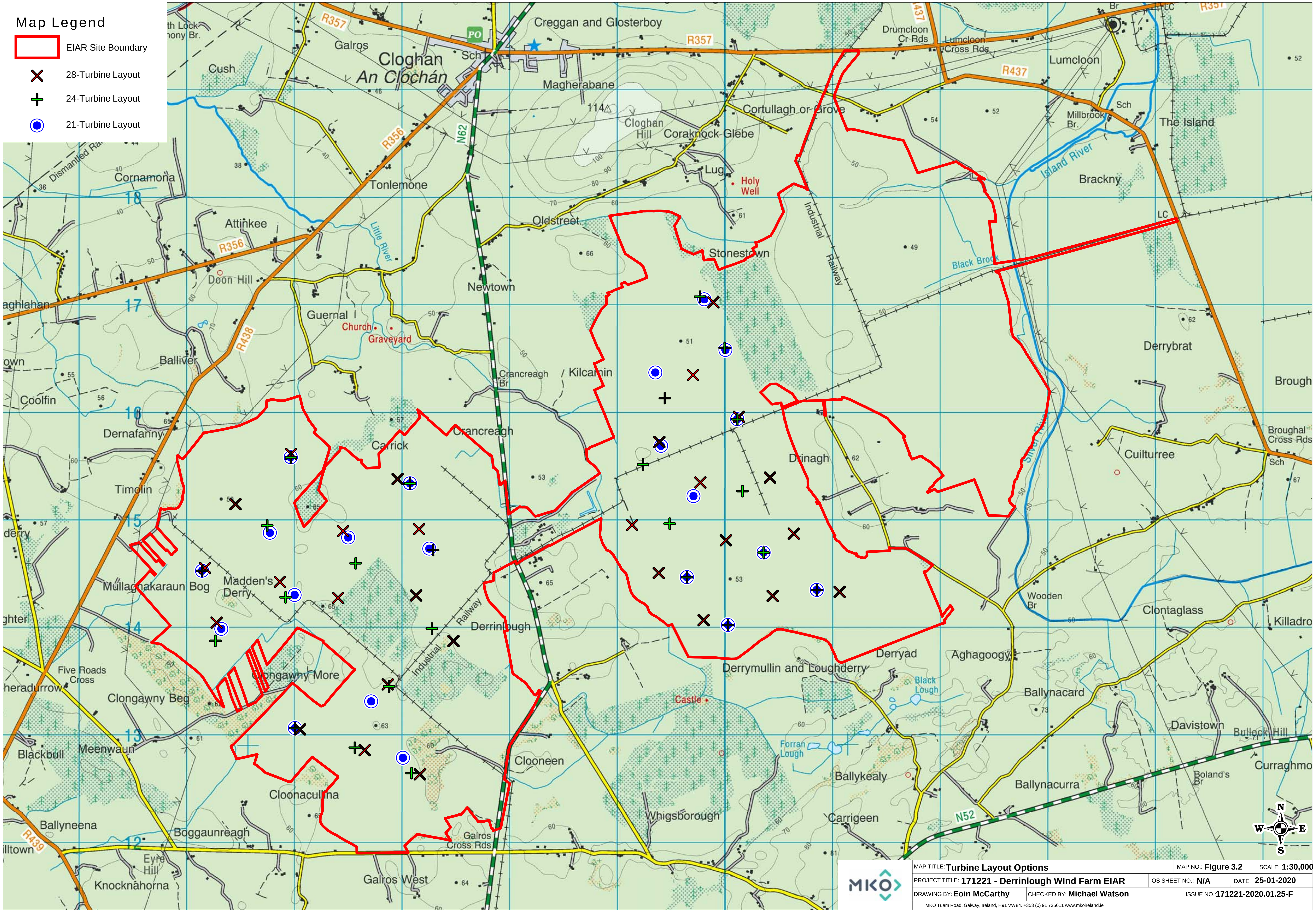
It is noteworthy that Bord na Móna opted to exclude Drinagh East from the available wind turbine developable area from the outset of the turbine layout design process given its ecological potential as a wetland area, despite these lands being included within the wind energy development area for County Offaly. The area of commercial forestry in North Drinagh was identified as a natural buffer between east and west Drinagh for the purpose of turbine layout design.

The initial constraints study identified a significant viable area within the overall site and a design of 28-turbines was developed around these constraints. This layout was refined to a 24-turbine layout following feedback from the project team on site investigations and baseline assessments; in addition to feedback from the Community Information Sessions which informed the sensitive receptor dataset and raised concerns around noise and visual impact.

Following the lodgement of a planning application for proposed amendments to Cloghan Wind Farm in August 2019 the layout was further revised to a 21-turbine layout as the proposed amendments (which comprised an increase in rotor diameter and the micro-siting of 6 No. turbines) impacted on turbines in an upwind and downwind direction.

The final proposed turbine layout takes account of all site constraints (e.g. ecology, ornithology, hydrology, peat depths etc.) and design constraints (e.g. setback distances from houses and third party lands/infrastructure and distances between turbines on-site etc.). The layout also takes account of the results of all site investigations and baseline assessments that have been carried out during the EIAR process in addition to feedback from ongoing discussions with the local community.

The final chosen turbine layout is considered the optimal layout given it has the least potential for environmental effects.



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3.3.5.3 Road Layout

Access tracks are required onsite in order to enable transport of infrastructure and construction materials within the proposed development. Such tracks must be of a gradient and width sufficient to allow safe movement of equipment and vehicles. It was decided at an early stage during the design of the proposed development that maximum possible use would be made of existing tracks where available to minimise the potential for impacts by using new roads as an alternative.

As the turbine layout was finalised, the most suitable routes between each component of the development were identified, taking into account the shortest routes, existing access tracks, the physical constraints of the site and associated buffers and utilising the most direct route between turbines in order to minimise the footprint. Locations were identified where upgrading of the existing road would be required and where new roads are to be constructed, in order to ensure suitable access to and linkages between the various project elements, and efficient and safe movement of vehicles around the site by applying the required vehicle turning radii. The road layout was modified with each revision of the turbine layout. Passing bays were designed for selected locations along the internal roads. These bays were located in specific areas to ensure minimum environmental effect by locating the passing bays away from higher value habitat and also in a configuration that facilitates the design of the amenity pathways/cycleways.

Finally, amenity paths were added linking the overall development to the public access points around the site.

An alternative option to making maximum use of the existing road network within the site would be to construct a new road network, having no regard to existing roads or tracks. This approach was deemed less desirable, as it would require unnecessary disturbance to the site and create the potential for additional environmental impacts to occur.

3.3.6 Location of Ancillary Structures

The ancillary structures required for the proposed development include temporary construction compounds, an electricity substation and associated grid connection, internal cabling and met masts.

3.3.6.1 Construction Compounds

The construction compounds will be used for the storage of all construction materials and turbine components. The construction compounds are interspersed at five locations throughout the site and are accessed off the internal site roads that will be constructed. The use of multiple temporary construction compounds was deemed preferable to the alternative of a single large compound in the centre of the site for a number of reasons. Principally, it will facilitate more efficient construction practices and will result in shorter distances for traffic movements within the site during construction. As a result, vehicle emissions and the potential for dust arisings will be reduced.

3.3.6.2 Electricity Substation and Grid Connection

At the outset of the project two potential locations were identified for the proposed substation, namely Drinagh North (Option 1) and West Clongawny (Option 2) as depicted on Figure 3.3.

As assessment of both options was carried out, taking into account the constraints associated with the site in addition to criteria such as grid capacity, access, peat depths/ground conditions, and set back from turbines.

Following the assessment, Option 1 emerged as the preferred option given the available capacity on the adjacent 110 kV line, ease of access from the local Stonestown Road, good ground conditions and limited environmental constraints. Therefore Option 1 is the only option being assessed in this EIAR.

It should also be noted that while the operational lifespan of the proposed turbines is expected to be 30 years (following which they may be replaced or decommissioned) the electricity substation and associated infrastructure will become an ESB asset and will be a permanent feature of the proposal as it will be required to continue to form part of the electrical infrastructure of the area in the event of the remainder of the site being decommissioned.

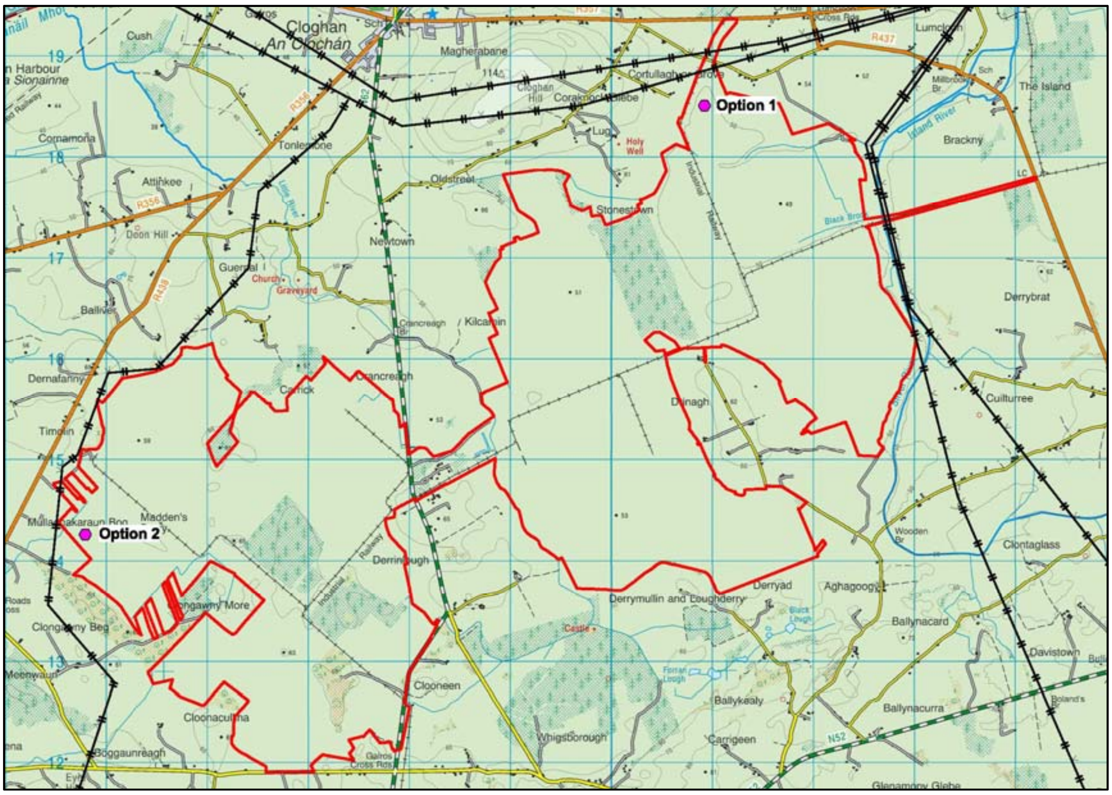

Figure 3.3 Substation Location Options

3.3.6.3 Borrow Pits

A review of potential borrow pit locations was carried out in consultation with internal Bord na Móna personnel with input from field studies and external geotechnical experts who were familiar with the site. Existing GIS data and site constraints were also considered, namely aerial photography, peat depths, biodiversity, on site drainage, proximity to the proposed internal road network, and proximity to sensitive receptors

Arising from this process, approximately 15 potential locations were identified and geological site investigations were carried out on site to determine their potential suitability. The findings of the geological site investigations did not present any evidence of borrow pit potential and consequently no borrow pits are included as part of the proposed development.

3.3.7 Site Entrances

Arising from peat extraction activities on site, there are a number of existing access points to both Clongawny and Drinagh Bogs. These comprise a mixture of machine and rail entrances. An initial review of all existing locations was carried out to identify the most suitable locations for site entrances.

Following the review, a number of potential site entrance points were identified and considered for their suitability for construction, operational or amenity access. The locations identified are discussed in the following paragraphs.

3.3.7.1 Clongawny

Five entrance points to Clongawny Bog were identified and considered as part of the design process as follows:

- Location 1: Existing machinery entrance on the N62 approximately 300m north of Derrinlough Briquette Factory.
- Location 2: Existing works entrance on the N62 immediately opposite Derrinlough Briquette Factory.
- Location 3: Existing machinery entrance on the N62 approximately 650m north of Galros crossroads;
- Location 4: Via a laneway off the R438 providing access to Clongawny Bog; and
- Location 5: Via a new entrance through Bord na Móna land off the L3006 local road west of Galros Cross Roads.

The assessment identified Location 1 as the optimal location for delivery of turbines and construction materials as it reduces the potential impact of this type of traffic on the local roads around the site, meets sightline requirements and has a lesser potential for environmental impacts. Location 2 was not considered suitable from a road safety perspective given its location on a bend opposite the briquette factory and Location 3 was discounted due to the potential for impacts on biodiversity in that area. Location 4 was considered less optimal than Location 1 for delivery of turbines and construction materials because of the requirement for third party land along the laneway for the road upgrade/new road required to access Bord na Móna lands. Therefore Location 1 was taken forward for assessment as part of this EIAR.

3.3.7.2 Drinagh

Five entrance points were also identified for Drinagh Bog and considered as part of the design process as follows:

- Location 1: Existing machinery entrance on the N62 approximately 190m north of Derrinlough Briquette Factory.
- Location 2: Existing Derrinlough Briquette Factory entrance.
- Location 3: Existing access off the L7009 Stonestown Road to the north of Drinagh.
- Location 4: Existing entrance off the R357 to the north of Drinagh.
- Location 5: Entrance off L7005 local Drinagh Road.

The assessment identified Location 1 as the optimal location for delivery of turbines and construction materials as it reduces the potential impact of this type of traffic on the local roads around the site, meets sightline requirements and has a lesser potential for environmental impacts. Location 2 was not considered suitable for delivery of turbines and construction materials from a road safety perspective and because of potential for conflict with operations at the Briquette Factory. However, it was considered that this location would be suitable for occasional use by windfarm maintenance personnel during the operational phase given the low volume of traffic associated with these elements.

Location 3 and Location 5 were also discounted as a construction entrance because of the potential impacts of traffic on this local road and the extent of widening /upgrade required and associated potential for environmental effects. Location 3 was however, considered suitable as an operational entrance for substation and windfarm maintenance personnel in addition to local amenity access given the low volumes of traffic associated with these elements.

Location 4 was considered to be suitable for delivery of construction materials and components for construction of the proposed substation only. It was also considered that this entrance could be retained as an operational amenity access point with car parking facilities. It was not considered suitable for turbine delivery given the requirements for third party land take and road upgrade requirements as discussed in Section 3.3.8.2, Turbine Delivery Route. Therefore locations 1,2, 3 and 4 have been included for assessment as part of this EIAR.

Further information on entrances is provided in Chapter 4, Description of the Proposed Development.

3.3.8 Alternative Transport Route

Wind turbine components (blades, nacelles and towers) are not manufactured in Ireland and therefore must be imported from overseas and transported overland to the site of a proposed development. With regard to the selection of a transport route to the proposed development site, alternatives were considered in relation to turbine components, general construction-related traffic, and site access locations.

3.3.8.1 Port of Entry

The alternatives considered for the port of entry of wind turbines into Ireland for the proposed development include Shannon-Foynes Port, County Limerick and the Port of Galway. Shannon Foynes Port is the principal deepwater facility on the Shannon Estuary and caters for dry bulk, break bulk, liquid and project cargoes. The Port of Galway also offers a roll-on roll-off procedure to facilitate import of wind turbines. Both ports and indeed others in the state (including Cork and Dublin), offer potential for the importing of turbine components.

3.3.8.2 Turbine Delivery Route

For turbine transport, cognisance was taken of the haul routes used for other wind farm developments in Offaly in addition to the general preference to primarily use National and Regional roads where possible with minimal requirements for junction accommodation works. This approach was deemed preferable to using local roads to minimise significant upgrade works to local roads and associated environmental effects.

The assessment of the most suitable delivery routes was conducted in parallel with the assessment of potential site entrances as outlined above. Two potential transport routes were therefore identified for turbine delivery to the site as follows:

- Option 1 comprised use of the M6 before turning south onto the N52 at Junction 5 (Tullamore/Kilbeggan). The route would follow the N52 south for approximately 50km bypassing Tullamore to the east and passing through the settlements of Blue Ball, Kilcormac and Five Alley. Deliveries would then turn right onto the N52 (at the junction known as Kennedy's Cross) and proceed northwards for circa 8km towards Cloghan to the proposed site entrances, immediately north of Derrinlough Briquette Factory.
- Option 2 would follow the same route as Option 1 as far as Blue Ball. From there deliveries would turn north onto the R357 for 19km to Cloghan Village turning south in the village centre onto the N62 for circa. 5km to the proposed site entrances just north of Derrinlough Briquette Factory.

As assessment of both options was carried out taking account of criteria such as third party land take, road upgrade requirements and associated environmental effects. Option 1 emerged as the preferred option given the limited road upgrade work required and its proven suitability for the transport of turbine components from the recently constructed Meenwaun Wind Farm, which is located directly to the south west of the proposed development site.

Further, the transport analysis (as presented in Chapter 14 of this EIAR), shows that only localised accommodation works will be required to accommodate delivery of the proposed Derrinlough Wind Farm turbines and these works are assessed in the EIAR. The turbine transport route will utilise the national and primary roads available to ensure the road network holds the capacity to manage large loads.

3.3.9 Alternative Mitigation Measures

Mitigation by avoidance has been a key aspect of the proposed project's evolution through the selection and design process. Avoidance of the most ecologically sensitive areas of the site limits the potential for environmental effects. As noted above, the site layout aims to avoid any environmentally sensitive areas. Where loss of habitat occurs in the site, this has been mitigated with the proposal of enhancement lands. The alternative to this approach is to encroach on the environmentally sensitive areas of the site and accept the potential environmental effects and risk associated with this.

The best practice design and mitigation measures set out in this EIAR will contribute to reducing any risks and have been designed to break the pathway between the site and any identified environmental receptors. The alternative is to either not propose these measures or propose measures which are not best practice and effective and neither of these options is sustainable.

4. DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) describes the development and its component parts which is the subject of a proposed application for planning permission to An Bord Pleanála in accordance with Section 37(e) of the Planning and Development Act 2000, (as amended) ('the proposed development'). The proposed development comprises:

1. *21 No. wind turbines with an overall blade tip height of up to 185 metres and all associated hard-standing areas.*
2. *2 No. permanent Anemometry Masts up to a height of 120 metres.*
3. *Provision of new and upgraded internal site access roads, passing bays, amenity pathways, amenity carpark and associated drainage.*
4. *2 No. permanent underpasses in the townland of Derrinlough. One underpass will be located beneath the N62 and one will be located beneath an existing Bord na Móna rail line.*
5. *1 No. 110 kV electrical substation, which will be constructed in the townland of Cortullagh or Grove. The electrical substation will have 2 No. control buildings, associated electrical plant and equipment and a wastewater holding tank.*
6. *5 No. temporary construction compounds, in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh and Cortullagh or Grove.*
7. *All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation.*
8. *2 No. temporary security cabins at the main construction site entrances in the townland of Derrinlough.*
9. *All works associated with the connection of the proposed wind farm to the national electricity grid, which will be to the existing Dallow/Portlaoise/Shannonbridge 110 kV line.*
10. *Removal of existing meteorological mast.*
11. *Upgrade of existing access and temporary improvements and modifications to existing public road infrastructure to facilitate delivery of abnormal loads including locations on the N52 and N62; construction access for delivery of construction materials at locations on the N62 and R357; operational access onto L7009 in the townland of Cortullagh or Grove and amenity access off R357 and L7005.*
12. *All associated site works and ancillary development including signage.*
13. *A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.*

The planning application for the proposed wind farm includes connection to the national electricity grid. All elements of the proposed project, including grid connection and any works required on public roads to accommodate turbine delivery, have been assessed as part of this EIAR.

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

4.2 Development Layout

The layout of the proposed development has been designed to minimise the potential environmental effects of the wind farm, while at the same time maximising the energy yield of the wind resource passing over the site. A constraints study, as described in Section 3.3.5.1 of Chapter 3: Consideration of

Reasonable Alternatives, has been carried out to ensure that turbines and ancillary infrastructure are located in the most appropriate areas of the site.

The overall layout of the proposed development is shown on Figure 4.1. This drawing shows the proposed locations of the wind turbines, electricity substation, construction compounds, internal roads layout and the site entrances. Detailed site layout drawings of the proposed development are included in Appendix 4-1 to this EIAR.

4.3 Development Components

4.3.1 Wind Turbines

4.3.1.1 Turbine Locations

The proposed wind turbine layout has been optimised using wind farm design software (a combination of WAsP and WindPro) to maximise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance. The Grid Reference coordinates of the proposed turbine locations are listed in Table 4.1 below. The final ground level of the turbine foundations will be determined by the actual ground conditions at each proposed turbine location and may differ slightly from those levels listed in Table 4.1.

Table 4.1 Proposed Wind Turbine Locations and Elevations

Turbine	Irish Grid Coordinates		Top of Foundation Elevation (m OD)
	Easting	Northing	
1	207077	215344	52
2	207222	214738	53
3	206717	213317	55
4	206008	213069	52
5	207012	212792	54
6	206503	214841	55
7	205775	214884	55
8	205969	215587	57
9	206005	214306	58
10	205144	214531	54
11	205324	213991	54
12	209713	215226	50
13	209652	214472	50
14	210033	214027	51
15	210859	214353	52
16	210364	214701	51
17	210119	215941	54
18	210010	216585	53
19	209411	215693	51
20	209358	216375	51
21	209813	217056	55

4.3.1.2 Turbine Type

Wind turbines use the energy from the wind to generate electricity. A wind turbine, as shown in Plate 4-1 below, consists of four main components:

- Foundation unit;
- Tower;
- Nacelle (turbine housing); and
- Rotor.

Plate 4.1 Wind Turbine Components

The proposed wind turbines will have a tip height of up to 185 metres. Within this size envelope, various configurations of hub height, rotor diameter and blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 185 metres above top of foundation. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics, with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be multi-ply coated to protect against corrosion. It is proposed that the turbines would be of an off-white or light grey colour so as to blend into the sky background. This minimises visual impact as recommended by the following guidelines on wind energy development:

- "Wind Farm Development – Guidelines for Planning Authorities" Department of the Environment, Heritage and Local Government (DoEHLG, 2006);
- "The Influence of Colour on the Aesthetics of Wind Turbine Generators" (ETSU, 1999).

For the purposes of this EIAR, various types and sizes of wind turbines within the 185-metre tip height envelope have been selected and considered in the relevant sections of the EIAR to assess the worst-case scenario. Turbine design parameters have a bearing on the assessment of shadow flicker, noise, visual impact, traffic and transport and biodiversity (specifically birds), as addressed elsewhere in this EIAR. In each EIAR section that requires the consideration of turbine parameters as part of the impact assessment, the turbine design parameters that have been used in the impact assessment are specified.

At the turbine selection stage of the project, pre-construction, new turbines models or variants may be available that were not on the market at the pre-planning and EIAR preparation stage, which would better suit the site and fit within the proposed size envelope. Should this circumstance arise, the specific parameters of the new turbines will be assessed for their compliance with the criteria set out and considered in this EIAR, the relevant guidance in place at the time and any conditions that may be attached to any grant of planning permission that might issue.

A drawing of the maximum size envelope of the proposed wind turbine is shown in Figure 4.2. Figure 4.2 also shows a typical turbine base layout, including turbine foundation, hard standing area, assembly area, access road and surrounding works area. The individual components of a typical geared wind turbine nacelle and hub are shown in Figure 4.3 below.

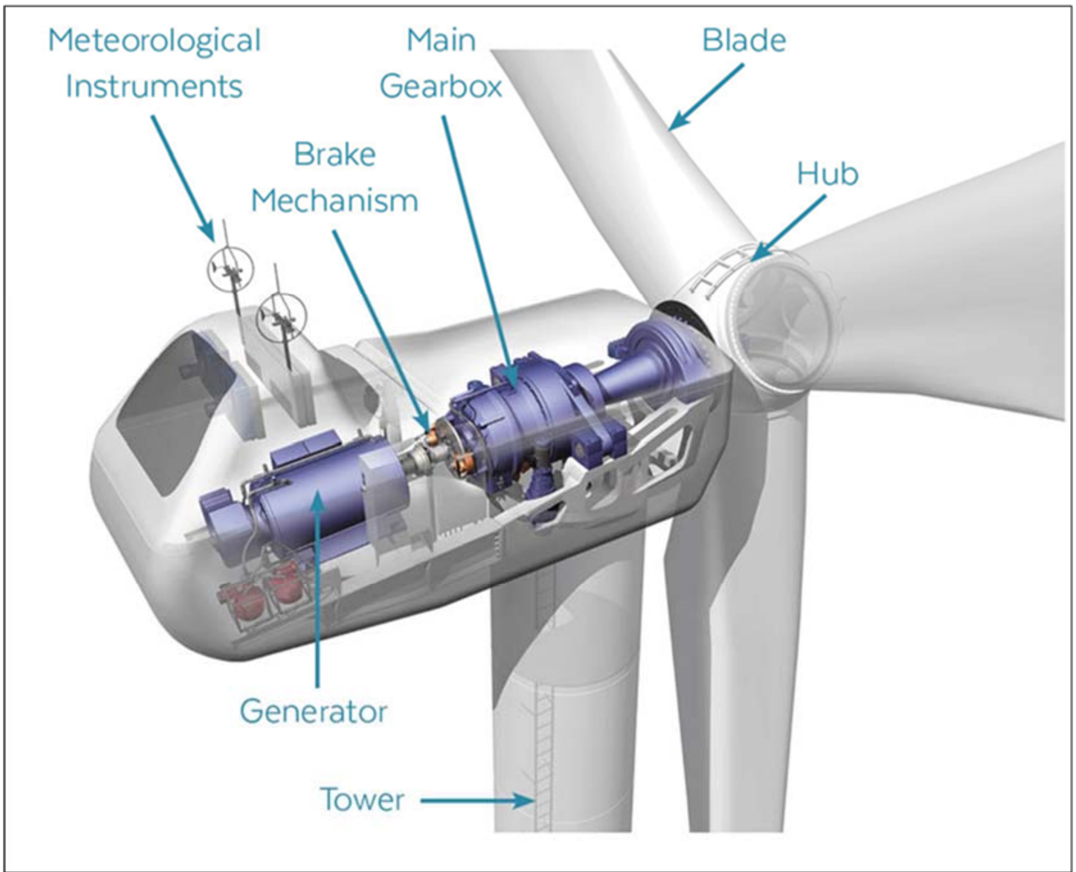

Figure 4.1 Turbine nacelle and hub components

4.3.1.3 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level on a granular sub-base after the excavation of soil and peat. The size of the foundation will be determined by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbines foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground. The typical horizontal and vertical extent of a turbine's foundation is shown in Figure 4.2.

After the foundation level of each turbine has been formed using piling methods or on competent strata, the bottom section of the turbine tower "Anchor Cage" is levelled and reinforcing steel is then built up around and through the anchor cage (Plate 4.2 below). The outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete and is backfilled accordingly with appropriate granular fill to finished surface level (Plate 4.3 below).

Plate 4.2 Turbine Base 'Anchor Cage'

Plate 4.3 Finished Turbine Base

4.3.1.4 Hard Standing Areas

Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position. The hard-standing areas are extended to cover the turbine foundations once the turbine foundation is in place. The sizes, arrangement and positioning of hard standing areas are dictated by turbine suppliers. The hard-standing area is intended to accommodate a crane during turbine assembly and erection. The proposed hard standing areas shown on the detailed layout drawings included in Appendix 4-1 to this EIAR are indicative of the sizes required, but the extent of the required areas at each turbine location may vary on-site depending on topography, position of the site access road, the proposed turbine position and the turbine supplier's exact requirements.

4.3.1.5 Assembly Area

Levelled assembly areas will be located on either side of the hard-standing area as shown on Figure 4.2. These assembly areas are required for offloading turbine blades, tower sections and hub from trucks until such time as they are ready to be lifted into position by cranes and to assist the main crane during turbine assembly. The exact location and number of assembly areas will be determined by the selected turbine manufacturer.

4.3.1.6 Power Output

It is anticipated the proposed wind turbines will have a rated electrical power output in the 3 to 5 megawatt (MW) range depending on further wind data analysis and power output modelling. Turbines of the exact same make, model and dimensions can also have different power outputs depending on the capacity of the electrical generator installed in the turbine nacelle. For the purposes of this EIAR, a rated output of 4.2 MW has been chosen to calculate the power output of the proposed 21-turbine wind farm, which would result in an estimated installed capacity of 88.2 MW.

Assuming an installed capacity of 88.2 MW, the proposed development therefore has the potential to produce up to 244,924 MWh (megawatt hours) of electricity per year, based on the following calculation:

A x B x C = Megawatt Hours of electricity produced per year

where: A = ... The number of hours in a year: 8,760 hours

B = ... The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc. A capacity factor of 31.7%[1] is applied here

C = ... Rated output of the wind farm: 88.2 MW

The 244,924 MWh of electricity produced by the proposed development would be sufficient to supply approximately 58,315 Irish households with electricity per year, based on the average Irish household using 4.2 MWh of electricity (this latest figure is available from the March 2017 CER Review of Typical Consumption Figures Decision).

4.3.2 Site Roads

4.3.2.1 Road Construction Types

To provide access within the site of the proposed development, to connect the wind turbines and associated infrastructure, approximately 29.3 kilometres of access roads will need to be constructed including the upgrade 450m of existing access road. Fehily Timoney & Company Ltd. (FTC) were appointed to assess the extent and condition of the existing site ground conditions and specify the type of road required to access all locations on site. The road construction preliminary design has taken into account the following key factors as stated in the FTC Peat and Spoil Management Plan in Appendix 4-2:

1. *Buildability considerations*
2. *Serviceability requirements for construction and wind turbine delivery and maintenance vehicles*
3. *Minimise excavation arisings*
4. *Requirement to minimise disruption to peat hydrology*

Whilst the above key factors are used to determine the road design, the actual construction technique employed for a particular length of road will be determined on the prevailing ground conditions encountered along that length of road.

The general road construction techniques to be considered are as follows:

- Construction of New Floating Roads over peat
- Construction of New Excavated Roads through peat
- Upgrade of Existing Tracks:
  - Existing Excavated Roads
  - Existing Floating Roads

The construction techniques proposed to be used for certain lengths of new and existing roads across the site are shown in the FTC Peat and Spoil Management Plan and are included in Section 4.9.2 below. Typical cross sections of the road types listed above are shown in Figures 4.4 to 4.7. The construction methodology for each road type is included in Section 4.9.2 below.

[1] *Energy in Ireland 2019 Report (Table 17) (SEAI, December 2019). Report available at: https://www.seai.ie/publications/Energy-in-Ireland-2019-.pdf*

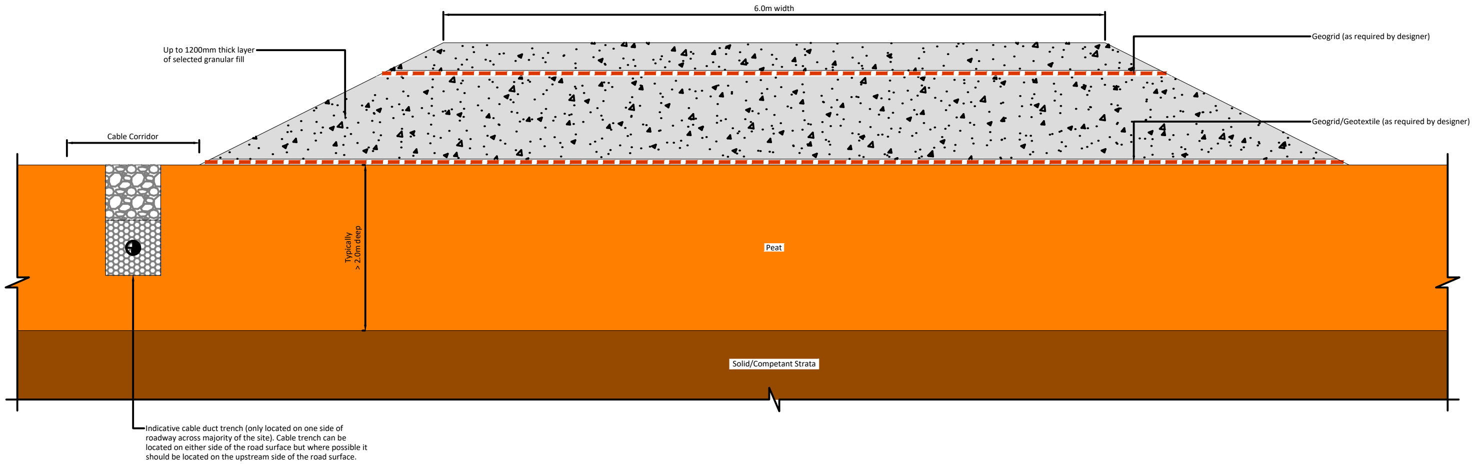

Figure 4.4	
DRAWING TITLE: Type D New Floated Access Road	
PROJECT TITLE: Derrinlough Wind Farm, Co. Offaly	
DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 171221	DRAWING No.: 171221 - 44
SCALE: 1:50 @ A3	DATE: 18.02.2020

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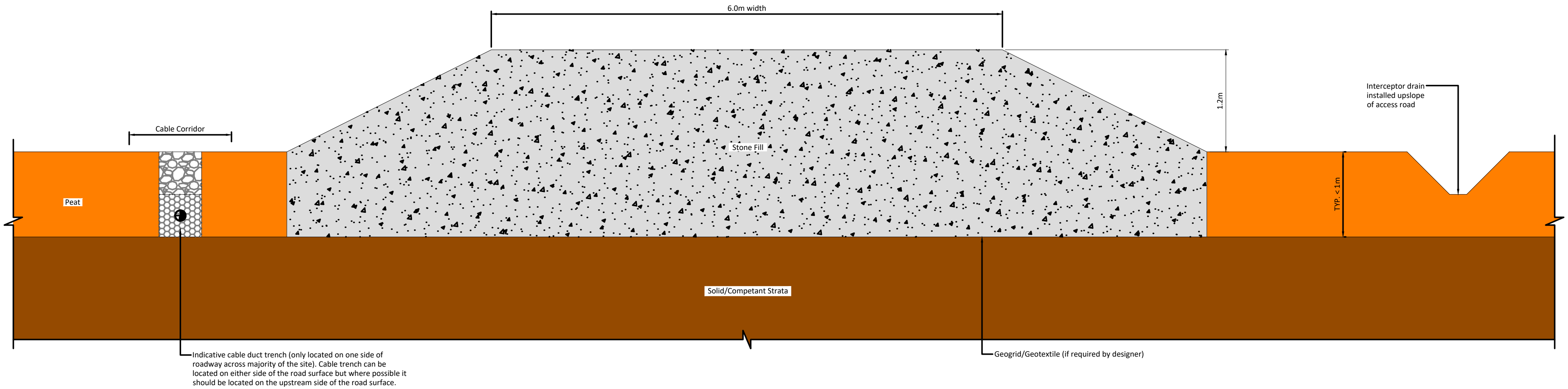

Figure 4.5

DRAWING TITLE:
Type C New Excavate and Replace Access Road

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 171221	DRAWING No.: 171221 - 43
SCALE: 1:50 @ A3	DATE: 18.02.2020

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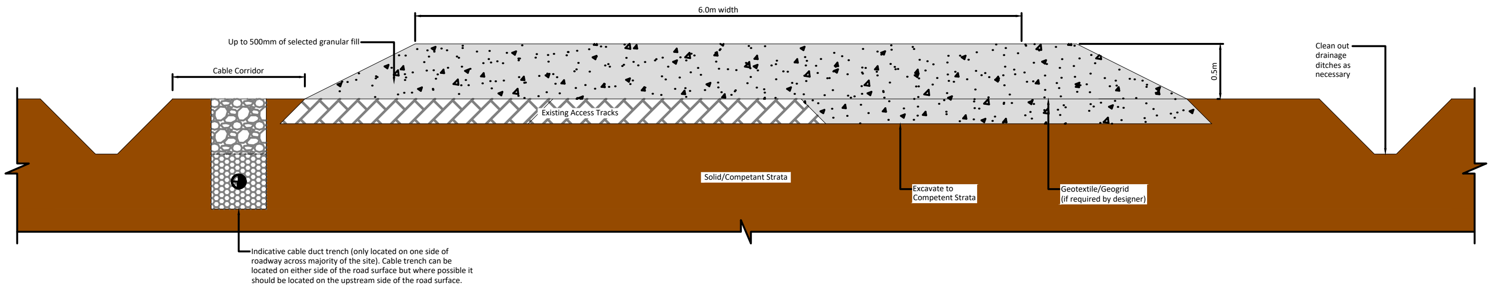

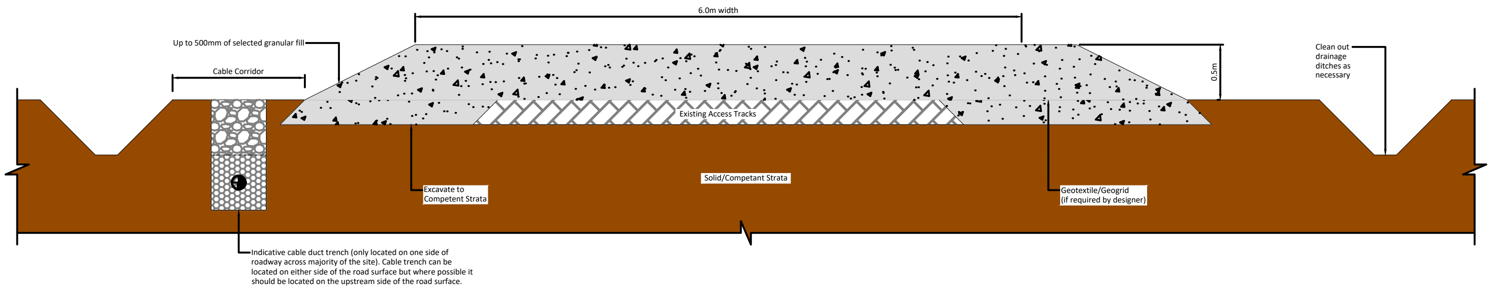

Figure 4.6

DRAWING TITLE:
Type A Upgrade of Existing Excavated Access Tracks

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

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PROJECT No.: 171221	DRAWING No.: 171221 - 41
SCALE: 1:50 @ A3	DATE: 18.02.2020

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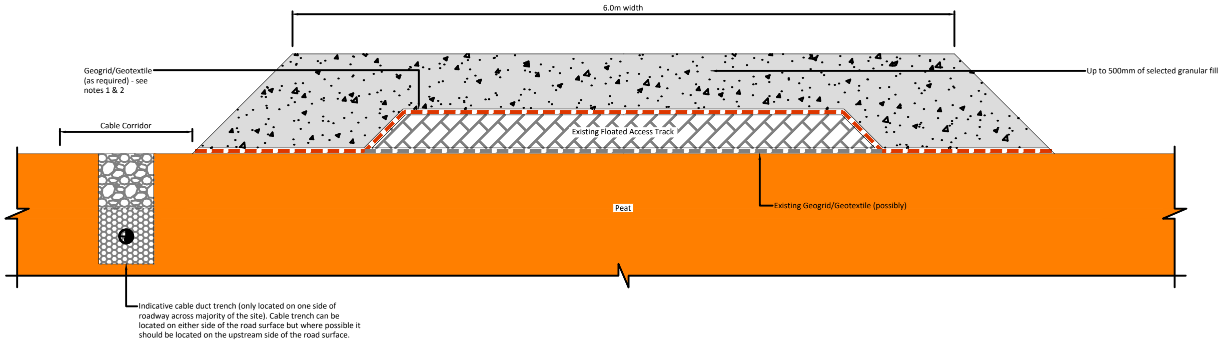
Indicative cable duct trench (only located on one side of roadway across majority of the site). Cable trench can be located on either side of the road surface but where possible it should be located on the upstream side of the road surface.



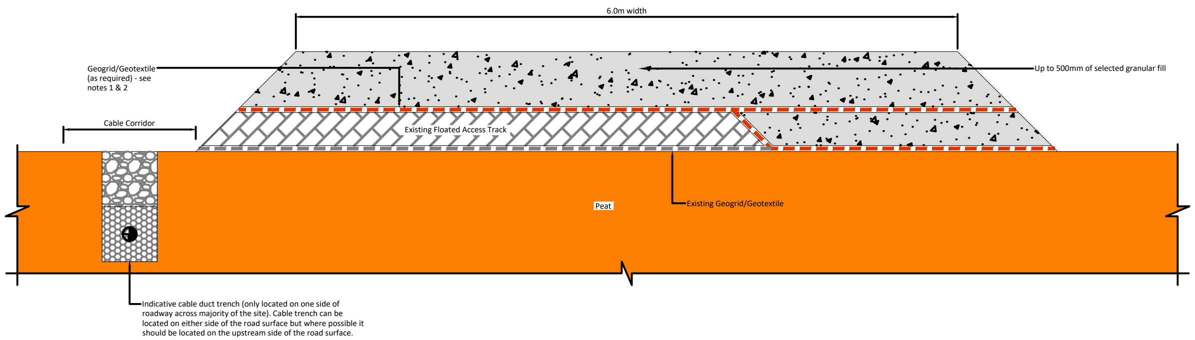


Figure 4.7

DRAWING TITLE:
Type B Upgrade of Existing Floated Access Tracks

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 171221	DRAWING No.: 171221 - 42
SCALE: 1:50 @ A3	DATE: 18.02.2020

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4.3.3 Underpasses

Two permanent, pre-cast concrete underpasses are proposed as part of the proposed development.

The first underpass will traverse beneath the N62, immediately north of Derrinlough Briquette Factory. This underpass will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used during the operational phase to provide access to facilitate wind farm maintenance.

A second underpass is proposed in Clongawny bog beneath an existing Bord na Móna railway line. This underpass will also be used for amenity purposes and for wind farm maintenance during the operational phase.

The underpasses will be approximately 35m in length, 4.5m wide and 4.5m high and will take the form of precast concrete box culverts which will be founded on an in-situ concrete base slab. As a worst-case, the structures may need to be underpinned by piles which have been assessed in this EIAR.

The locations of the underpasses are shown on the layout drawings in Appendix 4.1 of this EIAR. The typical plan view and sections of the proposed underpasses are shown in Figure 4.8.

4.3.4 Electricity Substation

It is proposed to construct an electricity substation within the site of the proposed development as shown in Figure 4.1. The proposed substation site is located within an area adjacent in the north eastern section of the site off the proposed new site road and just south of the north eastern site entrance off the R357 Regional Road.

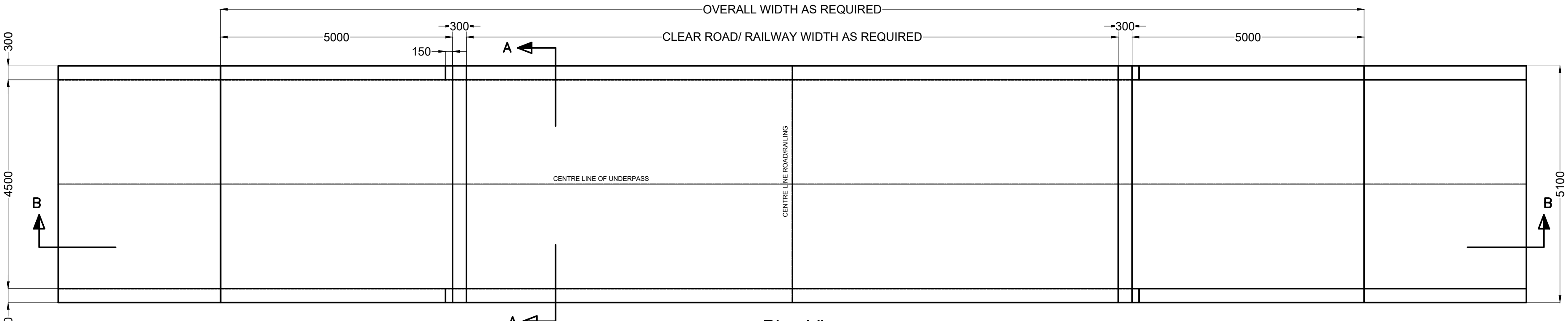
The footprint of the proposed onsite electricity substation compound measures approximately 17,500m^2. It will include two control buildings and the electrical components necessary to consolidate the electrical energy generated by each wind turbine and export that electricity from the wind farm to the national grid. Further details regarding the connection of the onsite substation to the national electricity grid are provided in Section 4.3.8 below.

The layout of the proposed onsite substation is shown on Figure 4.9. Sections and elevations of the proposed substation are shown in Figure 4.10. The substation compound will be surrounded by an approximately 2.6 metre high steel palisade fence as shown in Figure 4.9 (or as otherwise required by Eirgrid), and internal fences will also segregate different areas within the main substation. The construction and exact layout of electrical equipment in the onsite electricity substation will be to Eirgrid networks specifications.

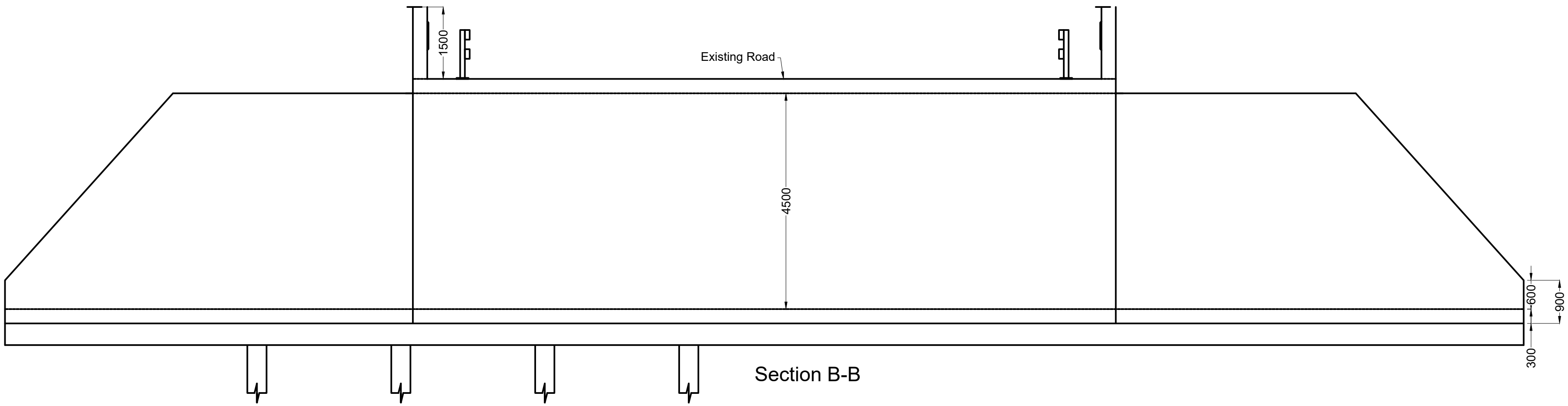
4.3.4.1 Wind Farm Control Buildings

Two substation control buildings will be located within the substation compound. The Transmission Asset Owner (TSO) Control Building will measure approximately 25 metres by 18 metres and approximately 9.6 metres in height. The Independent Power Provider (IPP) Control Building will measure approximately 19 metres by 12 metres and approximately 7 metres in height. The layouts of the control buildings are shown on Figure 4.11 and Figure 4.12.

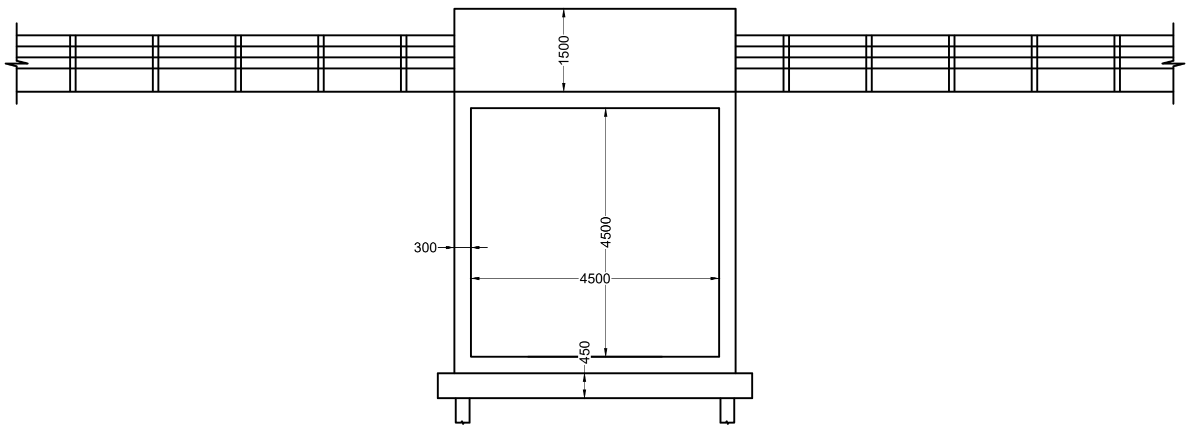
The wind farm control buildings will include staff welfare facilities for the staff that will work on the proposed development during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the proposed development there will be a very small water requirement for occasional toilet flushing and hand washing and therefore the water requirement of the proposed development does not necessitate a potable source. It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies* (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. A pump house is not currently envisaged as



Plan View



Section B-B



Section A-A

Figure 4.8

DRAWING TITLE:

Typical Underpass Detail

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 45**
SCALE: **1:100 @ A3**	DATE: **18.02.2020**

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.

SUBSTATION COMPONENT LEGEND:

ID	DESCRIPTION
BBPI	BUSBAR POST INSULATOR
BW	BORED WELL
CB	CIRCUIT BREAKER
CC	CABLE CHAIR
CCTV	CLOSED CIRCUIT TELEVISION
CT	CURRENT TRANSFORMER
CT/VT	COMBINED CURRENT & VOLTAGE TRANSFORMER
DA	BUSBAR DISCONNECTOR
DB	BUSBAR DISCONNECTOR
DE	EARTH SWITCH
DEM	TRANSFORMER EARTH SWITCH
DG	DIESEL GENERATOR
DL	LINE DISCONNECTOR
DT	TRANSFORMER DISCONNECTOR
FHT	FOUL HOLDING TANK
HOT	HOUSE TRANSFORMER
IFK	INTERFACE KIOSK
LM	LIGHTNING MAST
LP	LAMP POST
LT	LAMP TRAP
NER	NETURAL EARTHING RESISTOR
NER CSE	NER CABLE SEALING END
OLG	OVERHEAD LINE GANTRY
PI	POST INSULATOR
RS	RURAL SUPPLY
SA	SURGE ARRESTER
TP	TELECOMMUNICATIONS POLE
VT	VOLTAGE TRANSFORMER

Drawing Legend

- Planning Application Boundary
- Proposed Road
- Works Area for Internal Cabling
- Amenity Pathway

N

Figure 4.9

DRAWING TITLE:

Substation Layout

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: Joseph O Brien	CHECKED BY: Eoin McCarthy
PROJECT No.: 171221	DRAWING No.: 171221 - 28
SCALE: 1:500 @ A1	DATE: 18.02.2020

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704, 3758, 3759, 3760, 3761, 3762

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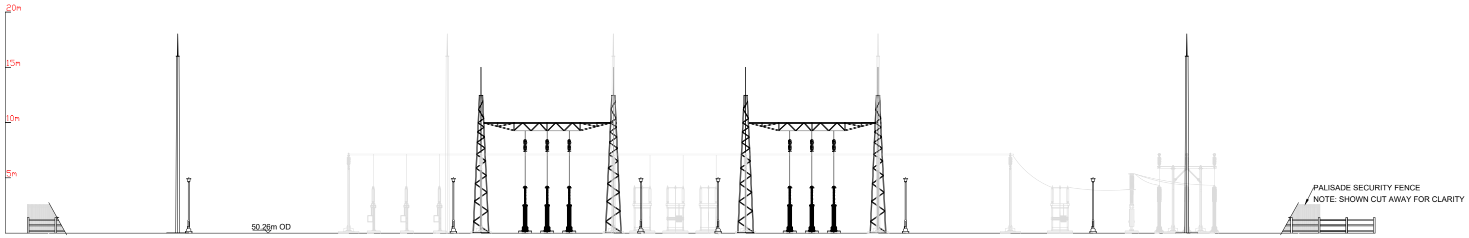
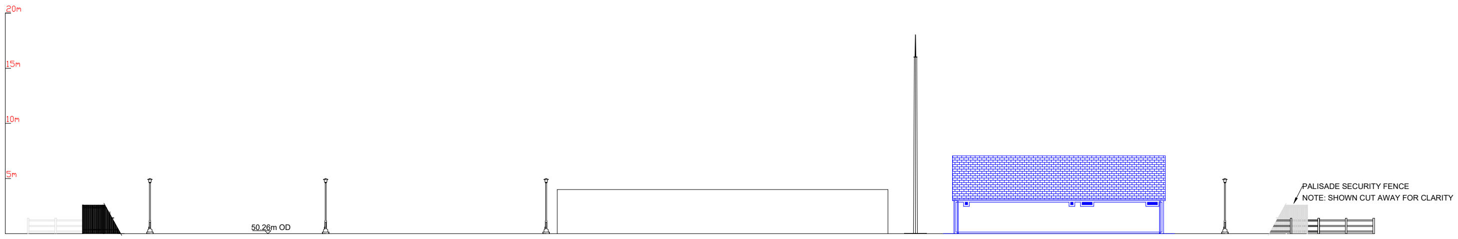
Drawing Notes

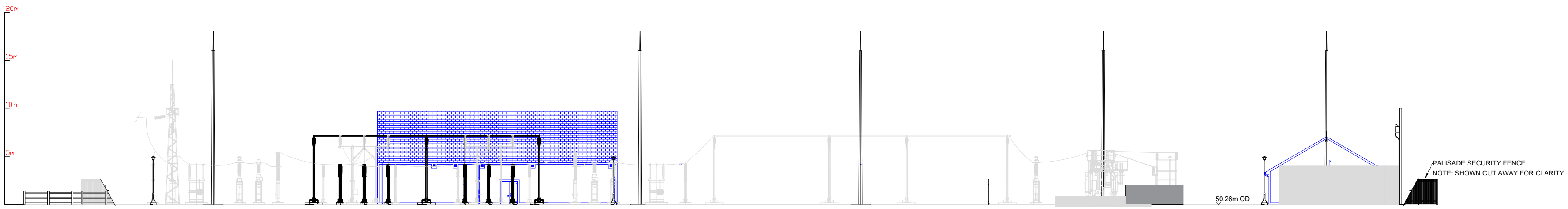
1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.



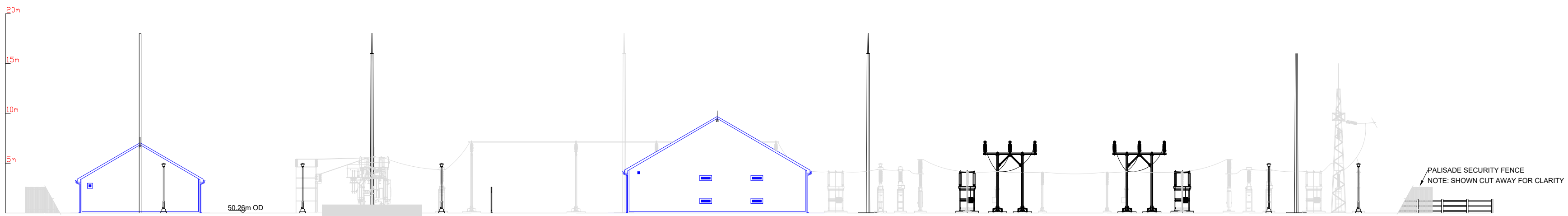
SECTION VIEW A - A



SECTION VIEW B - B



SECTION VIEW C - C



SECTION VIEW D - D

Figure 4.10

DRAWING TITLE:

Substation Sections

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: JMcD	CHECKED BY: NM
PROJECT No.: 1712221	DRAWING No.: 171221 - 29
SCALE: 1:500 @ A3	DATE: 18.02.2020

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Drawing Notes

1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.

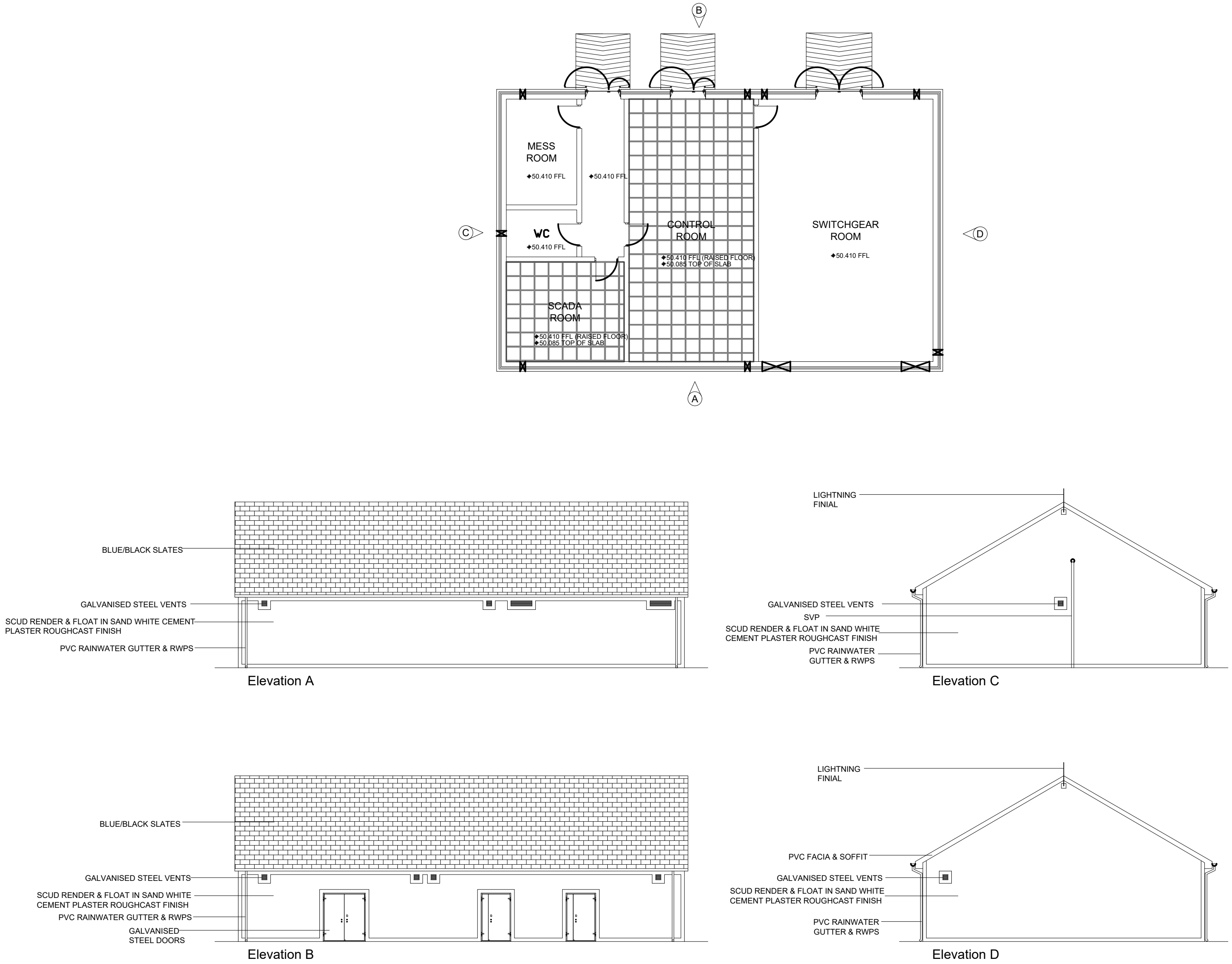

Figure 4.11

DRAWING TITLE: **IPP Control Building**	
PROJECT TITLE: **Derrinlough Wind Farm, Co. Offaly**	
DRAWING BY: JMcD	CHECKED BY: NM
PROJECT No.: 1712221	DRAWING No.: 171221 - 30
SCALE: 1:200 @ A3	DATE: 18.02.2020

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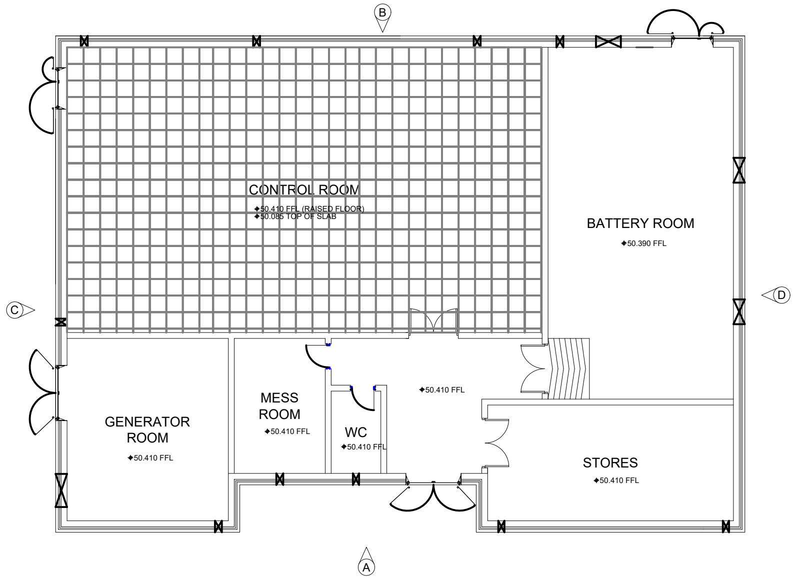
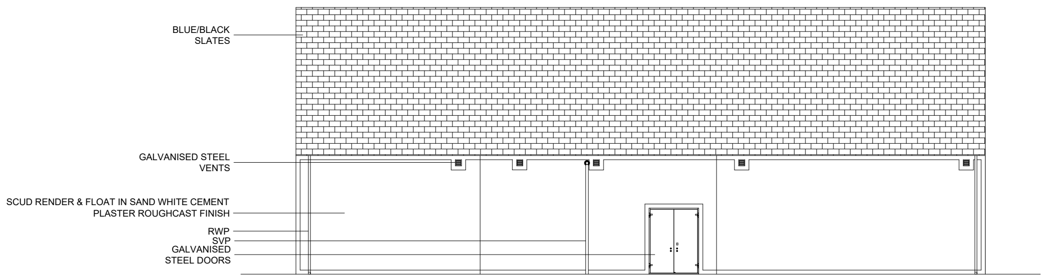
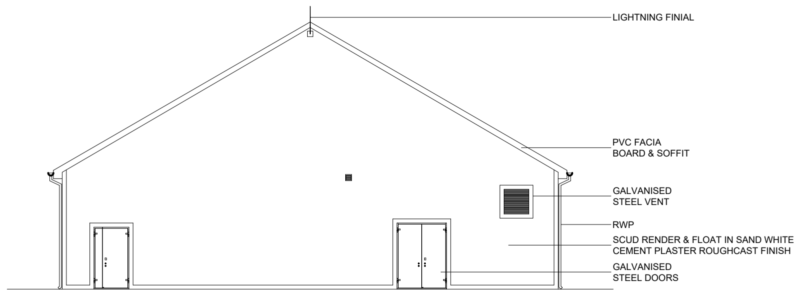
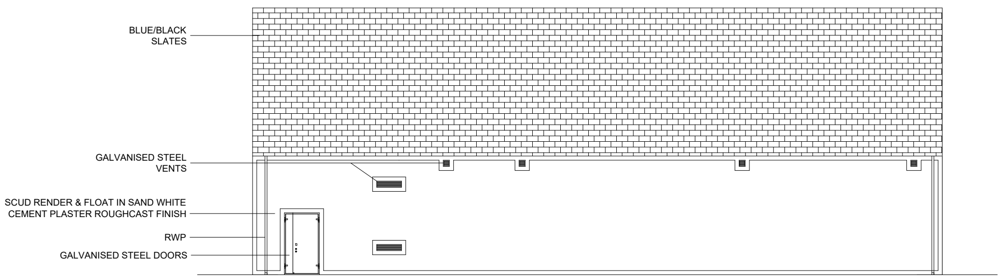








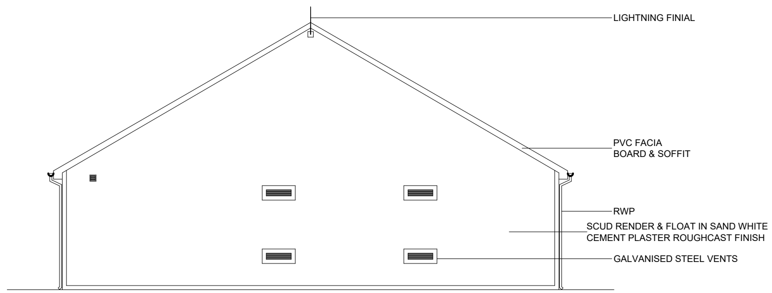


Figure 4.12

DRAWING TITLE: **TSO Control Building**	
PROJECT TITLE: **Derrinlough Wind Farm, Co. Offaly**	
DRAWING BY: JMcD	CHECKED BY: NM
PROJECT No.: 1712221	DRAWING No.: 171221 - 31
SCALE: 1:200 @ A3	DATE: 18.02.2020

an in-well pump will direct water to a water tank within the roof space of the control building (subject to final design). Bottled water will be supplied for drinking, if required.

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site, and therefore the EPA's 2009 *'Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses'* (EPA, 2009) does not apply. Similarly, the EPA's 1999 manual on *'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'* also does not apply, as it too deals with scenarios where it is proposed to treat wastewater on-site.

Such a proposal for managing the wastewater arising on site has become almost standard practice on wind farm sites, which are often proposed in areas where finding the necessary percolation requirements for on-site treatment would be challenging, and has been accepted by numerous Planning Authorities and An Bord Pleanála as an acceptable proposal.

The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. Full details of the proposed tank alarm system can be submitted to the Planning Authority in advance of any works commencing on-site. The wastewater storage tank alarm will be part of a continuous stream of data from the sites turbines, wind measurement devices and electricity substation that will be monitored remotely 24 hours a day, 7 days per week. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended), will be employed to transport wastewater away from the site. When the final destination of the materials is known following the appointment of a permitted contractor, this information can be submitted to the Planning Authority if necessary.

4.3.5 Site Cabling

Each turbine will be connected to the on-site electricity substation via an underground 33 kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in cable ducts approximately 1.3 metres below the ground surface, along the sides of or underneath the internal roadways. The route of the cable ducts will follow the access track to each turbine location. The indicative position of the cable trench relative to the roadways is shown in section in Figure 4.4 to Figure 4.7 above. Figure 4.13 below shows numerous variations of a typical cable trench arrangement.

Clay plugs will be installed at regular intervals of not greater than 50 metres along the length of the trenches to prevent the trenches becoming conduits for runoff water. While the majority of the cable trenches will be backfilled with native material, clay subsoils of low permeability will be used to prevent conduit flow in the backfilled trenches. This material will be imported onto the site should sufficient volumes not be encountered during the excavation phase of roadway and turbine foundation construction.

4.3.6 Grid Connection

A connection between the proposed development and the national electricity grid will be necessary to export electricity from the proposed wind farm. This connection will originate at the proposed onsite substation and will be connected to the national grid via either an underground grid connection cable or overhead line which will connect into the existing 110 kV transmission line located approximately 300m north of the substation. This connection route is illustrated in Figure 4.14. Planning permission is being sought for the overhead line and underground cabling options, however, only one option will be used to connect the proposed development to the national electricity grid.

Should the connection option of overhead line be chosen then approximately 530m of new 110kV transmission line and the installation of 6 No. new lattice towers will be required. The proposed lattice towers will all be located within the proposed development site. Each tower can have a footprint of up to approximately 70m^2 and an overall height of up to 20m. They will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing.

Should the connection be underground cable, approximately 700m of transmission cable will be required to connect from the proposed substation to the existing overhead line.

The cables will be laid in trenches as per Eirgrid and ESB Networks Specifications (Refer to Figure 4.13 which depicts the typical trench bedding details). Further information is also included in Section 4.9.4. Two Line Cable Interface Masts (LCIM) will be used to connect the high voltage underground cable into the existing 110 kV line (Refer to Figure 4.15).

The LCIMs will be within the proposed development site. Each mast has a footprint of approximately 70m^2 and an overall height of up to 20m. The LCIMs will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing and are very similar in size and character to the masts proposed for the overhead line option.

The exact final detail and specifications of the grid connection route and method for the proposed development will ultimately be decided by ESB/EirGrid.

4.3.7 Rural (Local) Electricity Supply

A rural/local electricity supply will be required as a back-up power supply to the proposed substation for light, heat and power purposes. There is a local MV supply adjacent to the development location which could be utilised, this is the Shannonbridge – Lumcloon MV supply. The rural/local supply will be designed and constructed by ESB Networks. The exact source of supply is to be confirmed by ESB Networks, however, the supply will enter the site by either MV overhead line or MV cable. The rural/local supply will have an associated step-down transformer (i.e. MV to LV) and will enter the substation building by underground cable and terminate onto the control building AC distribution board.

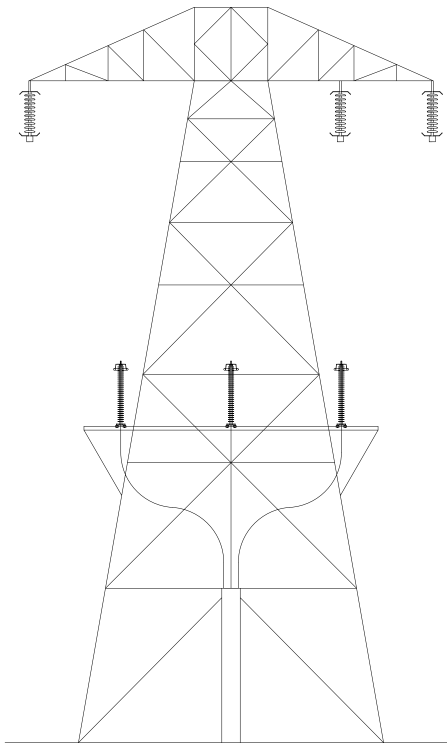
4.3.8 Anemometry Mast

Two permanent anemometry masts are proposed as part of the proposed development. The anemometry masts will be equipped with wind monitoring equipment at various heights. The masts will be located at E114,3322 N234,996 and E114,3322 N234,996 as shown on the site layout in Figure 4.1 and will be slender structures up to 120 metres in height. The masts will be free-standing structures and will be constructed on a hard-standing area sufficiently large to accommodate the crane that will be used to erect the mast, adjacent to an existing track. The typical design of the proposed anemometry masts is shown in Figure 4.16.

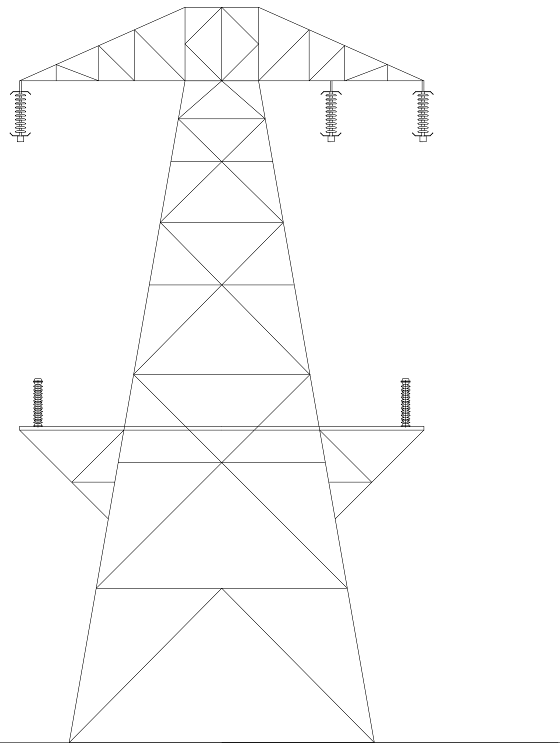
4.3.9 Temporary Construction Compounds

Five temporary construction compounds are proposed as part of the proposed development. They will be located in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh, and Cortullagh or Grove.

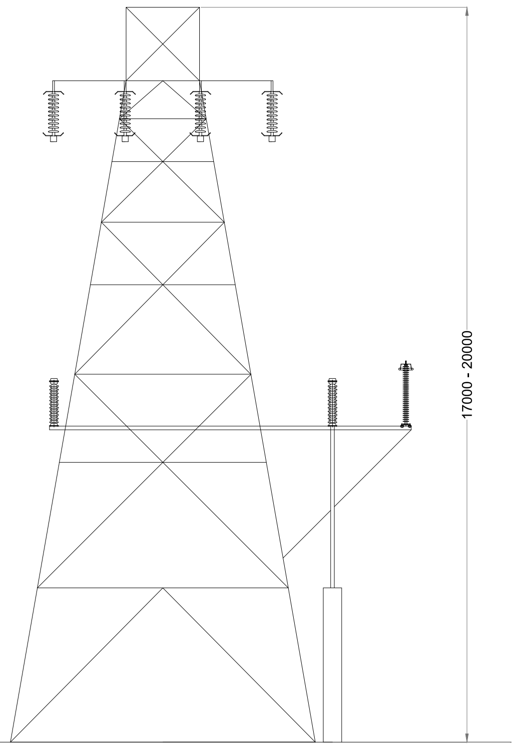
Each compound will measure approximately 50 metres by 100 metres, with a footprint of 5,000m^2 in area. The location of the proposed construction compounds is shown on the site layout drawing in Figure 4.1.



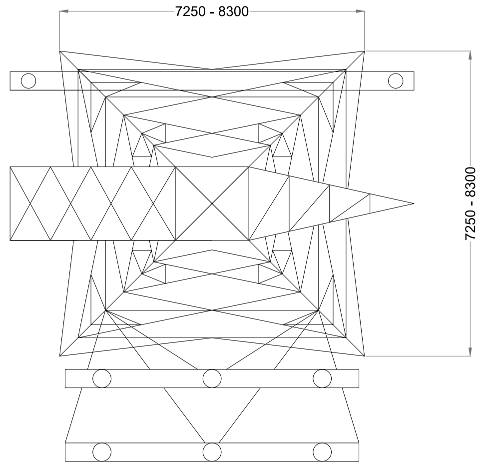
FRONT ELEVATION



REAR ELEVATION



SIDE ELEVATION



PLAN VIEW

Figure 4.15

DRAWING TITLE: **110 kV Overhead Line - Line Cable Interface Tower**	
PROJECT TITLE: **Derrinlough Wind Farm, Co. Offaly**	
DRAWING BY: **JMcD**	CHECKED BY: **NM**
PROJECT No.: **1712221**	DRAWING No.: **171221 - 33**
SCALE: **1:150 @ A3**	DATE: **18.02.2020**

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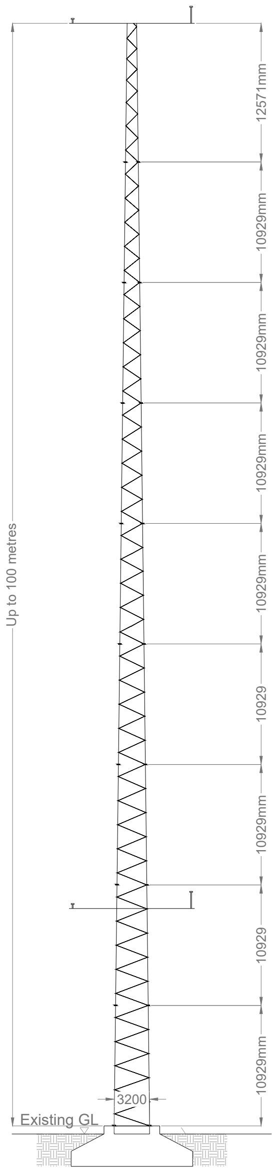

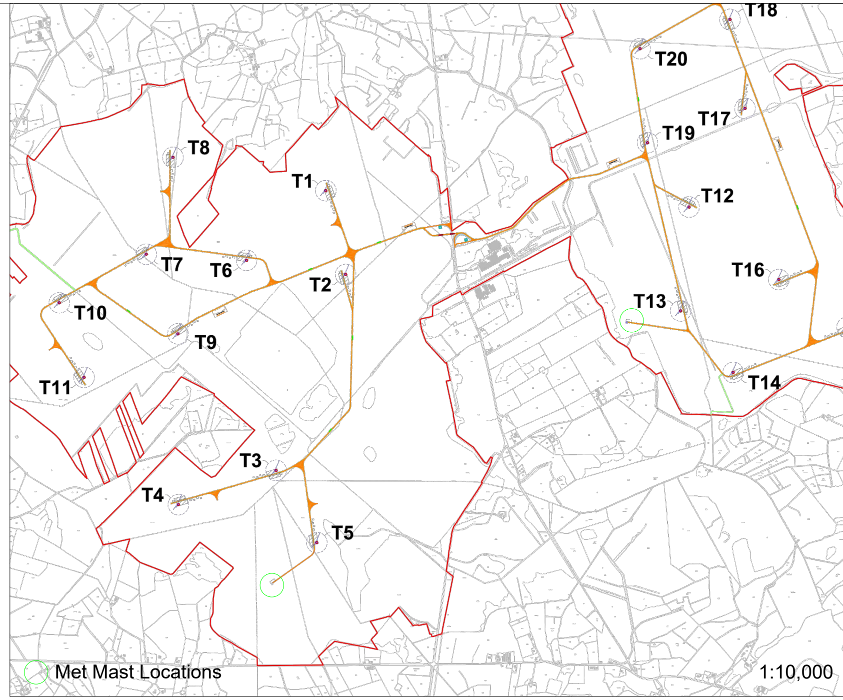

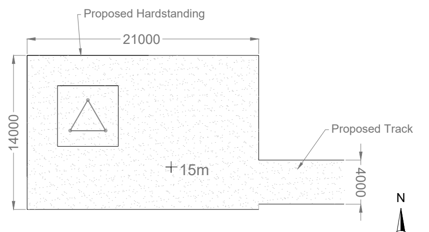

Met Mast Compound Plan

Figure 4.16

DRAWING TITLE:
Typical Free Standing Anemometry Mast

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 39**
SCALE: **1:500 @ A3**	DATE: **18.02.2020**

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The construction compounds will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors. The layout of the construction compounds is shown on Figures 4.17 to 4.21. Construction materials and turbine components will be brought directly to the proposed turbine locations following their delivery to the site.

Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.

4.3.10 Temporary Security Cabins

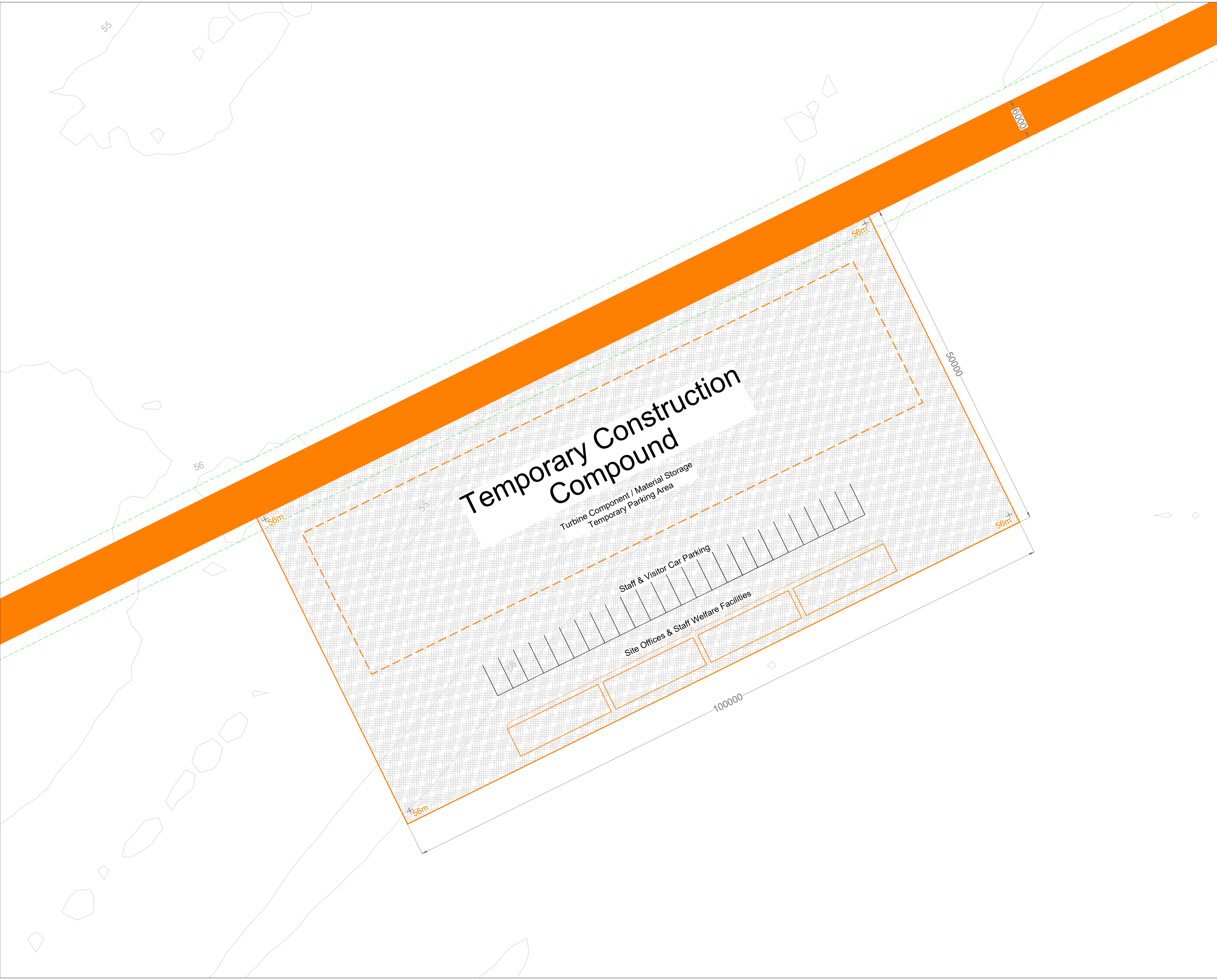
Two temporary security cabins will be installed within the site for the duration of the construction phase of the proposed development. The security cabins will be located close to the eastern and western construction site entrances off the N62 National Route.

The security cabins will be prefabricated structures measuring 7.2 metres by 2.5 metres and 2.85 metres in height. The cabins will serve as the check in and check out point for staff and visitors during the construction phase. The cabins will be removed upon commissioning of the wind farm development. The typical layout and sections of the proposed security cabins is shown in Figure 4.22.

4.3.11 Sand and Stone Requirements

The volumes of granular fill (sand and stone) required for the construction of the proposed development, outlined in Table 4.3 below, have been estimated based on the proposed development footprint and the proposed final levels for the various infrastructure. Construction grade granular fill and higher quality, final surfacing fill (including sand) will both be required for the construction of the proposed development. Granular fill volumes have been estimated using the following methodology:

- The peat located beneath all proposed hardstanding areas (excluding the substation compounds) and roads will be excavated and replaced with construction grade granular fill up to the existing ground level.
- The hardstanding areas and roads will be constructed to approximately 1 metre above the existing ground level. The first 600mm (approx.) above ground level will comprise construction grade granular fill and the final 600mm (approx.) surface layer will comprise higher quality, final surfacing materials generally washed gravels.
- The proposed substation compound will be constructed to approximately 50.26 metres OD. The peat excavated beneath the various construction compound footprints will be replaced with construction grade granular fill. The final 500mm will comprise the higher quality, surfacing materials.
- The internal site underground cable trenches will be approximately 1200mm in depth. The cable trench will be backfilled up to approximately 600mm with sand, within which the ducting will be placed. Suitable materials from the excavations of the trenches will be reinstated to form the final layer of the trench.



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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Construction Compound layout is indicative. Final Arrangement will be on per contractor's requirements.

Drawing Legend

Proposed Road

Works Area for Internal Cabling

N

Figure 4.17

DRAWING TITLE:

Temporary Construction Compound 1

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 23**
SCALE: **1:500 @ A3**	DATE: **18.02.2020**

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704

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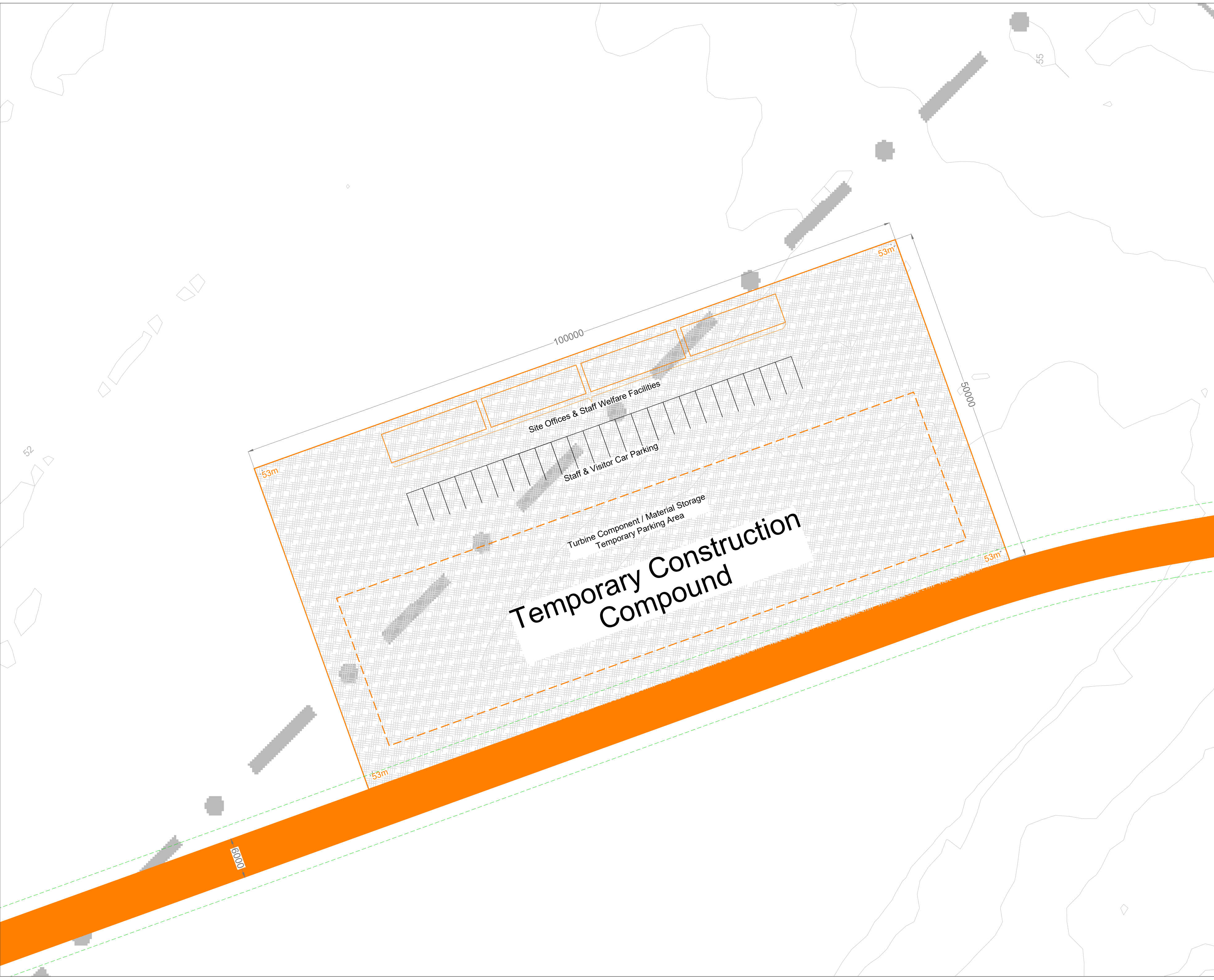

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Construction Compound layout is indicative. Final Arrangement will be on per contractor's requirements.

Drawing Legend

Proposed Road

Works Area for Internal Cabling

N

Figure 4.18

DRAWING TITLE:

Temporary Construction Compound 2

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 24**
SCALE: **1:500 @ A3**	DATE: **18.02.2020**

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704

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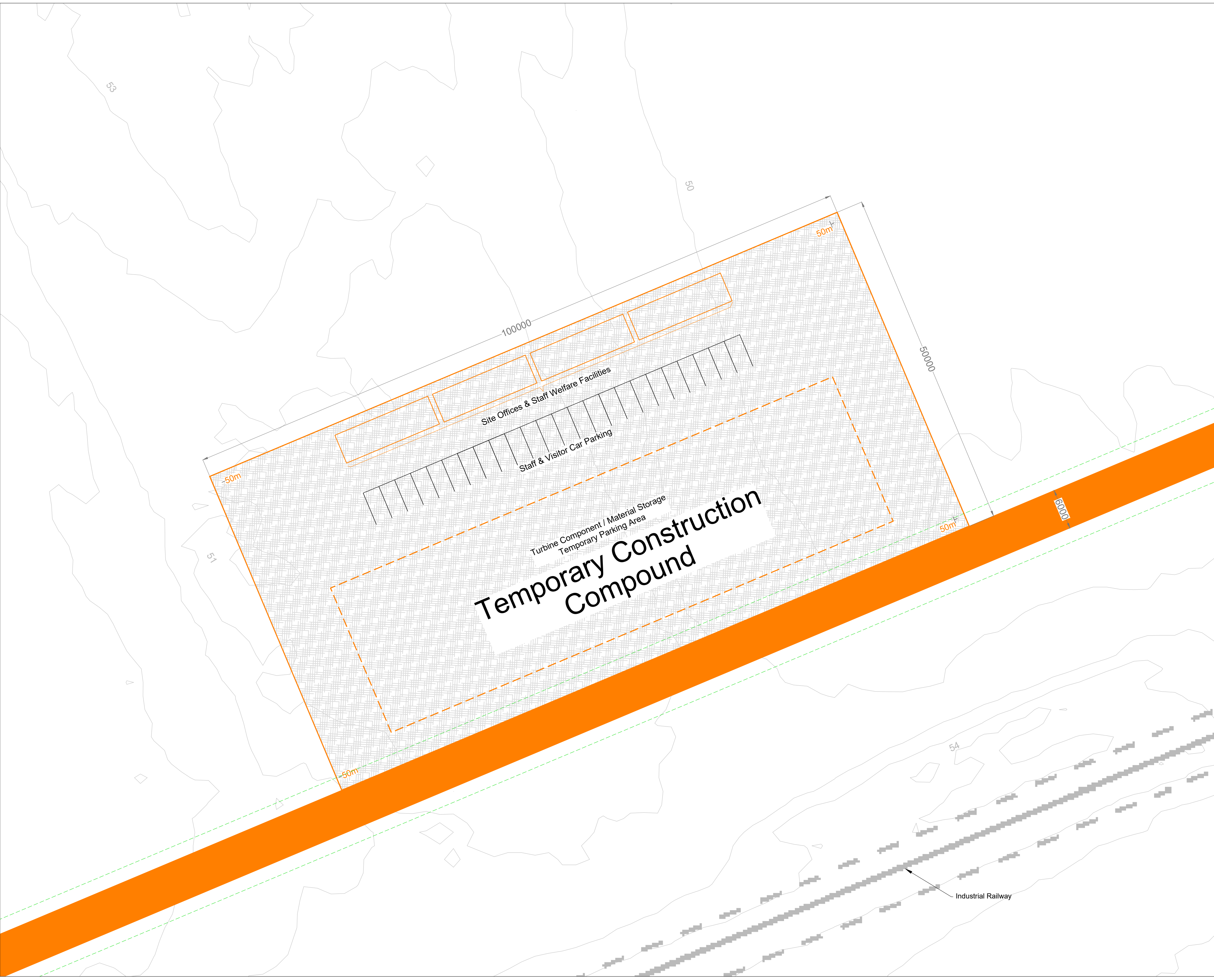

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Construction Compound layout is indicative. Final Arrangement will be on per contractor's requirements.

Drawing Legend

- Proposed Road
- Works Area for Internal Cabling

N

Figure 4.19

DRAWING TITLE:
Temporary Construction Compound 3

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: Joseph O Brien	CHECKED BY: Eoin McCarthy
PROJECT No.: 171221	DRAWING No.: 171221 - 25
SCALE: 1:500 @ A3	DATE: 18.02.2020

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Construction Compound layout is indicative. Final Arrangement will be on per contractor's requirements.

Drawing Legend

Proposed Road

Works Area for Internal Cabling

N

Figure 4.20

DRAWING TITLE:
Temporary Construction Compound 4

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 26**
SCALE: **1:500 @ A3**	DATE: **18.02.2020**

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704

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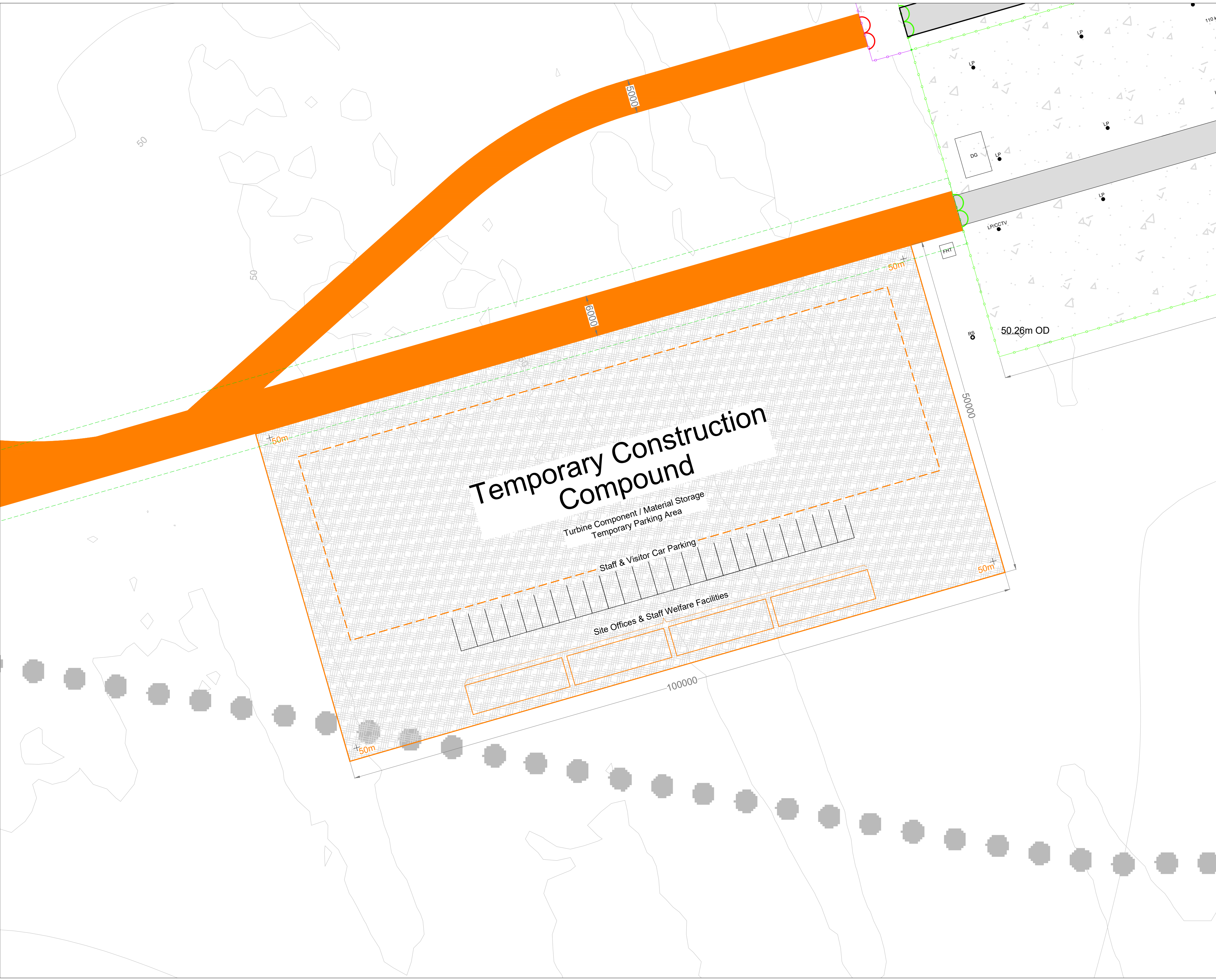

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Construction Compound layout is indicative. Final Arrangement will be on per contractor's requirements.

Drawing Legend

- Proposed Road
- Works Area for Internal Cabling

N

Figure 4.21

DRAWING TITLE:
Temporary Construction Compound 5

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 27**
SCALE: **1:500 @ A3**	DATE: **18.02.2020**

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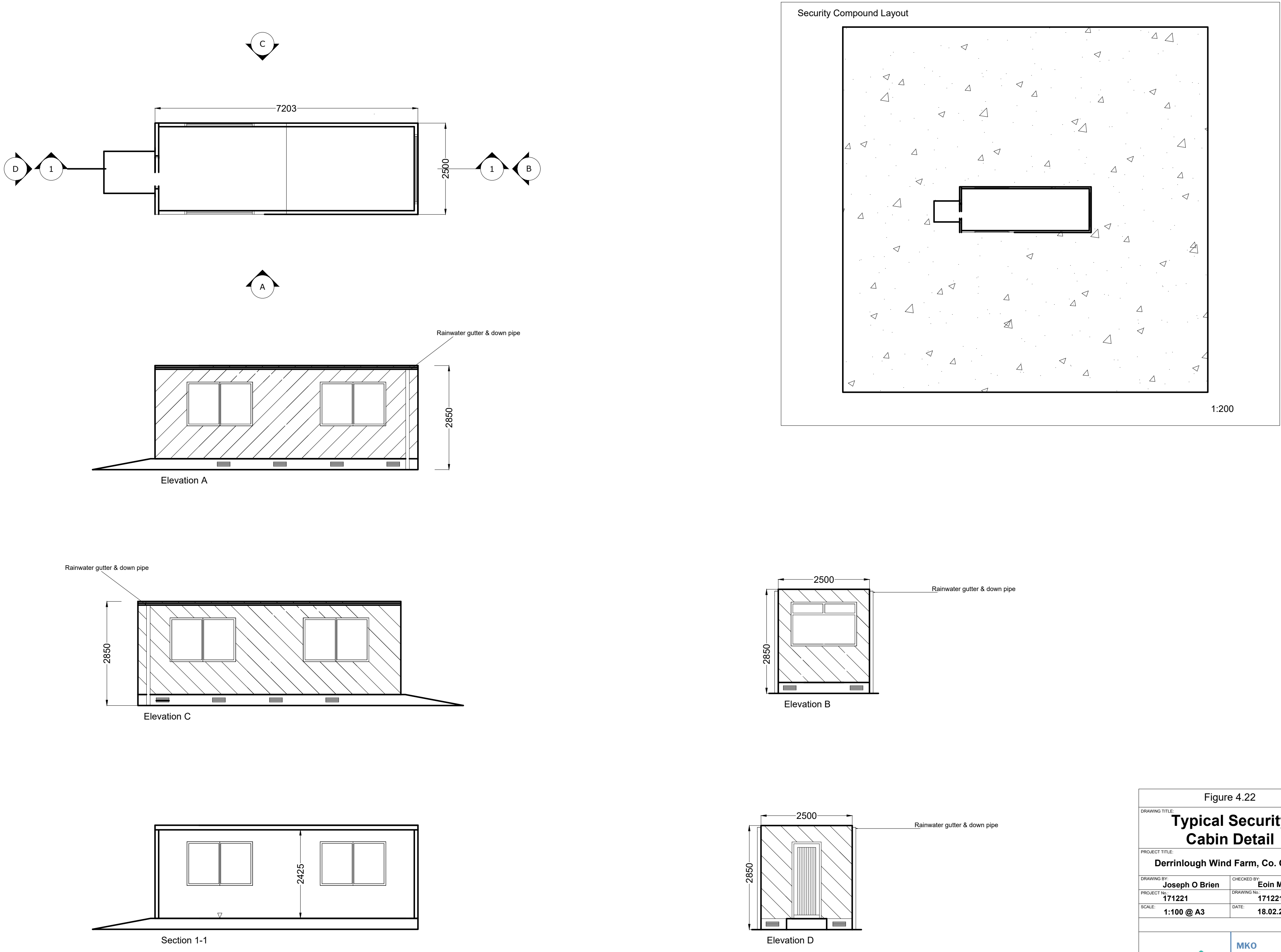

Figure 4.22

DRAWING TITLE:

Typical Security Cabin Detail

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No: **171221**	DRAWING No: **171221 - 48**
SCALE: **1:100 @ A3**	DATE: **18.02.2020**

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Table 4.2 outlines the sources of both the construction grade and surfacing granular fill. The construction grade granular fill and the higher quality, surfacing granular fill and sand will be sourced from local, authorised quarries. The locations of existing in relation to the proposed site are shown in Figure 4.23. These and/or other authorised quarries will be used as sources of stone during the construction of the proposed development.

Table 4.2 Granular Fill Volumes Required

Development Component	Area (m^2) (approx.)	Stone Fill Required (m^3)
Turbine no. 1	6,775	8,054
Turbine no. 2	6,775	8,054
Turbine no. 3	6,775	8,574
Turbine no. 4	6,775	9,613
Turbine no. 5	6,775	12,210
Turbine no. 6	6,775	8,574
Turbine no. 7	6,775	13,249
Turbine no. 8	6,775	9,093
Turbine no. 9	6,775	9,093
Turbine no. 10	6,775	8,574
Turbine no. 11	6,775	8,054
Turbine no. 12	6,775	8,054
Turbine no. 13	6,775	8,054
Turbine no. 14	6,775	8,833
Turbine no. 15	6,775	8,054
Turbine no. 16	6,775	8,054
Turbine no. 17	6,775	8,054
Turbine no. 18	6,775	8,054
Turbine no. 19	6,775	8,054
Turbine no. 20	6,775	8,054
Turbine no. 21	6,775	9,093
New Access Roads	199,740	310,785

Development Component	Area (m^2) (approx.)	Stone Fill Required (m^3)
Construction Compounds	25,000	32,300
Substation	17,500	39,560
Met Masts	1,490	2,750
2 No. Underpass	N/A	1,000
Amenity Pathways	19,500	9,750
Security Cabin Compounds	800	800
N52-N62 Junction Bypass	1,300	5,775
Totals (m^3) (including 25% contingency factor)		735,275

4.3.12 Peat and Spoil Management Plan

4.3.12.1 Quantities

The approximate quantity of peat and non-peat material (spoil), requiring management on the site of the proposed development has been calculated, as presented in Table 4.3 below. These quantities were calculated by FTC as part of the Peat and Spoil Management Plan in Appendix 4.2 of this EIAR.

Table 4.3 Approximate Peat and Spoil Volumes Requiring Management

Development Component	Peat Volume (m^3)	Spoil Volume (m^3)
21 no. Turbines and Hardstanding Areas	152,535	57,700
Access Roads	57,150	29,465
Substation	18,963	6,326
Met Masts	3,490	780
Temporary Construction Compounds and Security Cabin Compounds	37,800	8,570
2 No. Underpasses	1,440	4,200

Cable Route and Grid Connection	7,345	0
N52/N62 Junction Bypass	0	6,920
Sub Total	**278,723**	**113,961**
Total Peat and Spoil to be managed (m^3)		**392,684**

Note a factor of 20% (bulking factor of 15% and contingency factor of 5%) has been applied and is included to the excavated peat and spoil volumes above to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

4.3.12.2 Peat and Spoil Management

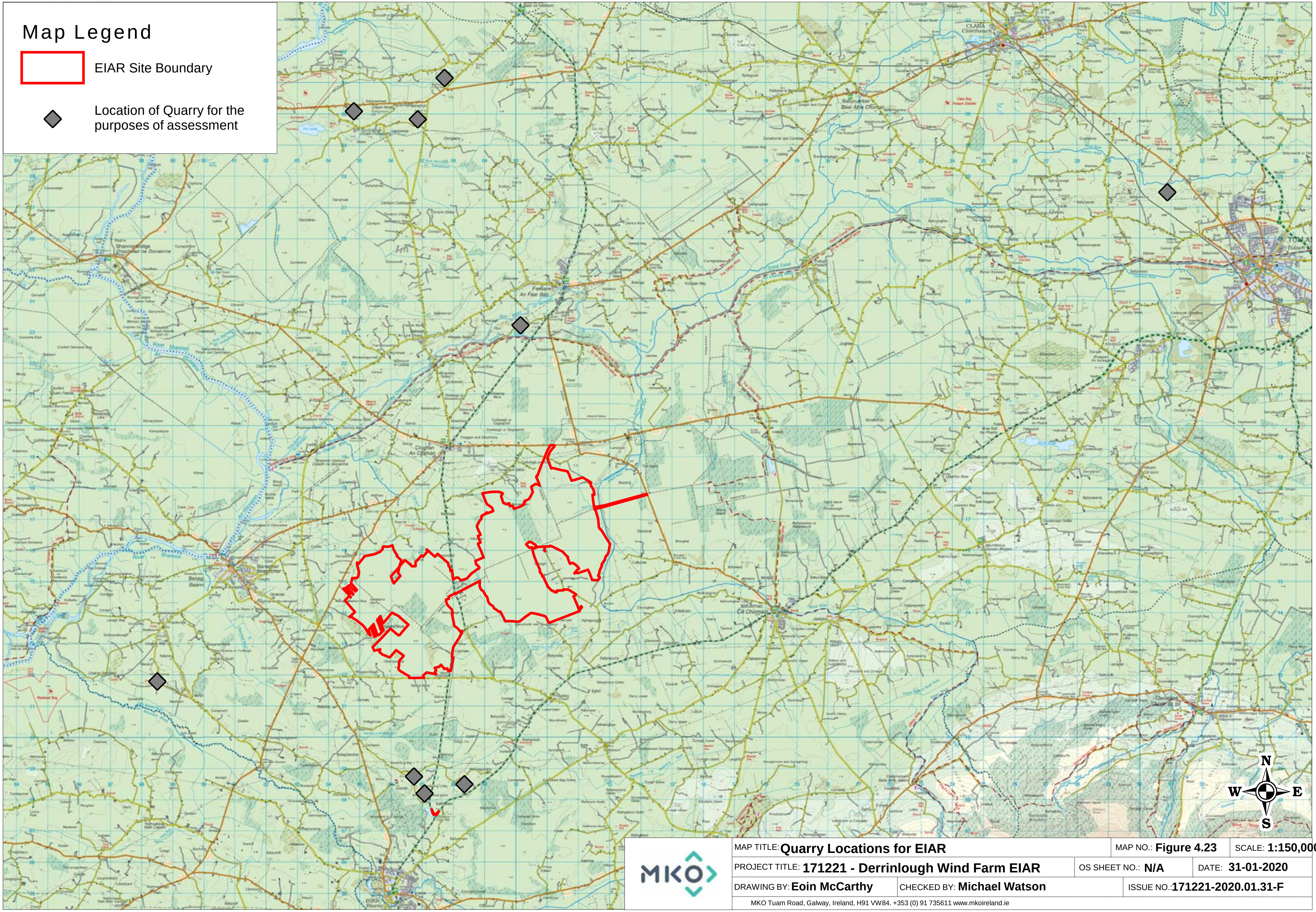
The site which is generally flat consists predominantly of bare, locally re-vegetated cutaway peat and shallow peat with an extensive drainage network. The site has been extensively harvested by Bord na Móna using mechanical harvesting equipment resulting in a well-drained and extensively trafficked peat. Bord na Móna has considerable experience in the handling of peat in these circumstances, both during peat production operations and during wind farm construction projects, particularly Mountlucas, Bruckana and Oweninny wind farms which are located on very similar terrain. This experience has shown that the most environmentally sensitive and stable way of handling and moving of peat is its placement across the site and at locations as close as possible to the excavation areas. The proposed methodology as outlined in the FTC Peat and Spoil Management Plan is summarised below.

- The following recommendations/best practice guidelines for the placement of peat and non-peat spoil alongside the proposed infrastructure elements should be considered and taken into account during construction.
- All excavated peat and non-peat will be placed/spread alongside the proposed infrastructure elements on site, where possible.
- The placement of excavated spoil should be restricted to areas where the peat depth is less than 2m. Given the flat topography/nature of the site, this approach for the placement of excavated spoil is deemed appropriate.
- The peat and spoil placed adjacent to the proposed infrastructure elements should be restricted to a maximum height of 1m over a 7m wide corridor on both sides of the proposed infrastructure elements. It should be noted that the designer should define/confirm the maximum restricted height for the placed peat and spoil.
- The placement of excavated peat and spoil is to be avoided without first establishing the adequacy of the ground to support the load. The placement of peat and spoil within the placement areas may require the use of long reach excavators, low ground pressure machinery and possibly bog mats in particular for drainage works.
- Where there is any doubt as to the stability of the peat surface then no excavated spoil shall be placed on to the peat surface. The risk of peat instability is reduced by not placing any loading onto the peat surface.
- Where practical, it should be ensured that the surface of the placed peat and spoil is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the peat and spoil should be carried out as placement of peat and spoil within the placement area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed peat and spoil.
- Finished/shaped side slopes in the placed peat and spoil shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat and spoil are encountered then slacker slopes will be required.

Map Legend

EIAR Site Boundary

Location of Quarry for the purposes of assessment



MAP TITLE: Quarry Locations for EIAR		MAP NO.: Figure 4.23	SCALE: 1:150,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR		OS SHEET NO.: N/A	DATE: 31-01-2020
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 171221-2020.01.31-F	

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- All placed spoil will be allowed to revegetate naturally from the extensive seed source of the plants that have already colonised in the area. Alternatively and possibly in addition, seeding of the placed spoil could be carried out which would aid in stabilising the placed spoil in the long term.
- Movement monitoring instrumentation may be required adjacent to the access road where peat has been placed. The locations where monitoring is required will be identified by the designer on site.
- Supervision by a geotechnical engineer or appropriately competent person is recommended for the works.
- An interceptor drain should be installed upslope of the designated spoil placement areas to divert any surface water away from these areas. This will help ensure stability of the placed spoil and reduce the likelihood of debris run-off.
- All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction

4.3.13 Site Activities

4.3.13.1 Environmental Management

All proposed activities on the site of the proposed development will be provided for in an environmental management plan. A Construction and Environmental Management Plan (CEMP) has been prepared for the proposed development and is included in Appendix 4-5 of this EIAR. The CEMP sets out the key environmental considerations to be taken into account by the contractor during construction of the proposed development. The CEMP also details the mitigation measures to be implemented in order to comply with the environmental commitments outlined in the EIAR. The contractor will be contractually obliged to comply with all such measures. It is intended that the CEMP would be updated prior to the commencement of the development, to include any additional mitigation measures, conditions and or alterations to the EIAR and application documents that may emerge during the course of the planning process and would be submitted to the Planning Authority for written approval in advance of commencement of any construction works on site.

4.3.13.2 Refuelling

Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles. However, for construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site in bunded areas.

On-site refuelling of machinery will be carried out at dedicated refuelling locations using a mobile double skinned fuel bowser. The fuel bowser, a double-axle custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the proposed wind farm. The 4x4 jeep will also carry 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.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays, spill kits and fuel absorbent mats will be used during all refuelling operations.

4.3.13.3 Concrete Deliveries

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching.

When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a temporary lined impermeable containment area, or a Siltbuster-type concrete wash unit (http://www.siltbuster.com) or equivalent. This type of Siltbuster unit catches the solid concrete and filters and holds wash liquid for pH adjustment and further solids separation. The residual liquids and solids will be removed off-site by an appropriately authorised waste collector for disposal at an authorised waste facility. Where temporary lined impermeable containment areas are used, such containment areas are typically built using straw bales and lined with an impermeable membrane. Two examples are shown in Plates 4.4 and 4.5 below.

Plate 4.4 Concrete washout area

Plate 4.5 Concrete washout area

The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents will be tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

Due to the volume of concrete required for each turbine foundation, and the requirement for the concrete pours to be continuous, deliveries are often carried out outside normal working hours in order to limit the traffic impact on other road users, particularly peak period school and work commuter traffic. Such activities are limited to the day of turbine foundation concrete pours, which are normally complete in a single day per turbine.

The risks of pollution arising from concrete deliveries will be further reduced by the following:

- Concrete trucks will not be washed out on the site but will be directed back to their batching plant for washout.
- Site roads will be constructed to the required standard to allow transport of the turbine components around the site, and hence, concrete delivery trucks will be able to access all areas where the concrete will be needed. No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport. All concrete used in the construction of turbine bases will be pumped directly into the shuttered formwork from the delivery truck. If this is not practical, the concrete will be pumped from the delivery truck into a hydraulic concrete pump or into the bucket of an excavator, which will transfer the concrete to the location where it is needed.
- The arrangements for concrete deliveries to the site will be agreed with suppliers before work starts, agreeing routes, prohibiting on-site washout and to agree emergency procedures.
- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site.

4.3.13.4 Concrete Pouring

Because of the scale of the main concrete pours that will be required to construct the proposed development, the main pours will be planned days or weeks in advance. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These will include:

- Using weather forecasting to assist in planning large concrete pours and avoiding large pours where prolonged periods of heavy rain is forecast.
- Restricting concrete pumps and machine buckets from slewing over watercourses while placing concrete.
- Ensuring that excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets.
- Ensuring that covers are available, and used when necessary, for freshly placed concrete to avoid the surface washing away in heavy rain.
- In the event of there being surplus concrete after completion of a pour, the concrete will be taken off-site and disposed of at an appropriately authorised facility.

4.3.13.5 Dust Suppression

In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

4.3.13.6 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. Site roads will already be constructed before other road-going trucks begin to make regular or frequent deliveries to the site (e.g. with steel or concrete). The site roads will be well finished with compacted hardcore, and so the public road-going vehicles will not be travelling over soft or muddy ground where they might pick up mud or dirt.

However, in the interest of best practice wheelwash facilities will be provided. Figure 4.24 includes typical details of a proposed self-contained wheelwash system for use during the construction phase of works. A wheelwash will be located at each of the construction and delivery entrances as shown on the site layout drawings included as Appendix 4.1.

The contractor will be responsible for ensuring that all vehicles egressing the site have used the wheelwash facilities. However, a road sweeper will be made available by the contractor for the cleaning of public roads in the event that they are dirtied by trucks associated with the proposed development.

Note
Wheel washes will be appropriately located at all entrances used during construction of the wind farm

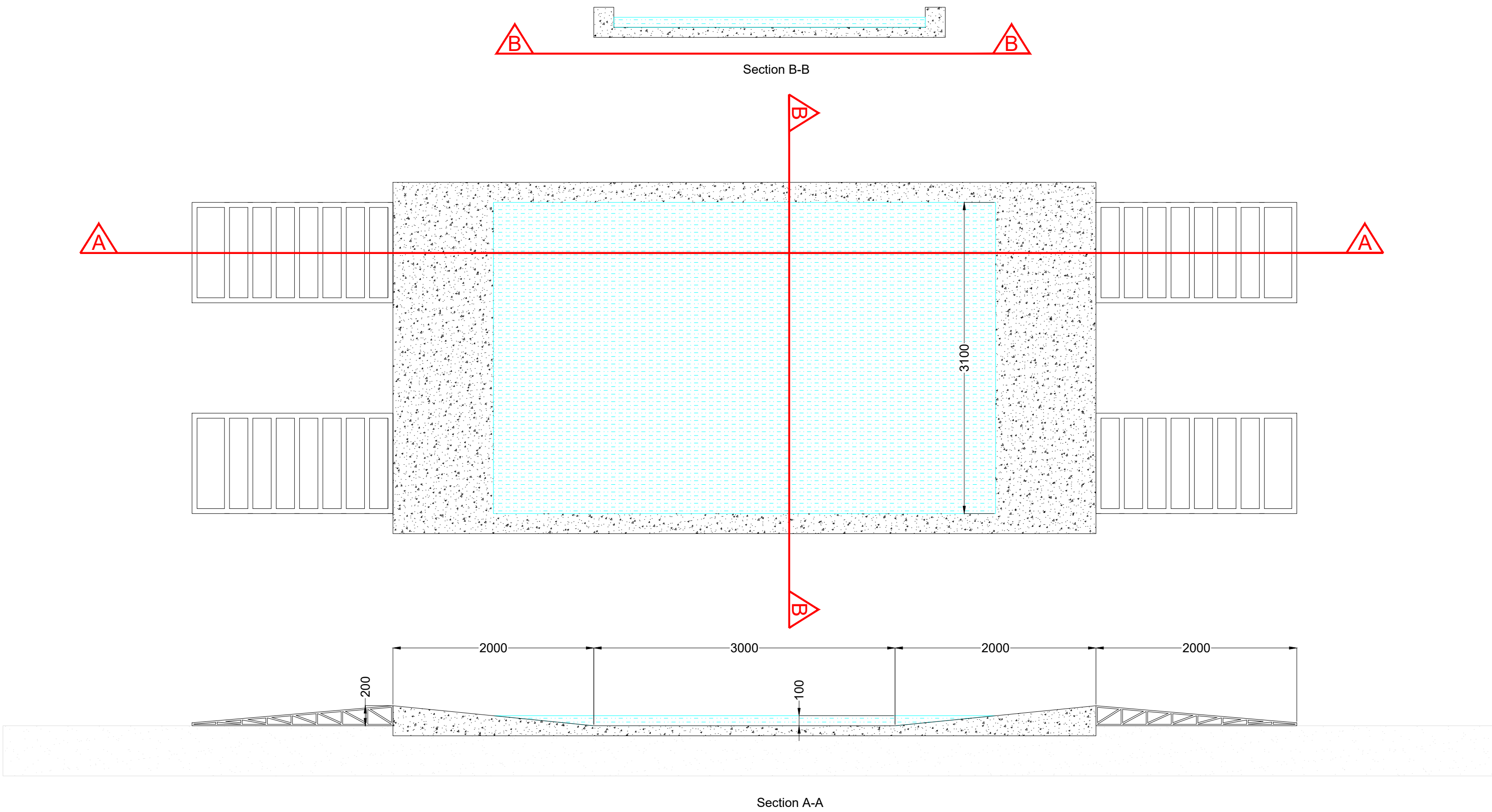

Figure 4.24

DRAWING TITLE:
Typical Wheel Wash Detail

PROJECT TITLE:
Derrinlough Wind Farm, Co. Offaly

DRAWING BY: Joseph O Brien	CHECKED BY: Eoin McCarthy
PROJECT No.: 171221	DRAWING No.: 171221 - 49
SCALE: 1:50 @ A3	DATE: 18.02.2020

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4.3.14 Site Entrances

The proposed development site will be accessed via existing site entrances off the N62, R357 and L7009 (local Stonestown Road).

Three entrances are proposed for the construction stage of the proposed development in order to transport turbine components, materials and equipment to the site. The entrance locations are depicted on Figure 4.1 and can be described as follows:

- Existing entrance off the N62 to Drinagh Bog;
- Existing entrance off the N62 to Clongawny Bog; and
- Existing entrance off the R357 which connects Drinagh and Noggus Bog.

The main entrances for the construction phase of the proposed development are located along the N62. These two entrances will provide access east and west into Drinagh and Clongawny bogs, respectively and will be designed to facilitate both materials delivery to the site (stone, steel and concrete) as well as large oversize components such as turbine blades and tower sections. Upgrade works will be required to these entrance locations in order to accommodate access and egress of turbine delivery and construction vehicles. Following construction these entrances will be closed by erecting fencing, however they may need to be reopened during the lifetime of the development should replacement blades or other abnormal loads be required to access the site.

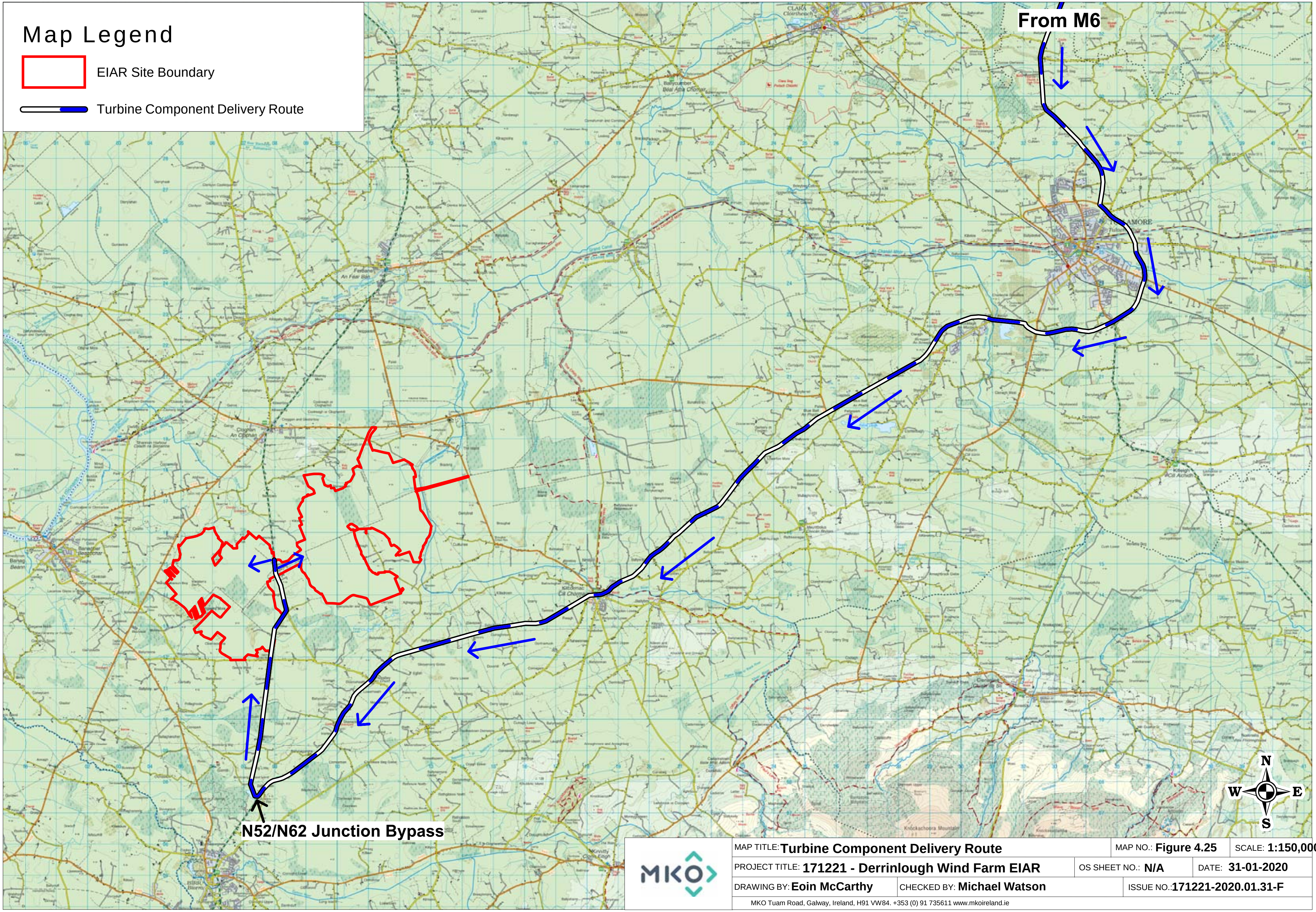
The access off the R357 will be used for the substation and grid connection works only and will not be used to provide access for turbine components. As such, this site entrance will have comparatively low level of construction traffic and associated material deliveries. Minor upgrade works will be required to this entrance location in order to accommodate access and egress of construction vehicles. This entrance will be upgraded after construction to provide permanent access to a proposed amenity car park. In addition, the existing machine pass off the L7009 Local Road will be upgraded to provide permanent access to the proposed substation and local access to the amenity during the operational phase.

New internal site roads (29.3km) will be constructed as part of the initial phase of the construction of the wind farm for access to turbine locations as depicted on Figure 4.1.

4.3.15 Turbine and Construction Materials Transport Route

It is proposed that the large wind turbine plant will be delivered via the M6 before turning south onto the N52 at Junction 5 (Tullamore/Kilbeggan). The route follows the N52 south, bypassing Tullamore to the east and passing through the settlements of Blue Ball, Kilcormac and Five Alley. Deliveries will turn right onto the N62 (at the junction known as Kennedy's Cross) and will proceed northwards towards Cloghan to the proposed site entrances, immediately north of Derrinlough Briquette Factory. The proposed route is shown on Figure 4.25. All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in Figure 4.25.

Other construction materials will be delivered to the site via the proposed haul route shown on Figure 4.25 and other haul routes that will be determined based on the source of the construction material which will be included in the Traffic Management Plan for the proposed development. Traffic movements generated by the proposed development are discussed in in Section 14.1 of Chapter 14, Material Assets.



MAP TITLE: Turbine Component Delivery Route
MAP NO.: Figure 4.25
SCALE: 1:150,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
DATE: 31-01-2020
DRAWING BY: Eoin McCarthy
CHECKED BY: Michael Watson
ISSUE NO.: 171221-2020.01.31-F

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4.3.15.1 Turbine Delivery Accommodation Works

A new temporary arrangement will be required at Kennedy's Cross, located in the townland of Ballindown, (junction of the N52 and N62 National Secondary Roads), comprising construction of a new junction bypass road across third party lands, to facilitate the delivery of turbine components and other abnormal loads. The proposed new road will measure approximately 160 metres in length and have a 6 metre running width.

The access road itself would be constructed as per the general construction methodology for new excavated roads as outlined in Section 4.9.2 below. The locations of these works and an overview of the proposed accommodation works are shown in Figure 4.26 and on the layout drawings in Appendix 4.1 of this EIAR. Gates will be installed at the junctions of the temporary road with the N52 and N62, respectively. These gates will be locked between scheduled turbine deliveries.

Following the completion of the construction phase of the proposed development the gates will remain in-situ. The temporary turbine delivery access road will be closed, covered with a layer of topsoil and reseeded. It would only be used again in the event that an oversized delivery was required for wind turbine maintenance purposes.

4.3.15.2 Traffic Management

A turbine with a maximum blade length of 75 metres has been used in assessing the traffic impact of the proposed development. The blade transporter for such a turbine blade would have a total vehicle length of 80.4 metres, including the blade which overhangs the back of the vehicle. The total length of the tower transporter is 49.6 metres with the axles located at the front and rear of the load with no overhang. The vehicles used to transport the nacelles will be similar to the tower transporter. All other vehicles requiring access to the site will be smaller than the design test vehicles.

The turbine delivery vehicles have been modelled accurately in the Autotrack assessments for the site, as detailed in Chapter 14: Material Assets of this EIAR.

The need to transport a wind turbine blade measuring up to 75 metres on the public roads is not an everyday occurrence in the vicinity of the site of the proposed development. However, the procedures for transporting abnormal size loads on the country's roads are well established. While every operation to transport abnormal loads is different and requires careful consideration and planning, escort vehicles, traffic management plans, drive tests, road marshals and convoy escorts from the Garda Traffic Corps are all measures that are regularly employed to gets unusual loads from origin to destination. Given the extensive number of wind farms already built and operating in Ireland, transport challenges are something the wind energy industry and the specialist transport sector has become particularly adept in finding solutions to.

A traffic management plan has been prepared as part of the traffic impact assessment set out in Chapter 14 of this EIAR and is included in the Construction Environmental Management Plan (CEMP) which is contained in Appendix 4.3.

The deliveries of turbine components to the site will be made in convoys of three to five vehicles at a time, and mostly at night when roads are quietest. Convoys will be accompanied by escorts at the front and rear operating a "stop and go" system. Although the turbine delivery vehicles are large, they will not prevent other road users or emergency vehicles passing, should the need arise. The delivery escort vehicles will ensure the turbine transport is carried out in a safe and efficient manner with minimal delay or inconvenience for other road users.

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.

Drawing Legend

- Planning Application Boundary
- Proposed Road

Figure 4.26

DRAWING TITLE:

Site Layout Plan - Sheet 8 of 8 (N52 - N62)

PROJECT TITLE:

Derrinlough Wind Farm, Co. Offaly

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Eoin McCarthy**
PROJECT No.: **171221**	DRAWING No.: **171221 - 11**
SCALE: **1:5,000 @ A3**	DATE: **18.02.2020**

OS SHEET No.: 3487, 3488, 3489, 3490, 3491, 3537, 3538, 3539, 3540, 3541, 3586, 3587, 3588, 3589, 3590, 3643, 3644, 3645, 3646, 3700, 3701, 3702, 3703, 3704

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It is not anticipated that any section of the local road network will be closed during transport of turbines, although there will be some delays to local traffic at pinch points. During these periods, it may be necessary to operate local diversions for through traffic. All deliveries comprising abnormally large loads will be made outside the normal peak traffic periods to avoid disruption to work and school-related traffic.

Prior to the construction of the proposed development a full dry run of the proposed transport operation along the proposed route will be completed using vehicles with attachments to simulate the dimensions of the turbine components. Following this dry run the Traffic Management Plan will be reviewed and updated with the haulage company when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. The plan will then be submitted to Offaly County Council for agreement in advance of any abnormal loads using the local roads. The plan will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

4.4 Community Benefit Proposals

Bord na Móna presently operate two wind farm community gain schemes at its wind farms in Mountlucas and Bruckana. These schemes were established in 2014 thanks to the help and cooperation of the communities surrounding the wind farms. The Community Gain Schemes for Bruckana and Mountlucas Wind Farms were set up on the basis of community involvement and public consultation.

The Community gain scheme consists of a fixed level of funding (based on the installed capacity of the wind farm) that is made available each calendar year for community led projects in the local area. During 2017 and 2018, a 'near neighbour' scheme was established for residents in the vicinity of the Bruckana and Mountlucas wind farms. The near neighbour schemes offer electricity bill payers living within a prescribed distance of a wind turbine an annual contribution towards their electricity usage. In addition to the electricity contribution payment, the Scheme will also offer participants a contribution towards the completion of energy measures on the property and/or education support.

Bord na Móna is proposing to replicate its proven Community Gain Scheme model for Derrinlough Wind Farm and a Community Gain Scheme will be established for the proposed development in accordance with best practice requirements. The fund will be available for the lifetime of the project and will look to support the local community, through funding of projects and services, as required. A description of the Community Benefit proposal is outlined below and in the 'Derrinlough Wind Farm Community Report' which is contained in Appendix 2.3.

4.4.1 Community Gain and Near Neighbour Scheme

In addition to employment during the construction and operational phases of the proposed development and annual rates that will be paid to the local authority by the developer, a range of other benefits associated with the development will be provided to the local community through the annual Community Gain Scheme. The aim of this scheme is to provide financial assistance to local communities and not-for-profit organisations around the development. In order to be eligible for funding, projects must fall within the thematic areas of: Amenities, Community Facilities, Culture/Heritage, Energy Efficiency/Improvements, Education and Recreation/Health. A key criterion is that the projects and initiatives will benefit the communities surrounding the wind farm.

The Near Neighbour Scheme will offer electricity bill payers living within a prescribed distance of a wind turbine an annual contribution towards their electricity usage. In addition to the electricity contribution payment, the Scheme will also offer participants a contribution towards the completion of energy measures on the property and/or education support. This is in line with existing near neighbour schemes that are active at other Bord na Móna Powergen Wind Farms.

The value of the fund for the Community Gain and Near Neighbour Schemes will be directly proportional to the installed capacity and energy produced at the site, which based on current proposals, will be in the region of €10 million over the lifetime of the project.

4.4.2 Renewable Energy Participation Scheme Scheme/Community Ownership

Public Consultation on the Renewable Electricity Support Scheme (RESS) 1 closed for submissions in January 2020. The consultation paper set out the high-level details for the provision of a Renewable Energy Participation Scheme (REP Scheme) in Annex C (REP Scheme) for Community Participation in renewable developments. The key element proposed is:

- Providing Irish Citizens, or not for profit community entities (to be defined), to invest in renewable electricity generation projects in the Republic of Ireland - prioritising those that live in closer proximity to the Relevant Projects.

The Department of Communications, Climate Action and Environment envisage finalisation of the RESS Scheme in 2020.

If the proposed development utilises the RESS then any community benefit stipulations that are outlined in the finalised RESS will be incorporated into the operation of the wind farm and will be of enduring benefit to the local community.

4.5 Amenity Pathways and Carpark

Approximately 18 kilometres of amenity pathways (walkways and cycleways) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. The roads will be re-purposed following construction to form the amenity pathways, in addition to being used for maintenance access during operation. The amenity pathways will have a high quality, final surfacing granular fill.

In addition, approximately 6.5 km of dedicated amenity pathways are proposed to provide access points/links into and out of the site as follows:

- Internal link to R437 allowing further access to Drinagh and Derrybrat to facilitate potential future connection to Lough Boora Parklands.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link to the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

These amenity pathways and additional connections are discussed and shown in the Derrinlough Amenity Plan which is contained in Appendix 4.4 and are illustrated in Figure 4.1. The additional connections will be 3 metres in width and will be constructed using a similar methodology as outlined in Section 4.9.2.1 below.

A new public car park will also be provided for recreational use during the operational stage. The car park will be located adjacent to the proposed access off the R357, immediately north of the proposed substation. The location and configuration of the proposed car park, which will have capacity for 15 vehicles and will include suitable signage, is shown in Appendix 4.1. As outlined in Section 4.3.3, amenity connectivity between Clongawny and Drinagh Bogs will be via an underpass beneath the N62 only.

4.6 Site Drainage

4.6.1 Introduction

The drainage design for the proposed wind farm development has been prepared by Hydro Environmental Services Ltd. (HES), and by the firm's principal, Mr. Michael Gill. The drainage design has been prepared based on experience of the project team of other wind farm sites in peat-dominated environments, and the number of best practice guidance documents referred to in the References section of the EIAR.

The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. There is an existing drainage system and surface water discharges from the site which are regulated by the Environmental Protection Agency (Licence Ref. P0500-01). The proposed development drainage design for the proposed development has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. The assessment of potential impacts on hydrology and hydrogeology due to the construction, operation and decommissioning of the proposed development is included in Chapter 9: Hydrology and Hydrogeology.

No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones around the existing natural drainage features have been used to inform the layout of the proposed development.

4.6.2 Existing Drainage Features

The surface of the cutover bog is drained by a network of parallel field drains that are typically spaced every 15 - 20m. The field drains are approximately 0.5 - 1.5m deep and in most areas, they intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the two bogs. There are a number of shorter cross drains which intersect the small field drains. There are various outfalls on the bog boundaries which comprise mainly pumped outfalls but also some areas of gravity drainage. Surface water draining/pumped from the site is routed via settlement ponds (in accordance with the IPC licence requirements) prior to discharge into off-site drainage channels, streams and rivers.

4.6.3 Drainage Design Principles

Drainage water from any works areas of the wind farm site will not be directed to any natural watercourses within the site. Two distinct methods will be employed to manage drainage water within the site. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, to allow attenuation and settlement prior to controlled diffuse release.

The drainage design is intended to maximise erosion control, which is more effective than having to control sediment during high rainfall. Such a system also requires less maintenance. The area of exposed ground will be minimised. The drainage measures will prevent runoff from entering the works areas of the site from adjacent ground, to minimise the volume of sediment-laden water that has to be managed. Discoloured run-off from any construction area will be isolated from natural clean run-off.

4.6.4 Drainage Design

A preliminary drainage design for the proposed wind farm, incorporating all principles and measures outlined in this drainage design description, has been prepared, and is included in the drainage figures included in Appendix 4.5 to this EIAR. The proposed wind farm drainage process flow is shown on Figure 4.27. The drainage design employs the various measures further described below.

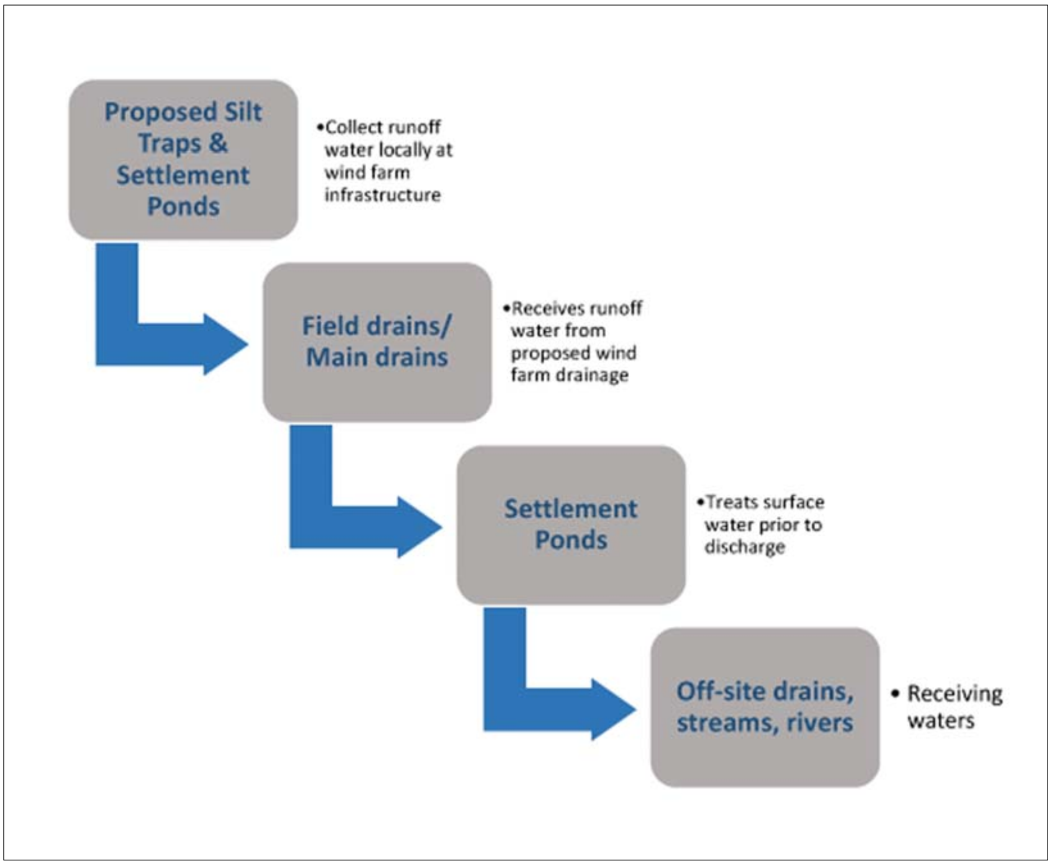


Figure 4.27 Proposed Wind Farm Drainage Process Flow

4.6.4.1 Interceptor Drains

Interceptor drains will be installed upgradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site where it might otherwise have come into contact with exposed surfaces and picked up silt and sediment. The drains will be used to divert upslope runoff around the works area to a location where it can be redistributed over the ground surface as sheet flow. This will minimise the volume of potentially silty runoff to be managed within the construction area.

The interceptor drains will be installed in advance of any main construction works commencing. The material excavated to make the drain will be compacted on the downslope edge of the drain to form a diversion dike. On completion of the construction phase works, it is envisaged that the majority of the interceptor drains will be removed. At that stage, there will be no open excavations or large areas of exposed ground that are likely to give rise to large volumes of potentially silt-laden run off. Any areas in which works were carried out to construct roads, turbine bases or hardstands, will have been built up with large grade hardcore, which even when compacted in place, will retain sufficient void space to allow water infiltrate the subsurface of these constructed areas. It is not anticipated that roadways or other installed site infrastructure will intercept ground-conveyed surface water runoff to any significant extent that would result in scouring or over-topping or spill over. Where the drains are to be removed, they will be backfilled with the material from the diversion dike. Interceptor drains may have to be retained in certain locations, for example where roadways are to be installed on slopes, to prevent the roadways acting as conduits for water that might infiltrate the roadway sub-base. In these cases, interceptor drains would be maintained in localised areas along the roadway with culverts under the roadway, which would allow the intercepted water to be discharged to vegetation filters downgradient of the roadway. Similarly, in localised hollows where water is likely to be funnelled at greater concentrations than on broader slopes, interceptor drains and culverts may be left in situ following construction.

The velocity of flow in the interceptor will be controlled by check dams (see Section 4.6.4.3), which will be installed at regular intervals along the drains to ensure flow in the channel is non-erosive. On steeper sections where erosion risks are greater, a geotextile membrane will be added to the channel.

Interceptor drains will be installed horizontally across slopes to run in parallel with the natural contour line of the slope. Intercepted water will travel along the interceptor drains to areas downgradient of works areas, where the drain will terminate at a level spreader (see Section 4.6.4.4). Across the entire length of the interceptor drains, the design elevation of the water surface along the route of the drains will not be lower than the design elevation of the water surface in the outlet at the level spreader.

4.6.4.2 Collector Drains

Collector drains are shallow drains that will be used to intercept and collect run off from construction areas of the site during the construction phase. Drainage swales will remain in place to collect runoff from roads and hardstanding areas of the proposed development during the operational phase. A swale is an excavated drainage channel located along the downgradient perimeter of construction areas, used to collect and carry any sediment-laden runoff to a sediment-trapping facility and stabilised outlet. Swales are proven to be most effective when a dike is installed on the downhill side. They are similar in design to interceptor drains and collector drains described above.

Collector drains will be installed downgradient of any works areas to collect surface flow runoff where it might have come into contact with exposed surfaces and picked up silt and sediment. Swales will intercept the potentially silt-laden water from the excavations and construction areas of the site and prevent it reaching natural watercourses.

Collector drains will be installed in advance of any main construction works commencing. The material excavated to make the swale will be compacted on the downslope edge of the drain to form a diversion dike.

4.6.4.3 Check Dams

The velocity of flow in the interceptor drains and collector drains, particularly on sloped sections of the channel, will be controlled by check dams, which will be installed at regular intervals along the drains to ensure flow in the swale is non-erosive. Check dams will also be installed in some existing artificial drainage channels that will receive waters from works areas of the site.

Check dams will restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam. The check dams will be installed as the interceptor drains are being excavated. Check dams may also be installed in some of the existing artificial drainage channels on the site, downstream of where drainage swales connect in.

The proposed check dams will be made up of straw bales or stone, or a combination of both depending on the size of the drainage swale it is being installed in. Where straw bales are to be used, they will be secured to the bottom of the drainage swale with stakes. Clean 4 to 6-inch stone will be built up on either side and over the straw bale to a maximum height of 600 mm over the bottom of the interceptor drain. In smaller channels, a stone check dam will be installed and pressed down into place in the bottom of the drainage swale with the bucket of an excavator.

The check dams will be installed at regular intervals along the interceptor drains to ensure the bottom elevation of the upper check dam is at the same level as the top elevation of the next down-gradient check dam in the drain. The centre of the check dam will be approximately 150 mm lower than the edges to allow excess water to overtop the dam in flood conditions rather than cause upstream flooding or scouring around the dams.

Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be left in place at the end of the construction phase to limit erosive linear flow in the drainage swales during extreme rainfall events.

Check dams are designed to reduce velocity and control erosion and are not specifically designed or intended to trap sediment, although sediment is likely to build up. If necessary, any excess sediment build up behind the dams will be removed. For this reason, check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

4.6.4.4 Level Spreaders

A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain, into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site, or areas where they are not likely to give rise to peat stability issues.

The water carried in interceptor drains will not have come in contact with works areas of the site, and therefore should be free of silt and sediment. The level spreaders will distribute clean drainage water onto vegetated areas where the water will not be re-concentrated into a flow channel immediately below the point of discharge. The discharge point will be on level or only very gently sloping ground rather than on a steep slope so as to prevent erosion.

The slope in the channel leading into the spreader will be less than or equal to 1%. The slope downgradient of the spreader onto which the water will dissipate will have a grade of less than 6%. The availability of slopes with a grade of 6% or less will determine the locations of level spreaders. If a slope grade of less than 6% is not available in the immediate area downgradient of a works area at the end of a diversion drain, a piped slope drain will be used to transfer the water to a suitable location.

The spreader lip over which the water will spill will be made of a concrete kerb, wooden board, pipe, or other similar piece of material that can create a level edge similar in effect to a weir. The spreader will be level across the top and bottom to prevent channelised flow leaving the spreader or ponding occurring behind the spreader. The top of the spreader lip will be 150mm above the ground behind it. The length of the spreader will be a minimum of four metres and a maximum length of 25 metres, with the actual length of each spreader to be determined by the size of the contributing catchment, slope and ground conditions.

Clean four-inch stone can be placed on the outside of the spreader lip, and pressed into the ground mechanically to further dissipate the flow leaving the level spreader over a larger area.

4.6.4.5 Vegetation Filters

Vegetation filters are the existing vegetated areas of land that will be used to accept surface water runoff from upgradient areas. The selection of suitable areas to use as vegetation filters will be determined by the size of the contributing catchment, slope and ground conditions.
Vegetation filters will carry outflow from the level spreaders as overland sheet flow, removing any suspended solids and discharging to the groundwater system by diffuse infiltration.

Vegetation filters will not be used in isolation for waters that are likely to have higher silt loadings. In such cases, silt-bearing water will already have passed through stilling (settlement) ponds prior to diffuse discharge to the vegetation filters via a level spreader.

4.6.4.6 Stilling Ponds/Settlement Ponds

Stilling ponds will be used to attenuate runoff from works areas of the site during the construction phase and will remain in place to attenuate runoff from roads and hardstanding areas of the proposed development during the operational phase. The purpose of the stilling ponds is to intercept runoff potentially laden with sediment and to reduce the amount of sediment leaving the disturbed area by reducing runoff velocity. Reducing runoff velocity will allow larger particles to settle out in the stilling ponds, before the run-off water is redistributed as diffuse sheet flow in filter strips downgradient of any works areas.

Stilling ponds will be excavated/constructed at each required location as two separate ponds in sequence, a primary pond and a secondary pond. The points at which water enters and exits the stilling ponds will be stabilised with rock aprons, which will trap sediment, dissipate the energy of the water flowing through the stilling pond system, and prevent erosion. The primary stilling pond will reduce the velocity of flows to less than 0.5 metres per second to allow settlement of silt to occur. Water will then pass from the primary pond to the secondary pond via another rock apron. The secondary stilling pond will reduce the velocity of flows to less than 0.3 metres per second. Water will flow out of the secondary stilling pond through a stone dam, partially wrapped in geo-textile membrane, which will control flow velocities and trap any sediment that has not settled out.

Water will flow by gravity through the stilling pond system. The stilling ponds will be sized according to the size of the area they will be receiving water from but will be sufficiently large to accommodate peak flows storm events. The stilling ponds will be dimensioned so that the length to width ratio will be greater than 2:1, where the length is the distance between the inlet and the outlet. Where ground conditions allow, stilling ponds will be constructed in a wedge shape, with the inlet located at the narrow end of the wedge. Each stilling pond will be a minimum of 1-1.5 metres in depth. Deeper ponds will be used to minimise the excavation area needed for the required volume.

The embankment that forms the sloped sides of the stilling ponds will be stabilised with vegetated turves, which will have been removed during the excavation of the stilling ponds area. All material excavated during pond construction will be used locally for landscaping and berm construction around these ponds.

Stilling ponds will be located towards the end of swales, close to where the water will be reconverted to diffuse sheet flow. Upon exiting the stilling pond system, water will be immediately reconverted to diffuse flow via a fan-shaped rock apron if there is adequate space and ground conditions allow. Otherwise, a swale will be used to carry water exiting the stilling pond system to a level spreader to reconvert the flow to diffuse sheet flow.

A water level indicator such as a staff gauge will be installed in each stilling pond with marks to identify when sediment is at 10% of the stilling pond capacity. Sediment will be cleaned out of the still pond if it exceeds 10% of pond capacity. Stilling ponds will be inspected weekly and following rainfall events.

Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

4.6.4.7 Silt Bags

Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing any remaining silt contained in the potentially silt-laden water collected from works areas within the site.

Dewatering silt bags are an additional drainage measure that can be used downgradient of the stilling ponds at the end of the drainage swale channels and will be located, wherever it is deemed appropriate, throughout the site. The water will flow, via a pipe, from the stilling ponds into the silt bag. The silt bag will allow the water to flow through the geotextile fabric and will trap any of the finer silt and sediment remaining in the water after it has gone through the previous drainage measures. The dewatering silt bags will ensure that there will be no loss of peaty silt into the stream.

The dewatering silt bag that will be used will be approximately 3 metres in width by 4.5 metres (see Plate 4.6 and Plate 4.7 below) in length and will be capable of trapping approximately four tonnes of silt. The dewatering silt bag, when full, will be removed from site by a waste contractor with the necessary waste collection permit, who will then transport the silt bag to an appropriate, fully licensed waste facility.

Plate 4.6 Silt Bag with water being pumped through

Plate 4.7 Silt bag under inspection

4.6.4.8 Sedimats

Sediment entrapment mats, consisting of coir or jute matting, will be placed at the outlet of the silt bag 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.

4.6.4.9 Silt Fences

Silt fences will be installed as an additional water protection measure around existing watercourses in certain locations, particularly where works are proposed within the 50-metre buffer zone of a stream.

Silt fences will be installed as single, double or a series of triple silt fences, depending on the space available and the anticipated sediment loading. The silt fence designs follow the technical guidance document *'Control of Water Pollution from Linear Construction Projects'* published by CIRIA (No. C648, 1996). Up to three silt fences may be deployed in series.

The Stage 1 (Coarse) silt fence will consist of a geotextile fabric such as Terram 1000 attached by staples to fixed stakes. The Terram sheets will be folded in an L shape with one metre extending horizontally in towards the works area. This horizontal section will be buried at a distance of approximately 150mm beneath a clean stone surface. Terram 1000 is a permeable fabric through which water can pass, but through which sediment particles cannot. It does however, impede water flow and can lead to the backing up of water and sediment, which reduce its effectiveness.

The Stage 2 (Medium) silt fence will consist of straw bales, embedded approximately 100mm into the soil/ground and fixed in place with stakes. A geotextile fabric will be pegged and stapled to the straw bales and stakes.

The Stage 3 (Fine) silt fence will be similar to the Stage 1 fence, with the addition of a course sand and/or fine gravel at the base of the geotextile.

In the case of all three types of fence, the geotextile fabric will be embedded at least 150mm below the ground surface.

In a small number of locations around the proposed site where space between the works areas and watercourses may be limited, silt fence designs will be combined to increase their effectiveness. For example, a straw bale silt fence (Stage 2) may be double wrapped with geotextile fabric (Stage 1) and course sand/fine gravel added on the upgradient side (Stage 3). The most suitable type, number or combination of silt fences will be determined on a location specific basis for the various parts of the site. Although they may be indicated in the drainage designs shown in Appendix 4.5 to be just a single line, silt fences may be installed in series on the ground.

Silt fences will be inspected regularly to ensure water is continuing to flow through the Terram, and the fence is not coming under strain from water backing up behind it.

4.6.4.10 Culverts

Culverts will be required where site roads, crane pads and turbine pads cross main bog drainage networks. Indicative locations of the culverts are shown on the drawings in Appendix 4.5.

Culverts will be installed with a minimum internal gradient of 1% (1 in 100). Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling doesn't occur above or below the culvert and water can continue to flow as necessary.

All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance.

4.6.5 Floating Road Drainage

Where sections of floating road are to be installed instead of excavated roads, cross drains will be installed beneath the road construction corridor to maintain existing clean water drainage paths. Large surface water drainage pipes will be placed at these locations below the level of the proposed road sub-base. These drainage pipes will be extended each side of the proposed road and cable trench construction corridor, along the paths of the existing drains.

With the exception of the installation of cross drains under the floating road corridor, minimal additional drainage will be installed to run parallel to the roads, in order to maintain the natural hydrology of the peatland areas over which the roads will be floated.

4.6.6 Cable Trench Drainage

Cable trenches are typically constructed in short controlled sections, thereby minimising the amount of ground disturbed at any one time and minimising the potential for drainage runoff to pick up silt or suspended solids. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section commences. This operation normally occurs over a period of 2-4 hours.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the up-gradient side of the trench and is temporarily sealed/smoothed over using the back of the excavator bucket. Should any rainfall cause runoff from the excavated material, the material is therefore collected and contained in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the proposed development, would be transported to one of the on-site borrow pit storage areas or used for landscaping and reinstatements of other areas elsewhere on site.

4.6.7 Site and Drainage Management

4.6.7.1 Preparative Site Drainage Management

All materials and equipment necessary to implement the drainage measures outlined above, will be brought on-site in advance of any works commencing.

An appropriate amount of straw bales, clean stone, terram, stakes, etc. will be kept on site at all times to implement the drainage design measures as necessary. The drainage measures outlined in the above will be installed prior to, or at the same time as the works they are intended to drain.

4.6.7.2 Pre-emptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the project will also take account of weather forecasts, and predicted rainfall in particular. Large excavations, large movements of overburden or large scale overburden or soil stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

4.6.7.3 Reactive Site Drainage Management

The final drainage design prepared for the proposed development prior to commencement of construction will have to provide for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the environmental clerk of works or supervising hydrologist on-site. The environmental clerk of works or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained in so far as is possible. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground as a particular time.

In the event that works are giving rise to siltation of watercourses, the environmental clerk of works or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

4.6.8 Drainage Maintenance

An inspection and maintenance plan for the drainage system onsite will be prepared in advance of commencement of any works. Regular inspections of all installed drainage features will be necessary, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water at parts of the systems where it is not intended. The inspection of the drainage system will be the responsibility of the environmental clerk of works or the supervising hydrologist. The drainage inspection and maintenance plan is included in the CEMP in Appendix 4.3 of this EIAR.

If necessary, any excess sediment build up behind check dams will be removed. For this reason, check dams will be inspected and maintained weekly during the construction phase of the project to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

Check dams will also be inspected weekly during the construction phase of the project and following rainfall events to ensure the structure of the dam is still effective in controlling flow. Any scouring around the edges of the check dams or overtopping of the dam in normal flow conditions will be rectified by reinforcement of the check dam.

Drainage swales will be regularly inspected for evidence of erosion along the length of the swale. If any evidence of erosion is detected, additional check dams will be installed to limit the velocity of flow in the channel and reduce the likelihood of erosion occurring in the future.

A water level indicator such as a simple staff gauge or level marker will be installed in each silt trap with marks to identify when sediment is at 50% of the trap's capacity. Sediment will be cleaned out of the silt trap when it exceeds 50% of trap capacity. Silt traps will be inspected weekly during the construction phase of the project and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

The frequency of drainage system inspections will be reduced following completion of the construction phase of the project. Weekly inspections during the construction phase will be reduced to monthly, bi-monthly and eventually quarterly inspections during the operational phase. The frequency will be increased or decreased depending on the effectiveness of the measures in place and the amount of remedial action required in any given period.

4.7 Construction Management

4.7.1 Construction Timing

It is estimated that the construction phase will take approximately 24 to 30 months from starting onsite to the full commissioning of the wind farm. The commencement of construction works where the removal of woody vegetation is required, or where works take place in sensitive breeding habitats (such as birch scrub and emergent wetland vegetation), will be scheduled to occur outside the bird nesting season (1st of March to 31st of August) to avoid any potentially significant effects on currently nesting birds. Construction may commence at any stage from September onwards to March, so that construction activities are ongoing by the time the next breeding bird season comes around, and can continue throughout the next breeding season.

4.7.2 Construction Sequencing

The construction phase can be broken down into three main phases, 1) civil engineering works: 18 months, 2) electrical works: 18 months, and 3) turbine erection and commissioning: 9 months. The main task items under each phase are outlined below.

Civil Engineering Works

- Create new entrance(s) and hardcore existing entrances (where required).
- Construct new site roads (permanent and temporary), drainage ditches and culverts.
- Clear and hardcore area for temporary site offices. Install same.
- Construct remaining new site roads and hard-standings and crane pads.
- Construct underpasses beneath the N62 and the existing industrial railway line.
- Construct the substation, control buildings and groundworks for the substation compound.
- Excavate/pile for turbine bases where required. Store soil/peat locally for backfilling and re-use. Place blinding concrete to turbine bases. Fix reinforcing steel and anchorage system for tower section. Construct shuttering. Fix any ducts etc. to be cast in. Pour concrete bases. Cure concrete. Remove shutters after 1-2 days.

Electrical Works

- Construct bases/plinths for transformer.
- Excavate trenches for site cables, lay cables and backfill. Provide ducts at road crossings.
- Install external electrical equipment at substations
- Install transformer at compound.
- Erect stock proof and palisade fencing around substation area.
- Install internal collector network and communication cabling.
- Construct grid connection.

Turbine Erection and Commissioning

- Backfill tower foundations and cover with suitable material.
- Erect towers, nacelles and blades.
- Complete electrical installation.
- Install anemometry masts and decommission and remove existing mast.
- Commission and test turbines.
- Complete site works, reinstate site.
- Remove temporary site offices. Provide any gates, landscaping, signs etc. which may be required.

The phasing and scheduling of the main construction task items are outlined in Figure 4.28 below, where 1st October 2022(Q4 2022) has been selected as an arbitrary start date for construction activities.

ID	Task Name	Task Description	Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023	Q1 2024	Q2 2024	Q3 2024
1	Site Health and Safty									
2	Site Compounds	Site Compounds, site access, fencing, gates								
3	Site Roads	Construction/upgrade of roads, construct underpasses install								
4	Turbine Hardstands	Excavate/pile for turbine bases where required								
5	Turbine Foundations	Fix reinforcing steel and anchorage system, erect								
6	Substation Construction and Electrical Works	Construct substation, underground cabling, grid								
7	Backfilling and Landscaping									
8	Turbine Delivery and Erection									
9	Substation Commissioning									
10	Turbine Commisioning									

Figure 4.28 Indicative Construction Schedule

4.7.3 Construction Phase Monitoring and Oversight

The requirement for a Construction and Environmental Management Plan (CEMP) to be prepared in advance of any construction works commencing on any development site and submitted for agreement to the Planning Authority is now well-established and is addressed in Section 4.3.13. The proposed procedures for the implementation of the mitigation measures outlined in such a CEMP and their effectiveness and completion is typically audited by way of a Construction and Environmental Management Plan Audit Report. The CEMP Audit Report effectively lists all mitigation measures prescribed in any of the planning documentation, all conditions attached to the grant of planning permission and any further mitigation measures proposed during the detailed design stage, and allows them to be audited on a systematic and regular basis. The first assessment is a simply Yes/No question, has the mitigation measure been employed on-site or not? Following confirmation that the mitigation measure has been implemented, the effectiveness of the mitigation measures has to be the subject of regular review and audit during the full construction stage of the project. If some remedial actions are needed to improve the effectiveness of the mitigation measure, then these are notified to the site staff immediately during the audit site visit, and in writing by way of the circulation of the audit report. Depending on the importance and urgency of rectifying the issue, the construction site manager is given a timeframe by when the remedial works need to be completed.

The Contractor will be responsible for implementing the mitigation measures specified throughout the EIAR and compiled in the Audit Report which is included in the CEMP. The Contractor will also be responsible for ensuring that all construction staff understand the importance of implementing the mitigation measures. The implementation of the mitigation measures will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.

4.8 Construction Methodologies

4.8.1 Turbine Foundations

Foundations for wind turbines may be of the gravity, rock anchored or piled type. Trial pitting, peat probing and gouge coring has been carried out at each of the turbine base locations to determine the depth of excavation and fill required (refer to Section 4.3.11 and Section 4.3.12). Based on the geotechnical investigations to date, the majority of the foundations at the proposed Derrinlough wind farm are expected to be piled. Piling depths will depend on site conditions. These will be established by confirmatory geotechnical investigations prior to the construction of the proposed development. The exact dimensions of foundations will be determined by pre-construction structural design calculations incorporating appropriate factors of safety.

Each of the turbines to be erected on site will have a reinforced concrete base. Overburden will be stripped off the foundation area to a suitable formation using a 360° excavator and will be placed across the site as close to the excavation as practical. A five-metre-wide working area will be required around each turbine base, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be surrounded by silt fences to ensure sediment-laden run-off does not occur.

The formation material will have to be approved by an engineer as meeting the turbine manufacturer's requirements. If the formation level is reached at a depth greater than the depth of the foundation, the ground level will have to be raised with clause 804 or similar hardcore material, compacted in 250 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with typically seven passes using 12 tonne roller). Drainage measures will be installed to protect the formation by forming an interceptor drain around the perimeter of the base which will outfall out at the lowest point level spreader or settlement pond.

An embankment approximately 600 mm high will be constructed around the perimeter of each turbine base and a fence will be erected to prevent construction traffic from driving into the excavated hole and to demarcate the working area. All necessary health and safety signage will be erected to warn of deep excavations etc. Access to and from excavated bases will be formed by excavating a pedestrian walkway to 1:12 grade.

There will be a minimum of 100 mm of blinding concrete laid on the formation material positioned using concrete skip and 360° excavator to protect ground formation and to give a safe working platform.

The anchor cage is delivered to site in 2 or more parts depending on the turbine type. A 360° excavator with suitable approved lifting equipment will be used to unload sections of the anchor cage and reinforcing steel. The anchor cage is positioned in the middle of the turbine base and is assembled accordingly. When the anchor cage is in final position it is checked and levelled by using an appropriate instrument. The anchor cage is positioned 250mm – 300mm from formation level by use of adjustable legs. Reinforcement bars are then placed around the anchor cage, first radial bars, then concentric bars, shear bars and finally the superior group of bars. Earthing material is attached during the steel foundation build up. The level of the anchor cage will be checked again prior to the concrete pour and during the concrete pour

Formwork to concrete bases will be propped/supported sufficiently so as to prevent failure. Concrete for bases will be poured using a concrete pump. Each base will be poured in three stages. Stage 1 will see the concrete being poured and vibrated in the centre of the anchor cage to bring the concrete up to the required level inside the cage. Stage 2 will see the centre of the steel foundation being poured and vibrated to the required level. Stage 3 will see the remaining concrete being poured around the steel foundation to bring it up to the required finished level. After a period of time when the concrete has set sufficiently the top surface of the concrete surface is to be finished with a power float.

Once the base has sufficient curing time it will be backfilled with suitable fill up to existing ground level and finished with the original material that was excavated.

4.8.2 Site Roads and Crane Pad Areas

The construction methodologies for the road types and crane pad areas are listed in Section 4.3.2 below are set out below.

Straight sections of proposed roadways will require a running width of approximately 6 metres (6.5m including shoulders) to accommodate the transportation of large turbine components. Corners and junctions will have to be wider than six metres to allow the trucks to manoeuvre around bends. The proposed new roadways will incorporate passing bays to allow traffic to pass easily while traveling around the site. All site access roads will comply with the turbine supplier's requirements.

4.8.2.1 Construction of New Floating Roads

Floating access roads are the predominant road construction type proposed for the site and will be used in areas where the peat depth is in excess of 1m. The use of new floated access tracks will be limited on site to areas of flatter terrain i.e. typically less than 5 degree slope.

The general construction methodology for the construction of floating roads, as presented in FTC's Peat and Spoil Management Plan in Appendix 4.2, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *Prior to commencing floating road construction movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Floating road construction shall be to the line and level requirements as per design/planning conditions.*
3. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
4. *Construction of road to be in accordance with appropriate design from the designer.*
5. *The typical make-up of the new floated access road is up to 1,200mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a geotextile separator. This may vary depending on designer requirements.*
6. *Following the detailed design of the floated access roads it may be deemed necessary to include pressure berms either side of the access road in some of the deeper peat areas. The inclusion of a 5m wide pressure berm (typically 1m in height) either side of the access road will reduce the likelihood of potential bearing failures beneath the access road.*
7. *The finished road surface width will be approximately 6m (to be confirmed by the designer).*
8. *Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.*
9. *To avoid excessive impact loading on the peat due to concentrated end-tipping all stone delivered to the floating road shall be tipped over at least a 10m length of constructed floating road.*
10. *Where it is not possible to end-tip over a 10m length of constructed floating road then dumpers delivering stone to the floating road shall carry a reduced stone load (not greater than half full) until such time as end-tipping can be carried out over a 10m length of constructed floating road.*
11. *Following end-tipping a suitable bull-dozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*
12. *A final surface layer shall be placed over the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

4.8.2.2 Construction of New Excavated Roads

The general construction methodology for the construction of excavated roads, as presented in the Peat and Spoil Management Plan (Appendix 4.2), is summarised below. This methodology includes procedures that are to be included in construction to minimise any adverse impact on peat stability.

1. *Prior to commencing the construction of the excavated roads movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.*
3. *Excavation of roads shall be to the line and level given in the design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer).*
4. *Road construction should be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without re-placement with stone fill unless otherwise agreed with the site designer or resident engineer on site.*
5. *All excavated peat shall be placed/spread alongside the excavations.*
6. *Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required. Battering of the side slopes of the excavations should be carried out as the excavation progresses.*
7. *The surface of the finished excavated access road will be 1.2m above existing ground level.*

8. *A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).*
9. *At transitions between floating and excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated roa.*
10. *Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability. It should be noted that slopes greater than 5 degrees are not envisaged on site.*
11. *A final surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

4.8.2.3 Upgrade of Existing Roads

This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations.

1. *Access road construction shall be to the line and level requirements as per design/planning conditions.*
2. *For upgrading of existing excavated access tracks the following guidelines apply:*
    a. *Excavation of the widened section of access road should take place to a competent stratum beneath the peat (as agreed with the designer) and backfilled with suitable granular fill.*
    b. *Benching of the excavation may be required between the existing section of access road and the widened section of access road depending on the depth of excavation required.*
    c. *The surface of the existing access track should be overlaid with up to 500mm of selected granular fill.*
    d. *A layer of geogrid/geotextile may be required at the surface of the existing access track and at the base of the widened section of access road (to be confirmed by the designer).*
    e. *For excavations in peat, side slopes shall be not greater than 1 (v): 2 or 3 (h). This slope inclination should be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required.*
3. *For upgrading of existing access tracks constructed using a floated construction technique the following guidelines apply:*
    a. *The surface of the existing access track should be graded/tidied up prior to the placement any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*
    b. *Where granular fill has been used in the existing access track make-up, a layer of geogrid should be placed on top of the existing access track.*
    c. *The geogrid may be overlaid with up to 500mm of selected granular fill.*
    d. *Additional geogrid and granular fill may be required in certain sections of the works (to be confirmed by the designer).*
4. *Where the ground is sloping across a section of access road (side long ground) any road widening works required should be done on the upslope side of the existing access road, where possible.*
5. *At transitions between floating and existing excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated road.*

6. *A final surface layer shall be placed over the existing access track, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

4.8.2.4 Crane Hardstands

All crane pads will be designed taking account of the loadings provided by the turbine manufacturer and will consist of a compacted stone structure. The crane hardstands will be constructed in a similar manner to the excavated site roads and will measure approximately to the turbine manufacturer's requirements. Where an excavated crane hardstand cannot be used due to the depth of peat, the hardstand will be supported by using reinforced concrete piles as per the methodology outlined for piled foundations summarised below. The position of the crane pads varies between turbine locations depending on topography, position of the site access road, and the turbine position.

4.8.3 Underpass

As outlined in Section 4.3.3, two permanent underpasses are proposed as part of the proposed development, the locations of which are as follows:

- Beneath the N62, immediately north of Derrinlough Briquette Factory.
- Beneath an existing Bord na Móna railway line in Clongawny Bog, immediately west of the N62 underpass.

Both underpasses will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used occasionally by vehicles for wind farm maintenance during the operational phase.

The underpasses will be approximately 35m in length, 4.5m wide and 4.5m high and will take the form of precast concrete box culverts which will be founded on an in-situ concrete base slab. As a worst-case, the structures may need to be underpinned by piles which have been assessed in this EIAR.

The method of construction proposed will ensure that the N62 will remain open during construction though traffic control will be required. It is envisaged that the structure will be completed in two phases, through single lane closure, in order to maintain traffic flow as follows:

- The site will be cleared and prepared for construction works. Material excavated will be stored locally for later reuse, where practicable.
- Temporary sheet piled walls will be installed to reduce the working width required and to provide protection and support to the excavations.
- One side of the existing road surface will be excavated to a depth of 6.5m.
- The required foundations for the precast concrete units will then be installed as required by the designers.
- A mobile telescopic crane will be required to lift the precast elements into place therefore temporary crane hardstands (approximately 25m x 10m) will be constructed on each side of the N62. Suitable laydown areas close to the excavation will also be required for storage of the precast elements upon delivery to site.
- The precast concrete box and wingwall sections will be placed in position by the telescopic crane. Elements of the installation may have to take place during off-peak periods and thus some limited night-time working is envisaged.
- Once the pre-cast elements are in place the area will be backfilled and the structural layers of the road will be built up.
- Road crash barriers will then be installed
- The above steps will be repeated for the other side of the road.
- The final road resurfacing (wearing course) will be installed and road edge protection will be completed.

Site drainage will be provided during the works to collect runoff which will be directed to a settlement pond.

A Traffic Management Plan will be implemented during the construction of the proposed development and will include for the construction of the underpass beneath the N62. This will be agreed prior to commencement of works with Offaly County Council and TII. The temporary traffic management arrangement will include some form of lane restrictions/road closures in order to construct the underpass.

4.8.4 Cable Trenching

The transformer in each wind turbine is connected to the substation through a network of buried electrical cables. The ground is trenched typically using a mechanical excavator. The top layer of soil is removed and saved so that it is replaced on completion. The electrical cables from wind turbines to the substation will be run in ducts approximately 1.2m below the ground surface. Typical trench details can be seen in Figure 4.14. On completion, the ground will be reinstated as previously described above.

Plate 4.8 Typical Cable Trench View

4.8.5 Grid Connection

As stated in Section 4.3.8 above, the proposed wind farm will connect to the existing national grid via a substation, in the north-eastern part of the Drinagh bog, and associated grid connections. The proposed wind farm will connect to the national electricity grid via either 110 kV overhead line or 110 kV underground cable.

4.8.5.1 Underground Cabling

The proposed underground cable option will be facilitated through two cable interface masts under the existing Shannonbridge to Portlaoise 110 kV overhead line. The existing overhead line conductor will be terminated at these two new structures in order to facilitate the looped cabling. There will be a double circuit underground trenching arrangement which will consist of 6 No. 160mm diameter HDPE power cable ducts to be installed into an excavated trench. This trench will be typically 2000mm wide by 1250mm deep to facilitate cabling into the station and trenching to accommodate 6 No. 160mm diameter HDPE power cable ducting exiting the station and continuing back to the interface masts.

The ducts are protected by CBM4 lean-mix concrete with cable protection strip laid over the concrete, warning tape, protective plates (if required) and backfill material. The trench will form part of a newly constructed permanent access track which will be utilised for maintenance and inspection works for the underground cable. The transition of the cabling system from underground into Derrinlough 110 kV Substation will be facilitated via cable chair.

The following text outlines the methodology to be followed during trenching works:

- Grade, smooth and trim trench floor when the required 1250mm depth and 2000mm width have been obtained. Any peat in cable trench to be removed and replaced with granular material.
- Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the ESB specification.
- Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
- Place cable protection strips on compacted CBGM B directly over the ducts.
- Lay the top row of ducts onto the freshly compacted CBGM B including the cable protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
- Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
- Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
- For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority.
- For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner.
- Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable installation at a later date. Excavated material will be stored close to the trench and utilised throughout the works.

4.8.5.2 Overhead Lines

The proposed design for the 110kV Looped line from the existing overhead line will require two new Loop In towers which will be constructed under the existing Shannonbridge – Portlaoise 110kV OHL. The existing OHL conductor will be terminated at these two interface structures in order to facilitate an OHL loop into Derrinlough 110kV Substation via lattice angle towers, terminal towers and onto gantry dropper's arrangement. The existing conductor will be removed between the loop in towers with the new connection looped through to the new Derrinlough 110kV Substation.

The new Loop In structure locations have been selected based on ground surveys, ground profiles, allowable angles and ruling span checks.

The following section outlines the methodology to be followed during construction works of the new Loop In tower structures which will be constructed underneath the existing 110 kV overhead line;

- The Steel lattice tower sites are scanned for underground services such as cables etc. Consultation with the landowner will help to identify services / constraints and ensure there are no unidentified services in the area.
- For each leg of 6 No. towers (24 in total) a foundation c.3m x 3.6m x 3.6m is excavated and the formation levels (depths) will be checked by the onsite foreman. See Plate 4.9 The excavated material will be temporarily stored close to the excavation and excess material will be used as berms along the site access roads.
- To aid construction, a concrete pipe is placed into each excavation to allow operatives level the mast at the bottom of the excavation. The frame of the reinforcing bars will be prepared and strapped to a concrete pipe with spacers as required. The reinforcing bars will be lifted into each excavated foundation using the excavator and chains/slings. The base and body section of each tower will then be assembled next to excavation.
- Concrete trucks will pour concrete directly into each excavation in distinct stages.
- A third pour for the leg of the tower 1m x 1m and will be 300mm over ground level.
- Once the main concrete foundation pour is cured after circa five days, metal shuttering is installed to accommodate the placement of concrete around the tower legs. During each pour, the concrete will be vibrated thoroughly using a vibrating poker.
- Once the concrete is set after the five days the shuttering is removed.
- The tower foundations will be backfilled one leg at a time with the material already excavated at the location. The backfill will be placed and compacted in layers. All dimensions will be checked following the backfilling process. All surplus excavated material and removed from the tower locations and stored in berms adjacent to the Substation Compound or distributed on site in accordance with approved environmental procedures.
- The existing overhead line will be de-energised by ESB so work can commence on the construction of the towers.
- An earth mat consisting of copper or aluminium wire will be laid circa 400mm below ground around the tower. This earth mat is a requirement for the electrical connection of the equipment on the tower structure.
- Once the base section of each tower is completed and the concrete sufficiently cured, it is ready to receive the tower body. Temporary hardstands may be removed and disposed of off site where necessary. See Plate 4.10.
- A hardstand area for the crane will be created by laying geogrid material on the ground surface and overlaying this geogrid with a suitable grade of aggregate.
- A physical barrier (Heras Fence Site Boundary) will be put in place to restrict plant from coming too close to the OHL.
- The towers will be constructed lying flat on the ground beside the recently installed tower base.
- The conductor will be moved off centre using a stay wire and weights to anchor the stay wire to ground.
- The tower section will be lifted into place using the crane and guide ropes.
- The body sections will be bolted into position.
- The conductor will be centred over the towers and held in place. Once the conductor is secured at both ends it is then cut and attached onto each tower. The section of conductor in between the two towers will be removed and utilised as connector wire for the new towers. See Plate 4.11

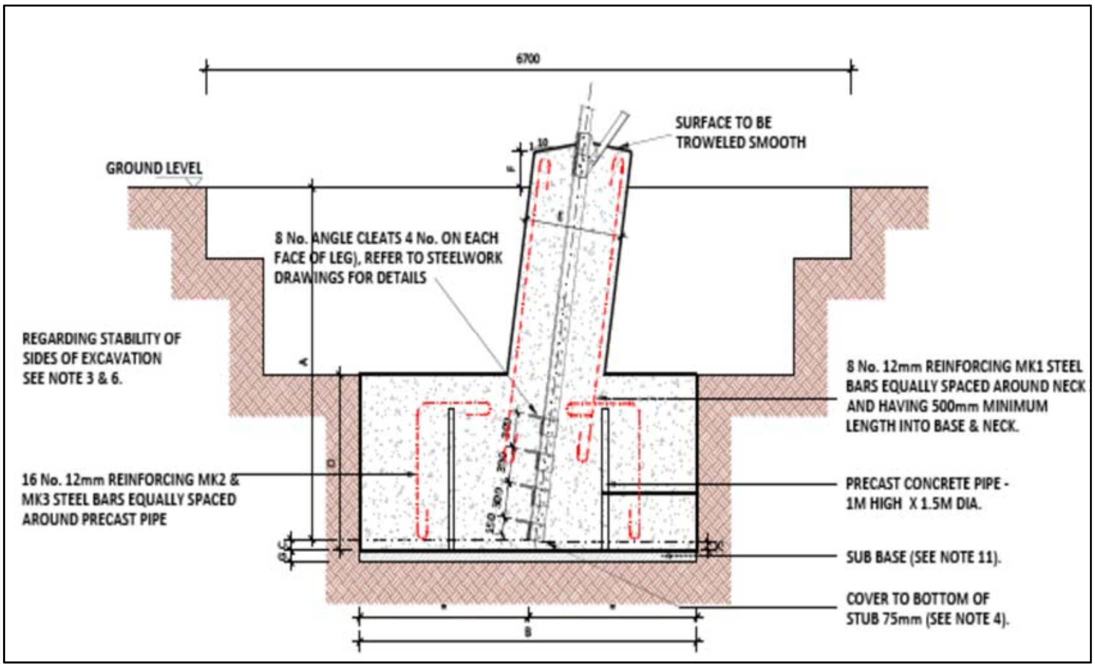


Plate 4.9 Steel lattice tower foundation

Plate 4.10 Steel lattice tower foundation complete

Plate 4.11 Completed End Mast Tower

4.8.5.3 Stringing of Conductors

Stringing of overhead lines on the supporting lattice structures will be kept clear of all obstacles along the straight by applying sufficient tension. This method requires the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (Steel rope) which is subsequently used to pull the conductors from the drum stands using specifically designed "puller – tensioner" machines (Plate 4.12). The main advantages with this method are:

- The line is protected from surface damage
- Major obstacles can be completed without any significant disruption.

Plate 4.12 Puller – Tensioner Machine

Once the conductors have been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist. Bird flight diverters or warning spheres can be added following the sagging procedure if required.

4.8.6 Anemometry Mast Removal

There is an existing 100m high meteorological mast (Pl. Ref. 17/155) on Clongawny Bog which will be decommissioned, disassembled and removed from site as it will no longer be required due to the presence of the 2 No. new masts. The disassembly process will generally follow the sequencing shown on Table 4.4.

Table 4.4 Met Mast Removal Sequencing

Demolition Sequence	Description
Removal of Equipment	Equipment and monitors on the mast will be removed
Removal of hazardous materials	Electrical cabling, solar panels and other remaining electrical equipment
Removal of Mast Structure	Disassemble Mast Structure
Removal of Groundworks	Ground anchors will either be dug up and removed or remain in situ
Source segregation of material fractions	C&D waste recovery
Transport of materials to authorised facilities	Authorised Waste Collection Permit holders and Waste Facility or Licence holders.

4.8.7 Onsite Electricity Substation and Control Building

Once ground preparation as per the methodology for site roads as described in Section 4.3.2 is completed, the onsite substation will be constructed by the following methodology:

- The area of the onsite substation will be marked out using ranging rods or wooden posts and the soil and overburden stripped and removed to nearby temporary storage area for later use in landscaping..
- The dimensions of the onsite substation area will be set to meet the requirements of Eirgrid and the necessary equipment to safely and efficiently operate the permitted wind farms;
- Two control buildings will also be built within the onsite substation compound;
- The foundations will be excavated down to the level indicated by the designer and appropriately shuttered reinforced concrete will be laid over it. An anti-bleeding admixture will be included in the concrete mix;
- The block work walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors;
- The block work will then be raised to wall plate level and the gables and internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- The concrete roof slabs will be lifted into position using an adequately sized mobile crane;
- The timber roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.
- The electrical equipment will be installed and commissioned.

- Perimeter fencing will be erected.
- The construction and components of the substation will be to ESB or Eirgrid specifications.

4.8.8 Temporary Construction Compounds

The temporary construction compounds will be constructed as follows:

- The area to be used as the compound will be marked out at the corners using ranging rods or timber posts. Drainage runs and associated settlement ponds will be installed around the perimeter;
- The compound platform will be established using a similar technique as the construction of the substation platform discussed above;
- A layer of geo-grid will be installed and compacted layers of well graded granular material will be spread and lightly compacted to provide a hard area for site offices and storage containers;
- Areas within the compound will be constructed as site roads and used as vehicle hardstandings during deliveries and for parking;
- The compound will be fenced and secured with locked gates if necessary; and,
- Upon completion of the proposed development the temporary construction compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with topsoil as required.

4.9 Operation

The proposed development is expected to have a lifespan of approximately 30 years. Planning permission is being sought for a 30-year operation period commencing from the date of full operational commissioning of the wind farm. During the operational period, on a day-to-day basis the wind turbines will operate automatically, responding by means of anemometry equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together and data relayed from the wind turbines to an off-site control centre. Each turbine will also be monitored off-site by the wind turbine supplier. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at an off-site control centre 24-hours per day.

Each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation and site tracks will also require periodic maintenance.

4.10 Decommissioning

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the proposed development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB/EirGrid.

Upon decommissioning of the proposed development, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration. . Site roadways will be in use as amenity and recreational pathways, and therefore will not be removed during decommissioning. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with Offaly County Council three months prior to decommissioning the proposed development. An outline decommissioning plan is contained in the CEMP in Appendix 4.3.

However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential significant, direct and indirect effects of the proposed Derrinlough Wind Farm development on population and human health and has been completed in accordance with the EIA guidance and legislation set out in Chapter 1: Introduction. The full description of the Proposed Development is provided in Chapter 4 of this EIAR.

One of the principal concerns in the development process is that individuals or communities, should experience no significant diminution in their quality of life from the direct or indirect effects arising from the construction, operation and decommissioning of a development. Ultimately, all the impacts of a development impinge on human health, directly and indirectly, positively and negatively. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values, shadow flicker, noise and health and safety.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin Gilson and Karen Mulryan and reviewed by Michael Watson, of MKO. Eoin is an environmental scientist with over two years of experience with MKO and has prepared the Population and Human Health chapter for a number of wind energy EIARs in that time. Eoin holds a BSc (Hons) in Microbiology and a MSc (Hons) in Applied Environmental Science Karen is an environmental scientist with over 3 years' experience in the commercial sector where she has undertaken extensive site surveys, watching briefs and report writing. She holds a BA and MSc in Archaeology and Heritage Studies. Michael Watson is a Project Director with MKO; with over 18 years' experience in the environmental sector. His project experience includes the management and productions of Environmental Impact Statements (EISs)/EIARs, particularly within the wind energy sector.

5.2 Population

5.2.1 Receiving Environment

Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the County Offaly Development Plan 2014 – 2020, Fáilte Ireland and any other literature pertinent to the area. The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2016, which is the most recent census for which a complete dataset is available, also the Census of Ireland 2011, the Census of Agriculture 2010 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town and District Electoral Division (DED) level.

The proposed development is located within several townlands as listed in Table 1.1 of Section 1.1 of this EIAR. The proposed wind farm site is located approximately 2km south of the town of Cloghan and 3.4km east of the town of Banagher, in County Offaly. Please refer to Figure 1.1 of Chapter 1: Introduction for the site location.

In order to assess the population in the vicinity of the proposed development, the Study Area for the Population section of this EIAR was defined in terms of the District Electoral Divisions (DEDs) where the proposed wind farm is located, as well as nearby DEDs which may be affected by the proposed development. The site of the proposed development lies predominantly within Banagher, Mounterin, Eglish, Derryad, Shannonharbour, Cloghan and Gallen DEDs as shown in Figure 5.1. All of these DEDs will collectively be referred to hereafter as the Study Area for this chapter.

The Population Study Area has a population of 4,601 persons, as of 2016 and comprises a total land area of 170.58 km^2 (Source: CSO Census of the Population 2016).

The closest dwelling to the proposed Derrinlough Wind Farm is located approximately 762m from the nearest proposed turbine (T15), i.e. greater than the recommended setback distance (i.e. 4 times the tip height, 740m), as per the Draft Revised Wind Energy Development Guidelines December 2019 (currently out for public consultation).

5.2.2 Population Trends

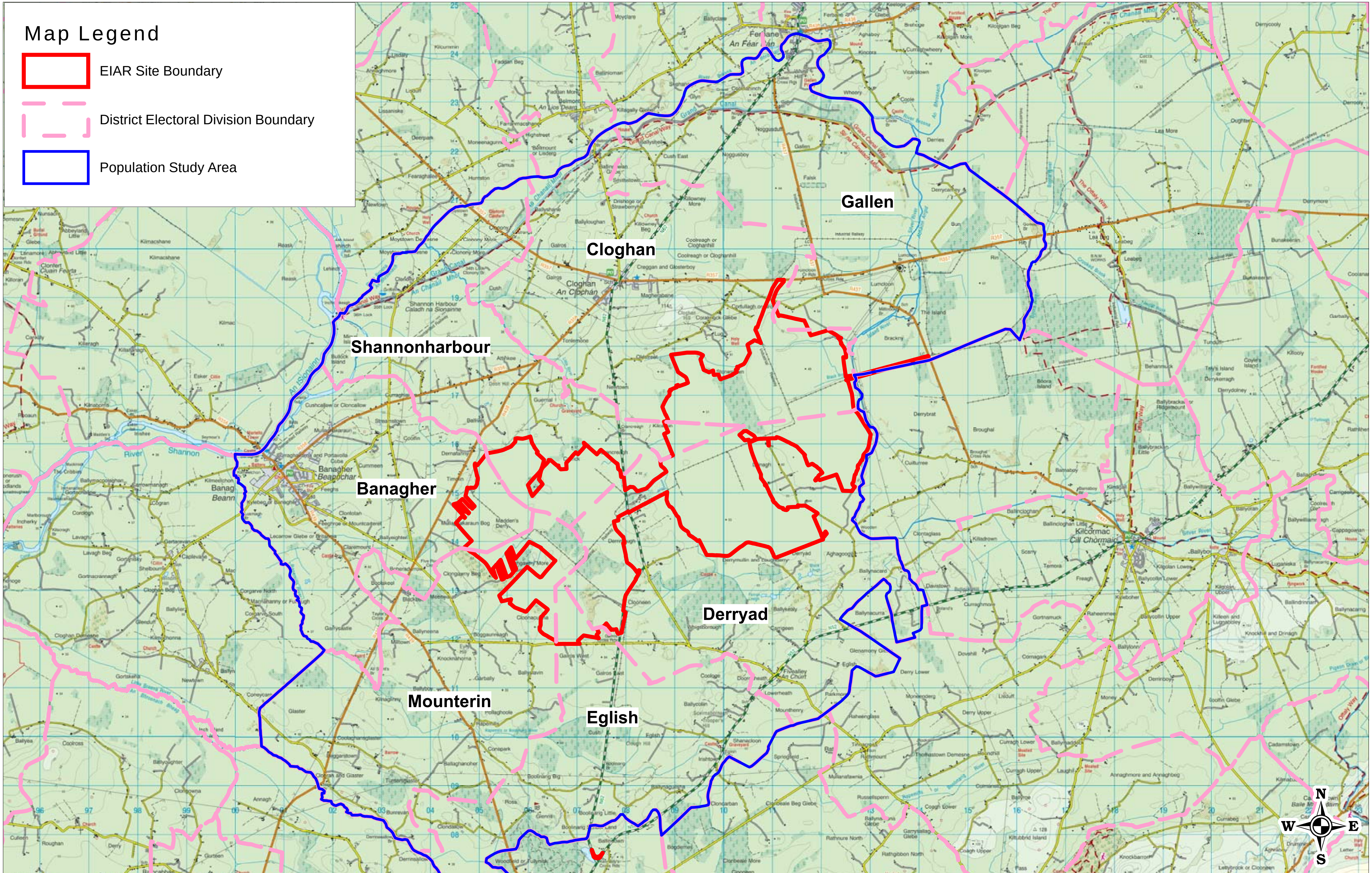
In the four years between the 2011 and the 2016 Census, the population of Ireland increased by 3.8%. During this time, the population of County Offaly grew by 1.7% to 77,961 persons. Other population statistics for the State, County Offaly and the Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5.1.

Table 5.1 Population 2011 – 2016 (Source: CSO)

Area	Population Change		% Population Change
	2011	2016	2011 - 2016
State	4,588,252	4,761,865	3.8
County Offaly	76,687	77,961	1.7
Study Area	4,530	4,601	1.6

The data presented in Table 5.1 shows that the population of the Study Area increased by 1.6% between 2011 and 2016. This rate of population growth is lower than that recorded at State level but is similar to the County level. When the population data is examined in closer detail, it shows that the rate of population increase within the Study Area has been unevenly spread through the District Electoral Divisions (DEDs). The highest increase in the population between 2011 and 2016 occurred within Banagher DED, which experienced a 5.7% population increase. In comparison, the populations of Mounterin DED, Shannonharbour DED, Cloghan DED and Gallen DED all decreased during the same time period.

Of the DEDs that make up the Study Area for this assessment, the highest population was recorded in Banagher DED, with 2,106 persons recorded during the 2016 Census. The lowest population was recorded in Eglish DED, with 147 persons recorded during the 2016 Census.



MAP TITLE: Population Study Area | MAP NO.: Figure 5.1 | SCALE: 1:100,000

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5.2.3 Population Density

The population densities recorded within the State, County Offaly and the Study Area during the 2016 Census are shown in Table 5.2.

Table 5.2 Population Density in 2016 (Source: CSO)

Area	Population Density (Persons per square kilometre)	
	2011	2016
State	65.57	68.06
County Offaly	38.32	38.96
Study Area	25.56	26.97

The population density of the Study Area recorded during the 2016 Census was 26.97 persons per km^2. This figure is significantly lower than the national population densities of 68.06 persons per km^2 and lower than the county population densities of 38.96 persons per km^2.

Similar to the observed population and household trends, the population density recorded across the Study Area varies between DEDs. Eglish DED has the lowest population density, at 7.55 persons per km^2, while Banagher DED has the highest population density, at 106.47 persons per km^2.

5.2.4 Household Statistics

The number of households and average household size recorded within the State, County Offaly and the Study Area during the 2011 and 2016 Censuses are shown in Table 5.3.

Table 5.3 Number of Household and Average Household Size 2011 – 2016 (Source: CSO

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,654,208	2.8	1,697,665	2.8
County Offaly	26,750	2.9	27,343	2.8
Study Area	1,581	2.8	1,668	2.7

In general, the figures in Table 5.3 show that while the number of households within the State, County and the 7 DEDs has increased slightly, the average number of people per household decreased slightly. Average household size recorded within the Study Area during the 2011 and 2016 Censuses are in line with that observed at State and County level during the same time periods. Similar to the trends observed above, the average household size recorded across the Study Area varies between DEDs. Mounterin DED had the highest, with 3.1 persons per household recorded in 2011 and 2016 respectively. Shannonharbour DED and Cloghan DED both recorded the lowest, with 2.8 and 2.7 persons per household recorded in 2011 and 2016, respectively.

5.2.5 Age Structure

Table 5.4 presents the population percentages of the State, County Offaly and Study Area within different age groups as defined by the Central Statistics Office during the 2016 Census. This data is also displayed in Figure 5.2.

Table 5.4 Population per Age Category in 2016 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	1,006,552	576,452	1,406,291	1,135,003	637,567
County Offaly	17,727	9,358	21,191	19,094	10,591
Study Area	879	559	1188	1213	762

The proportion of the DED Study Area population within each age category is similar to those recorded at national and County level for most categories, For the Study Area, the highest population percentage occurs within the 45-64 age category.

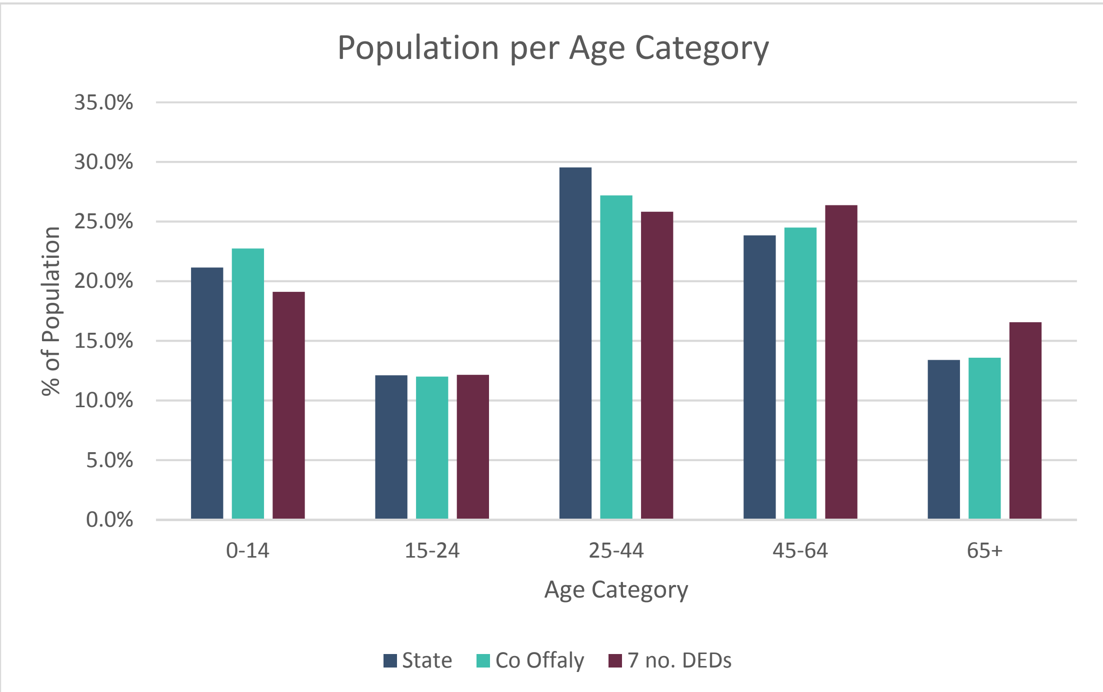


Figure 5.2 Population per Age Category in 2016 (Source: CSO)

5.2.6 Employment and Economic Activity

5.2.6.1 Employment by Socio-Economic Group

Socio-economic grouping divides the population into categories depending on the level of skill or educational attainment required. The 'Higher Professional' category includes scientists, engineers, solicitors, town planners and psychologists. The 'Lower Professional' category includes teachers, lab technicians, nurses, journalists, actors and driving instructors. Skilled occupations are divided into manual skilled such as bricklayers and building contractors; semi-skilled such as roofers and gardeners; and unskilled, which includes construction labourers, refuse collectors and window cleaners. Figure 5.3

shows the percentages of those employed in each socio-economic group in the State, County Offaly and the Study Area during 2016.

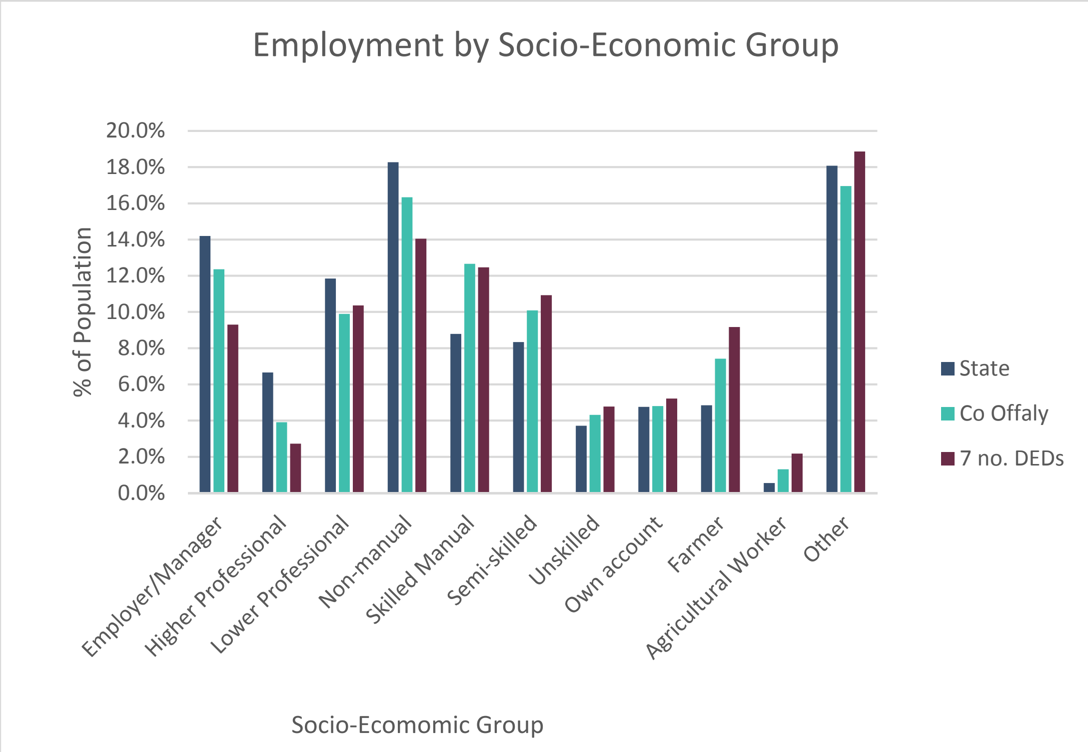


Figure 5.3 Employment by Socio-Economic Group in 2016 (Source: CSO)

The highest level of employment within the Study Area was recorded in the Other category. The levels of employment within the Employer/Manager, Higher Professional and Non-Manual categories in the Study Area were lower than those recorded for the State and County Offaly, while those recorded within the Semi-Skilled, Un-Skilled, Farmer, Agricultural Worker and Own Account categories were higher.

The CSO employment figures grouped by socio-economic status includes the entire population for the Study Area, County and State in their respective categories. As such, the socio-economic category of 'Other' is skewed to include those who are not in the labour force.

5.2.6.2 Employment and Investment Potential in the Irish Wind Energy Industry

5.2.6.2.1 *Background*

A report entitled 'Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy' was published in 2009 by Deloitte, in conjunction with the Irish Wind Energy Association (IWEA). This report focused on the ability of the Irish wind energy industry to create investment and jobs. In terms of the overall economic benefit to be obtained from wind energy, the report states in its introduction:

> *"Ireland is fortunate to enjoy one of the best wind resources in the world. Developing this resource will reduce and stabilise energy prices in Ireland and boost our long-term competitiveness as an economy. It will also significantly reduce our dependence on imported fossil fuels."*

More recently, a report published in 2014 by Siemens entitled '"An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland', also in conjunction with the Irish

Wind Energy Association (IWEA), concluded that, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'*

5.2.6.2.2 Energy Targets

The Climate Action Plan 2019 (CAP) was published on the 1st August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Irelands environment, society, economic and natural resources. The CAP includes a commitment that 70% of Ireland's electricity needs will come from renewable sources by 2030. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target.

5.2.6.2.3 Employment Potential

The Deloitte report (2009) estimated at the time of its publication that the Island of Ireland's installed wind energy capacity would need to reach 7,800 Megawatts (MW) by 2020, in order to meet the Government's renewable energy targets. Based on these estimates, the Deloitte report stated that the Irish wind energy sector to 2020 would be capable of supporting more than 10,760 jobs through direct and indirect involvement in the sector. This number includes construction, operation and maintenance of all wind farms and assumes a steady growth in the industry over the period to 2020. It also encompasses planning and financing of wind farms, and support services such as administration, payroll and marketing/communications. There are also further employment opportunities available in other areas of the wind energy sector relating to policy, Research and Development, support services and other, which total to 935 jobs across Ireland.

Of the 10,760 jobs estimated to be created through the development of the wind energy sector, the Deloitte report states the majority of these would be provided within the construction industry:

> *"The wind sector offers great opportunities to a sector such as construction, which is currently facing downturn and rising unemployment. It is estimated that approximately 7,258 jobs will be supported by the construction element of wind farms."*

The Deloitte study on employment and investment potential assumed that there would be a steady growth in the amount of wind power rolled out between 2009 and 2020. The report states:

> *"It is crucial that the industry expands at a sustainable rate. If Ireland's increase in installed capacity is rolled out at a steady growth rate over the next eleven years then Irish companies will have sufficient time to adapt and build up their companies in order to cope with the increasing number of MW being added every year."*

The Sustainable Energy Authority of Ireland estimates, in their 'Wind Energy Roadmap 2011-2050', that onshore and offshore wind could create 20,000 direct installation and operation/maintenance jobs by 2040 and that the wind industry would also have an annual investment potential of €6-12 million by the same year.

The 2014 report 'The Value of Wind Energy to Ireland', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

As of June 2019, there were 5,030 Megawatts (MW) of wind energy capacity installed on the island of Ireland. Of this, 3,748 MW was installed in the Republic of Ireland, with 1,282 MW installed in Northern Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Donegal, Cork and Kerry.

5.2.6.2.4 Economic Value

The Deloitte report states that the construction and development of wind energy projects across the island of Ireland would involve approximately €14.75 billion of investment from 2009 up to 2020, €5.1 billion of which would be retained in the Irish economy (€4.3 billion invested in the Republic of Ireland and €0.8 billion in Northern Ireland).

The report also states that increasing the share of our energy from renewable sources will deliver significant benefits for the electricity customer, the local economy and society. It estimates that between 25 and 30% of capital investment is retained in the local economy. This typically flows to companies in construction, legal, finance and other professional services. The report states:

> *".. the framework acknowledges the need to put the energy/climate change agenda at the heart of Ireland's economic renewal. Every new wind farm development provides a substantial contribution to the local and national economy through job creation, authority rates, land rents and increased demand for local support services. More wind on the system will also result in lower and more stable energy prices for consumers while helping us achieve our energy and emissions targets."*

A 2019 report by Baringa, 'Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020', has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. The analysis indicated that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 (2018-2020 results being projective) will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market. As such, the economic benefit of renewable energy to consumers is greater than what would have been if Ireland did not invest in wind power.

The proposed development will be contributing to the economic value that renewable energy brings to the country.

5.2.7 Land-Use

As previously noted, most of the wind farm site is cutover bog with a small proportion of commercial forestry noted on the site. The predominant surrounding land use within the Population study area is that of farmland. The total area of farmland within the 7 DEDs around the wind farm site measures approximately 8,995 hectares, comprising 52.4% of the Study Area, according to the CSO Census of Agriculture 2010. There are 269 farms located within the 7 DEDs, with an average farm size of 33.3 hectares. This is slightly smaller than the 36.5-hectare average farm size for Co. Offaly.

Within the Study Area, farming employs 537 people, and the majority of farms are family-owned and run. Table 5.5 shows the breakdown of farmed lands within the 7 DEDs. Pasture accounts for the largest proportion of farmland, followed by silage.

Table 5.5 Farm Size and Classification within the Study Area in 2010 (Source: CSO)

Characteristic	Value
Size of 7 DEDs	17,060 hectares
Total Area Farmed within 7 DEDs	8,995 hectares
Farmland as % of 7 DEDs	52.4%

Breakdown of Farmed Land	Area (hectares)
Total Pasture	3,092 ha
Total Silage	1,572 ha
Grazing	220 ha
Total Hay	250 ha
Total Potatoes	2 ha
Total Cereals	215 ha
Total Crops	254 ha

5.2.8 Services

The wind farm site is located approximately 3km east of Banagher town and 2km south of Cloghan, a village, in which the main services are located. Additionally, the nearby town of Birr lies approximately 7km south of the proposed development where local amenities including a community centre, church and shop are located.

5.2.8.1 Education

The nearest school to the site boundary of the proposed development is Lumcloon National School, located approximately 1.2 km to the northeast of the site boundary at its closest point. St. Mary's National School, Cloghan is located approximately 1.9 km to the northwest of the site boundary at its closest point and Broughal National School is located approximately 2.1 kilometres to the east of the proposed development.

The closest secondary school is Coláiste na Sionna in Banagher, located approximately 3.5 km west of the site of the proposed development.

5.2.8.2 Access and Public Transport

The site of the proposed development is accessed via the N62 National Primary Route which traverses the centre of the site. The nearest bus routes from which several daily connections are available, can be accessed in Banagher approximately 3.5 km northwest of the site.

5.2.8.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas available in the area are in the nearby settlements of Banagher, Cloghan and Ferbane, as well as in the town of Birr. Offaly County Council has a branch library at Banagher.

The varied environment of this area of County Offaly provides many opportunities for walking and cycling. The Grand Canal Greenway, The Offaly Way and The Hymany Way are all located within 10 kilometres of the site of the proposed development. The Offaly Way traverses the Lough Boora Discovery Park (https://www.loughboora.com/),which includes a large network of walking routes and is located to the east of the proposed development site.

Community Benefit proposals, which would enhance local amenities and community facilities are described in Chapter 4: Description of the Proposed Development.

5.3 Tourism

5.3.1 Tourism Numbers and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. During 2018, total tourism revenue generated in Ireland was approximately €9.1 billion, an increase on the €8.8 billion revenue recorded in 2017. Overseas tourist visits to Ireland in 2018 grew by 6.5% to 9.6 million ('Tourism Facts 2018, Fáilte Ireland, September 2019).

Ireland is divided into seven tourism regions. Table 5.6 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2018 ('Tourism Facts 2018, Fáilte Ireland, September 2019).

Table 5.6 Overseas Tourists Revenue and Numbers 2018 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€2,095m	6,309
Mid-East/Midlands	€ 393m	1,030
South-East	€261m	1,028
South-West	€987m	2,512
Mid-West	€511 m	1,497
West	€727m	1,963
Border	€244m	752
Total	€5,218 m	15,091

The proposed wind farm site is located within the Mid-East/Midland Region. According to 'Regional tourism performance in 2018' (Fáilte Ireland, September 2019) the Mid-East/Midland Region which comprises Counties Offaly, Laois, Longford, Meath, Westmeath, Kildare, Louth and Wicklow, benefited from approximately 6.8% of the total number of overseas tourists to the country and approximately 7.53% of the associated tourism income generated in Ireland in 2018.

5.3.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself although it is proposed to develop a recreational and amenity facility as part of the Proposed Development.

The varied environment of this area of County Offaly provides many opportunities for walking and cycling. The Grand Canal Greenway, The Offaly Way and The Hymany Way are all located within 10 kilometres of the site of the proposed development. The Lough Boora Discovery Park (is located approximately 6 km to the east of the proposed site and includes a number of walking, cycling routes and also offers bird watching and angling facilities. Cloghan Lake is located approximately 500 metres from the northeastern boundary of the proposed development site and is a popular fly-fishing lake.

Clonmacnoise, an early Christian site including ruins of a cathedral, eight churches, two round towers and Christian graves is located approximately 15 km to the north. Clonmacnoise has been put forward as a UNESCO World Heritage Site and is currently on UNESCO's tentative list.

Birr Castle, Gardens and Science Centre is located approximately 7km to the southwest of the site.

The River Shannon is used by a large number of recreational craft. Marinas and boat rental companies can be found along the Shannon in Banagher, 3 km to the west of the site.

5.3.3 Tourist Attitudes to Wind Farms

5.3.3.1 Scottish Tourism Survey 2016

BiGGAR Economics undertook an independent study in 2016, entitled 'Wind Farms and Tourism Trends in Scotland', to understand the relationship, if any, that exists between the development of onshore wind energy and the sustainable tourism sector in Scotland. In recent years, the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. This study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Eight local authorities had seen a faster increase in wind energy deployment than the Scottish average. Of these, five also saw a larger increase in sustainable tourism employment than the Scottish average, while only three saw less growth than the Scottish average. The analysis presented in this report shows that, at the Local Authority level, the development of onshore wind energy does not have a detrimental impact on the tourism sector. It was found that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. There was no pattern emerging that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development.

5.3.3.2 Fáilte Ireland Surveys 2007 and 2012

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The survey involved face-to-face interviews with 1,300 tourists (25% domestic and 75% overseas). The results of the survey are presented in the Fáilte Ireland Newsletter 2008/No.3 entitled 'Visitor Attitudes on the Environment: Wind Farms'.

The Fáilte Ireland survey results indicate that most visitors are broadly positive towards the idea of building wind farms in Ireland. There exists a sizeable minority (one in seven) however who are negative towards wind farms in any context. In terms of awareness of wind farms, the findings of the survey include the following:

- Almost half of those surveyed had seen at least one wind farm on their holiday to Ireland. Of these, two thirds had seen up to two wind farms during their holiday.

- Typically, wind farms are encountered in the landscape while driving or being driven (74%), while few have experienced a wind farm up close.
- Of the wind farms viewed, most contained less than ten turbines and 15% had less than five turbines.

Regarding the perceived impact of wind farms on sightseeing, the Fáilte Ireland report states:

> *"Despite the fact that almost half of the tourists interviewed had seen at least one wind farm on their holiday, most felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing, with 15% claiming that they had a negative impact."*

In assessing the perceived impact of wind farms on beauty, visitors were asked to rate the beauty of five different landscapes types: Coastal, Mountain, Farmland, Bogland and Urban Industrial, and then rate on a scale of 1-5 the potential impact of a wind farm being sited in each landscape. The survey found that each potential wind farm must be assessed on its own merits. Overall however, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

Regarding the perceived impact of wind farms on future visits to the area, the Fáilte Ireland survey states:

> *"Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland. Of those who feel that a potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon emissions."*

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the proposed development throughout the site design and assessment processes. Reference has been made to the 'Planning Guidelines on Wind Energy Development 2006' and the 'Draft Revised Wind Energy Development Guidelines December 2019' in addition to IWEA best practice guidance, throughout all stages, including pre-planning consultation and scoping.

The 2007 survey findings are further upheld by a more recent report carried out by Fáilte Ireland on tourism attitudes to wind farms in 2012. The results of the updated study were published in the 'Fáilte Ireland Newsletter 2012/No.1 entitled 'Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research'. The updated survey found that of 1,000 domestic and foreign tourists who holidayed in Ireland during 2012, over half of tourists said that they had seen a wind turbine while travelling around the country. Of this number of tourists, 21% claimed wind turbines had a negative impact on the landscape. However, 32% said that it enhanced the surrounding landscape, while 47% said that it made no difference to the landscape. Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 5.5 below.

5.4 Public Perception of Wind Energy

5.4.1 IWEA Interactions Opinion Poll on Wind Energy

Published in January 2020, IWEA undertook a national opinion poll on Wind Energy November 2019 with the objective to "*measure and track public perceptions and attitudes around wind energy amongst Irish adults*." Between November 20th – 30th 2019, a nationally represented sample of 1,019 adults and a booster sample of 200 rural residents participated in an online survey. The 2019 results indicate that 79% of both the nationally represented sample and rural sample strongly favour or favour wind power while 16% of both samples neither favour or oppose it. Amongst those in favour of wind power, the majority cited environmental and climate concerns as their main reasons for supporting such developments. Other reasons cited for supporting wind energy developments include: "economic benefits," "reliable/efficient," "positive experience with wind energy" and recognise it as a "safe resource." When questioned about wind developments in their local area, 55% of nationally represented sample favour or tend to favour such proposals and 51% of the rural population reported the same. Reasons cited for supporting wind developments in their local area include: "good for the environment," "social responsibility," "create jobs," "good for the community."

The IWEA November 2019 survey follows previous national opinion polls on wind energy undertaken in October 2017 and November 2018. The 2019 survey results are consistent with the 2017 and 2018 figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support for wind energy in recent years.

5.4.2 Sustainable Energy Ireland Survey 2003

5.4.2.1 Background

The results of a national survey entitled 'Attitudes Towards the Development of Wind Farms in Ireland' were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

5.4.2.2 Findings

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual impact of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that impact on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental impacts of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the impact of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

5.4.2.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the SEAI, show 47% of Irish adults polled said they were are strongly in favour of wind power in Ireland while a further 38% favour it. Overall this is a 4% increase in favourable attitudes towards wind power compared with similar research in 2013.

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents in favour of the use of wind energy in Ireland. Approximately two thirds of respondents (70%) would prefer to power their home with renewable energy over fossil fuels, and 45% would be in favour of a wind farm development in their area.

The survey also captured the perceived benefits of wind power among the public. Of those surveyed three quarters selected good for the environment and reduced Carbon Dioxide emissions while fewer people, just over two in three, cited cheaper electricity.

5.4.2.4 Conclusions

The main findings of the SEAI survey indicate that the overall attitude to wind farms is "almost entirely positive". The study highlights that two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a "Not In My Back Yard" (NIMBY) effect. The final section of the report states:

> *"The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments – especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities."*

5.4.3 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005

5.4.3.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen ('Green on Green: Public Perceptions of Wind Power in Scotland and Ireland', Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

5.4.3.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. Surveys were also carried out in Ireland, at two sites in Counties Cork and Kerry, each of which has two wind farms in proximity.

5.4.3.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as "overwhelmingly positive" at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed wind farms than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, may people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative impacts of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is *"not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)".*

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that *"those who see the wind farms most often are most accepting of the visual impact"*. The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse impact on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals *"a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms".*

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

5.4.3.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY syndrome does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.5 Health Impacts of Wind Farms

5.5.1 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research has generally not supported these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition', Expert Panel on behalf of Renewable UK, July 2010***

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled 'Wind Turbine Syndrome', in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- *"The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;*
- *The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and*
- *Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpoint's respondents by the mechanisms proposed."*

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects in humans arising from noise at the levels of that generated by wind turbines.

2. *'Wind Turbine Sound and Health Effects – An Expert Panel Review', American Wind Energy Association and Canadian Wind Energy Association, December 2009*

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- *"There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.*
- *The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.*
- *The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."*

The report found, amongst other things, that:

- *"Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.*
- *Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;*
- *The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."*

3. *'A Rapid Review of the Evidence', Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010*

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential impacts on human health and to validate the finding of the 'Wind Turbine Sound and Health Effects - An Expert Panel Review' (see Item 2 above) that:

- *" There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*
- *There is currently no published scientific evidence to positively link wind turbines with adverse health effects.*
- *'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

4. *'Position Statement on Health and Wind Turbines', Climate and Health Alliance, February 2012*

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to*

them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. There is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from infrasound (a component of low frequency sound) at the low levels that may be emitted by wind turbines."

The Position Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. It states that:

"Fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms... Local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of place and people's sense of identity."

CAHA notes the existence of *"misinformation about wind power"* and, in particular, states that:

"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."

CAHA notes that:

"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."

This, it states, contrasts with the health impacts of fossil fuel energy generation.

5. ***'Wind Turbine Health Impact Study -Report of Independent Expert Panel' – Massachusetts Departments of Environmental Protection and Public Health (2012)***

An expert panel was established with the objective to, inter alia, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential impacts and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under several headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."

The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.

None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."

In relation to shadow flicker, the expert panel found the following:

> *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
>
> *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

6. ***Wind Turbines and Health, A Critical Review of the Scientific Literature, Massachusetts Institute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)***

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, were compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 5.1 of this EIAR. Another recent publication by Chapman and Crichton (2017) entitled 'Wind turbine syndrome; A communicated disease' critically discusses why certain health impacts might often be incorrectly attributed to wind turbines.

7. ***Position Paper on Wind Turbines and Public Health: HSE Public Health Medicine Environment and Health Group, February 2017***

The Health Service Executive (HSE) position paper on wind turbines and public health was published in February 2017 to address the rise in wind farm development and concerns regarding potential impacts on public health. The paper discusses previous observations and case studies which describe a broad range of health effects that are associated with wind turbine noise, shadow flicker and electromagnetic radiation.

A number of comprehensive reviews conducted in recent years to examine whether these health effects are proven has highlighted the lack of published and high-quality scientific evidence to support adverse effects of wind turbines on health.

The HSE position paper determines that current scientific evidence on adverse impacts of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more informative for identifying potential health effects of exposure to wind turbine effects. They advise developers on making use of the Draft Wind Energy Development Guidelines (2006), as a means of setting noise limits and set back distances from the nearest dwellings.

8. ***Environmental Noise Guidelines for the European Region: World Health Organisation Regional Office for Europe, 2018.***

The WHO Environmental Noise Guidelines provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as transportation noise, wind turbine noise and leisure noise. The Guideline Development Group (GDG) defined priority health outcomes and from this were able to produce guideline exposure levels for noise exposure.

For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden. The GDG recognise the potential for increased risk of annoyance at levels below this value but cannot determine whether this increase risk can impact health. Wind turbine noise above this level is associated with adverse health effects.

The GDG points out that evidence on health effects from wind turbine noise (apart from annoyance) is either absent or rated low/very low quality and effects related to attitudes towards wind turbines are hard to differentiate from those related to noise and may be partly responsible for the associations. The GDG also recognises that the percentage of people exposed to noise from wind turbines is far lower than other sources such as road traffic and state that any benefit from specifically reducing population exposure to wind turbine noise in all situations remains unclear.

That being said, the GDG recommends renewable energy policies include provisions to ensure noise levels from wind farm developments do not rise above the guideline values for average noise exposure. The GDG also provides a conditional recommendation for the implementation of suitable measures to reduce noise exposure.

5.5.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s 'Wind Energy Development Guidelines for Planning Authorities 2006' and the 'Draft Revised Wind Energy Development Guidelines' (Department of Housing, Planning and Local Government (DoHPLG), December 2019) (currently out for public consultation), iterate that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations and should be kept to a minimum. People or animals can safely walk up to the base of the turbines.

The adopted 2006 Guidelines and the Draft 2019 Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to resuming operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the site of the proposed development or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

5.5.3 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The ESB document 'EMF & You' (ESB, 2017) provides further practical information on EMF (https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0)..

Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Chapter 14: Material Assets.

5.5.4 Assessment of Effects on Human Health

As set out in the Department of Housing, Planning, Community and Local Government 'Key Issues Consultation Paper on the Transposition of the EIA Directive 2017' and the guidance listed in Section 1.8.1 of Chapter 1: Introduction, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters.

Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (Traffic and Transport) provide an assessment of the effects of the proposed development on these areas of consideration. There is the potential for negative effects on human health during the wind farm construction phase related to potential emissions to air of dust, potential emissions to land and water of hydrocarbons, release of potentially silt-laden runoff into watercourses and noise emissions. The assessments however show that the residual impacts are not significant and will not lead to significant effects on any environmental media with the potential to lead to health effects for humans. On this basis, the potential for negative health effects associated with the proposed development is imperceptible.

The proposed site design and mitigation measures outlined in Chapter 8 and Chapter 9 ensures that the potential for impacts on the water environment are not significant. No impacts on local water supplies are anticipated.

As set out in Chapter 9, potential health effects are associated with negative impacts on public and private water supplies and potential flooding. There are no mapped public or group groundwater scheme protection zones in the area of the proposed wind farm site.

The preliminary Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is also very low.

A wind farm is not a recognised source of pollution. It is not an activity which requires Environmental Protection Agency licensing under the Environmental Protection Agency Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects.

The proposed project is for the development of a renewable energy project, a wind farm, capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a long term, slight, positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health.

5.5.5 Vulnerability of the Project to Natural Disasters and Major Accidents

As outlined in Section 5.5.4 above a wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur the potential sources of pollution onsite during both the construction, operational and decommissioning phases are limited. Sources of pollution with the potential to cause significant environmental pollution and associated negative effects on health such as bulk storage of hydrocarbons or chemicals, storage of wastes etc. are limited.

There is limited potential for significant natural disasters to occur at the proposed Derrinlough Wind Farm site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to flooding and fire. The risk of flooding is addressed in Chapter 9: Hydrology and Hydrogeology. It is considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm to have significant environmental effects is limited and therefore a significant effect on human health is similarly limited. As described earlier, there are no significant sources of pollution in the wind farm with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for impacts on human health. The issue of turbine safety is addressed in Section 5.5.2.

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. The wind farm site is not regulated or connected to or close to any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there are no potential effects from this source.

5.6 Property Values

In the absence of any Irish studies on the effect of wind farms on property values, this section provides a summary of the largest and most recent studies from the United States and Scotland.

The largest study of the impact of wind farms on property values has been carried out in the United States. 'The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single-family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study was visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that "The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact."*

This study has been recently updated by LBNL who published a further paper entitled "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property prices. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

Both LBNL studies note that their results do not mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they are considered to be statistically insignificant. Therefore, although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialise in all the major U.S. studies conducted thus far.

A further study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. Its main conclusions are:

- Overall the analysis found that the county-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the five sites examined across England and Wales has not had a detectable negative impact on house price growth within a five-kilometre radius of the sites.

A relatively new study issued in October 2016 'Impact of wind Turbines on House Prices in Scotland' (2016) was published by Climate Exchange. Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5.2 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study are:

- No evidence of a consistent negative effect on house prices: Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km or find the effect to be positive.
- Results vary across areas: The results vary across different regions of Scotland. Our data does not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described above demonstrates that at an international level, wind farms have not impacted property values in the local areas. It is a reasonable assumption based on the available international literature, that the provision of a wind farm at the proposed location would not impact on the property values in the area.

5.7 Shadow Flicker

5.7.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room, and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker impact depends on several factors, each of which is outlined below.

1. ***Whether the sunlight is direct and unobstructed or diffused by clouds:***

If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud for over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to Ireland's geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep the country in humid, cloudy airflows for much of the time. A study at 12 stations over a 25-year period showed that the mean cloud amount was at a minimum in April and maximum in July. Cloud amounts were less at night than during the day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum occurring between 1000 and 1500 GMT at most stations. (Source: Met Éireann, www.met.ie)

2. ***The presence of intervening obstructions between the turbine and the observer:***

For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. ***How high the sun is in the sky at a given time:***

At distances of greater than approximately 500m between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. The current adopted 'Wind Energy Development Guidelines for Planning Authorities' published by the Department of Environment, Heritage and Local Government (DoEHLG) in 2006, iterates that at distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low.

Error! Reference source not found. illustrates the shadow cast by a turbine at various times during the day; the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

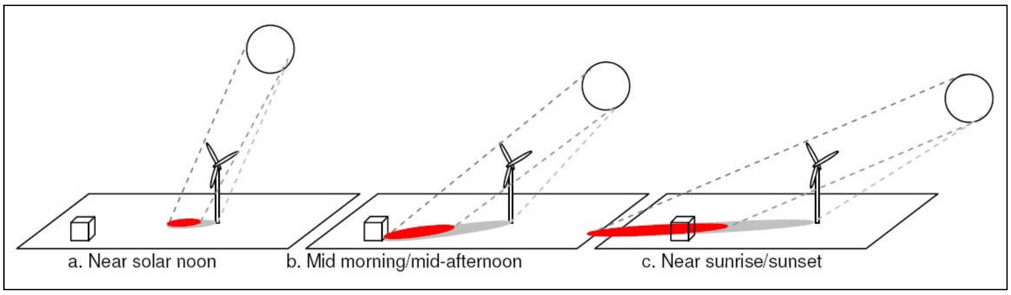


Figure 5.4 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

4. ***Distance and bearing, i.e. where the property is located relative to a turbine and the sun:***

The further a property is from the turbine the less pronounced the impact will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and, the centre of the rotor's shadow passes more quickly over the land reducing the duration of the impact.

At a distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This impact occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak impact is observed at distance from the turbines. (Source: Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change, 2010).

5. ***Property usage and occupancy:***

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed.

6. ***Wind direction, i.e. position of the turbine blades:***

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades must be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 5.5 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC).

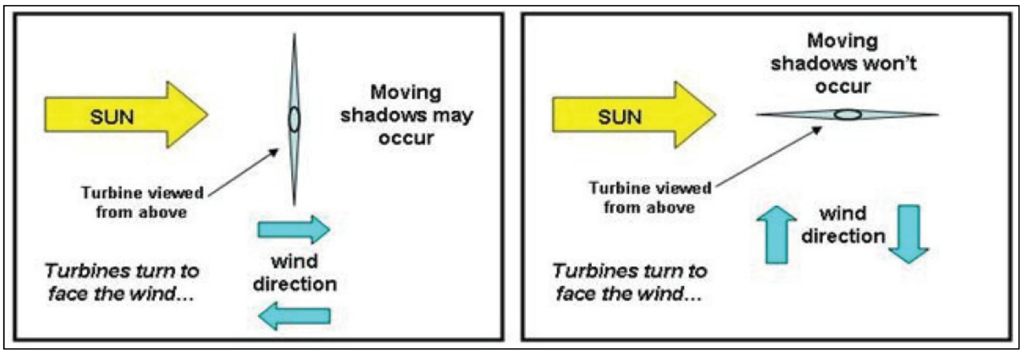


Figure 5.5 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

7. ***Rotation of turbine blades:***

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, no shadow flicker will occur.

5.7.2 Guidance

The current, adopted guidance for shadow flicker in Ireland is derived from the 'Wind Energy Development Guidelines for Planning Authorities 2006' (DoEHLG), and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012). The 2006 DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019 which have been released for public consultation. The Draft 2019 guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:

"no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required."

The Draft 2019 Guidelines are based on the recommendations set out in the 'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review' (December 2013) and the 'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach' (June 2017).

The assessment herein is based on compliance with the 2006 guidelines. However, it should also be noted the proposed development can be brought in line with the requirements of the 2019 draft guidelines through the implementation of the mitigation measures outlined in Section 5.9.3.3.

5.7.3 Scoping

Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the proposed Derrinlough Wind Farm. The only comment in relation to shadow flicker was included in the Health Service Executive's response to the EIA Scoping request which reiterated what was stated in the scoping document in that shadow flicker would be assessed using a specialist computer software programme specifically designed for the wind energy industry. This assessment is included in the following sections of the EIAR.

5.7.4 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The DoHPLG guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker, all of which have been employed at the site of the proposed development. Proper siting of wind turbines is key in eliminating shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential impact can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed as detailed further below.

For the purposes of this shadow flicker assessment, the software package WindFarm Version 4.1.2.3 has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

5.7.5 Shadow Flicker Assessment Criteria

5.7.5.1 Turbine Dimensions

Planning permission is being sought for a turbine size envelope with a tip height of up to 185 metres above the top of foundation. For the purposes of this assessment, a turbine with a rotor diameter of 150m and a hub height of 110m was modelled in order to assess a worst-case scenario. While these dimensions have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process and could include turbines of a different rotor diameter and hub height configuration (within the 185-metre tip height envelope) than considered as part of this assessment.

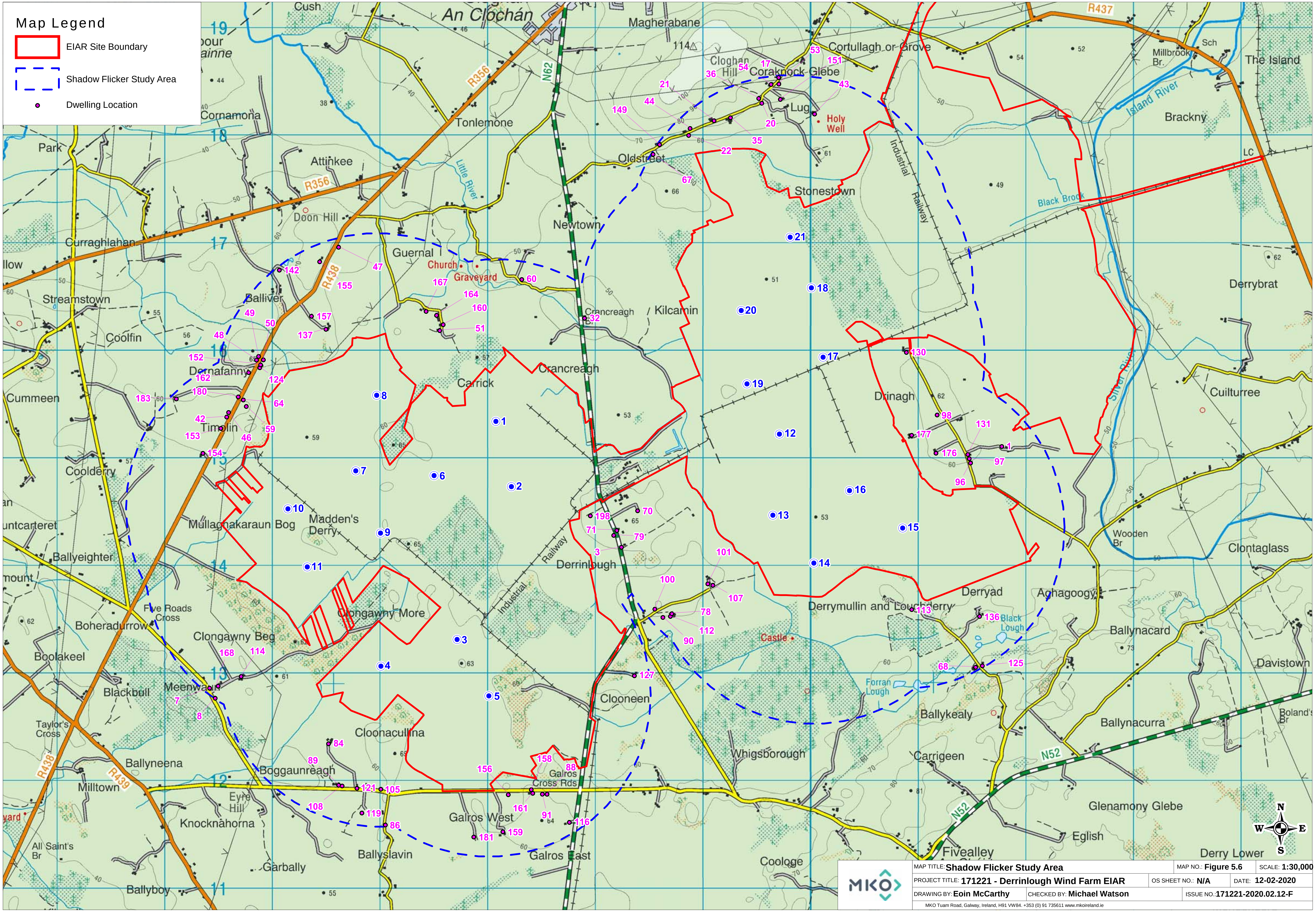
Regardless of the make or model of the turbine eventually selected for installation on site, it will have a maximum tip height of up to 185 metres and the potential shadow flicker impact it will give rise to will be no more than that predicted in this assessment. With the benefit of the mitigation measures outlined in section 5.9.3.3, all turbines installed onsite will comply with the current adopted 2006 DoEHLG guidelines. Any references to the turbine dimensions in this shadow flicker assessment should be considered in the context of the above and should not be construed as pre-determining the dimensions of the wind turbine to be used on the site.

5.7.5.2 Study Area

At the outset of the project, during the constraints mapping process detailed in Section 3.3.5.1 of this EIAR, all sensitive receptors within 2km of the development site boundary were identified and mapped. This included all occupied and unoccupied dwellings. In addition, a planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. These properties were also added to the sensitive receptors' dataset.

The study area for the shadow flicker assessment is ten times rotor diameter from each turbine as set out in the Wind Energy Development Guidelines for Planning Authorities', DoEHLG, 2006. All residential properties located within ten rotor diameters which is assumed to be 1.5 kilometres have been included in the assessment. The closest residential property is located in excess of 750 metres from the nearest proposed turbine location.

There is a total of 82 No. sensitive receptors located within 10 rotor diameters (assumed at 1.5km) of the proposed turbine locations. No dwellings are located within the 4 times tip height setback distance of each turbine, a measure outlined in the 2019 Draft Revised Guidelines, should these come into force while this project is in the application process. The shadow flicker study area and sensitive receptor locations are shown in Figure 5.6.



MAP TITLE: Shadow Flicker Study Area

MAP NO.: Figure 5.6

SCALE: 1:30,000

PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR

OS SHEET NO.: N/A

DATE: 12-02-2020

DRAWING BY: Eoin McCarthy

CHECKED BY: Michael Watson

ISSUE NO.: 171221-2020.02.12-F

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5.7.5.3 Assumptions and Limitations

Due to the latitude of Ireland and the UK, shadow flicker impacts are only possible at properties 130 degrees either side of north as turbines do not cast shadows on their southern side (ODPM Annual Report and Accounts 2004: Housing, Planning, Local Government and the Regions Committee; Planning Policy Statement 22; Draft Revised Wind Energy Development Guidelines 2019). As such properties located outside of this potential shadow flicker zone will not be impacted. However, in this assessment, all 82 no. properties within 360 degrees of the proposed development out to 1.5km were assessed for shadow flicker impact.

At each property, shadow flicker calculations were carried out based on 4 no. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The degrees from north value for each window is:

- Window 1: 0 degrees from North
- Window 2: 90 degrees from North
- Window 3: 180 degrees from North
- Window 4: 270 degrees from North

Each window measures one-metre-high by one-metre-wide, and tilt angle is assumed to be zero. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the study area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any incidences or durations or shadow flicker can be countered by the measures outlined in Section 5.9.3.3 below.

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, referred to as the 'worst-case impact', due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific 'cut-in speed', and cease operating at a specific 'cut-out speed'. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turned on at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modelled maximum aspect.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 26.6% of the daylight hours per year. This percentage is based on Met Éireann data recorded at Birr, Co. Offaly over the 30-year period from 1979 to 2008 (www.met.ie). The actual sunshine hours at the proposed development site and therefore the percentage of time shadow flicker could actually occur is 26.6% of daylight hours. Table 5.7 therefore lists the annual shadow flicker calculated for each property when the regional average of 26.6% sunshine is considered, to give a more accurate annual average shadow flicker prediction.

The model also does not consider that the turbine will not always be yawed such that the rotor is in the worst-case orientation. In order to include the probability of the rotor being orientated within the sun turbine vector a wind directionality factor has also been applied.

Table 5.7 outlines whether a shadow flicker mitigation strategy is required for any property within 1.5km of the proposed wind turbines which may be impacted by shadow flicker.

5.7.6 Shadow Flicker Assessment Results

5.7.6.1 Daily and Annual Shadow Flicker

The WindFarm computer software was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume worst-case conditions, including

- 100% sunshine during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the sun is behind the turbine blades,
- That the turbine blades are facing the property, and
- That the turbine blades are moving.

The maximum daily shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 26.6% has been applied. Taking these probabilities into consideration, an approximation of the 'estimated actual' annual shadow flicker occurrence has been calculated and is presented in Table 5.7.

The estimated annual levels are then considered in the context of the DoEHLG's Draft Revised Wind Energy Development Guidelines in December 2019 which require that no existing dwelling or other affected property experience shadow flicker as a result of any proposed wind energy development.

As stated in Section 5.1, the closest occupied dwelling is approximately 762m from any of the proposed turbine locations. For the purpose of this assessment, a buffer zone of 1.5km has been applied and all dwellings within this zone (totalling 82) were assessed for any potential shadow flicker impacts from the proposed turbine locations.

The 82 No. buildings have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5.7.

Of the 82 No. residential properties modelled; it is predicted that 50 properties may experience daily shadow flicker. Based on the 2006 DoEHLG guidelines, the daily threshold for shadow flicker is exceeded at 34 properties, however, the annual threshold for shadow flicker, once the regional sunshine average factor has been considered, is not exceeded at any property.

Additionally, it is worth nothing that the 'estimated actual' shadow flicker listed in Table 5.7 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these properties is likely to be eliminated or significantly reduced as the following items are not considered by the model:

- Receivers may be screened by topography, cloud cover and/or vegetation/built form i.e. adjacent buildings, farm buildings, garages or barns;
- Each receiver will not have windows facing in all directions onto the wind farm.

Section 5.9.3.3 below outlines the mitigation strategies which may be employed at the potentially affected properties to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any dwelling within the 1.5km study area. The same mitigation strategies, outlined in Section 5.9.3.3, also demonstrate that the proposed Derrinlough Wind Farm can be brought in line with the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019) should they be adopted while this application is in the planning system.

Table 5.7 Maximum Potential Daily & Annual Shadow Flicker – Proposed Derrinlough Wind Farm, Co. Offaly

House No.	ITM (Easting)	ITM (Northing)	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	26.6% Average Regional Sunshine applied	Proposed Turbine(s) Giving Rise to any potential Shadow Flicker impact	Mitigation Strategy Required
1	211779	215112	1219	15	00:32:24	37:24:00	09:56:54	15,16	Yes
2	208245	214175	1947	1	00:33:36	56:18:00	14:58:33	2,13	Yes
21	209105	218139	1292	21	00:16:12	04:54:00	01:18:12	21	No
22	208869	218003	1334	21	00:30:00	31:30:00	08:22:44	21	No
32	207901	216303	1264	1	00:30:36	42:30:00	11:18:18	1,20	Yes
42	204575	215385	1031	8	00:33:36	57:18:00	15:14:30	7,8,10	Yes
44	208882	218068	1390	21	00:28:48	26:24:00	07:01:21	21	No
46	204592	215428	1061	10	00:30:00	50:24:00	13:24:23	7,8,10	No
48	204852	215915	1167	8	00:31:48	44:36:00	11:51:49	7,8	Yes
49	204871	215949	1157	8	00:32:24	42:12:00	11:13:31	7,8	Yes
50	204916	215917	1100	8	00:33:36	44:36:00	11:51:49	7,8	Yes
51	206555	216189	840	8	01:04:12	87:12:00	23:11:43	1,8	Yes

House No.	ITM (Easting)	ITM (Northing)	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	26.6% Average Regional Sunshine applied	Proposed Turbine(s) Giving Rise to any potential Shadow Flicker impact	Mitigation Strategy Required
59	204757	215484	1024	10	00:32:24	36:24:00	09:40:57	7,8	Yes
64	204729	215544	1247	8	00:31:12	34:30:00	09:10:37	7,8	Yes
67	208538	217827	1494	21	00:26:24	13:48:00	03:40:15	21	No
70	208395	214514	1193	2	00:31:12	55:54:00	14:52:10	2,12,13	Yes
71	208201	214330	1060	2	00:36:36	46:30:00	12:22:08	2,13	Yes
78	208712	213557	1310	13	00:27:36	16:18:00	04:20:09	14	No
79	208172	214285	1052	2	00:37:12	59:30:00	15:49:37	2,13	Yes
90	208630	213523	1392	13	00:26:24	14:30:00	03:51:25	14	No
96	211489	214958	867	15	00:42:36	70:48:00	18:49:58	15,16	Yes
97	211477	214998	892	15	00:40:48	72:06:00	19:10:43	15,16	Yes
98	211179	215405	1081	16	00:36:00	82:12:00	21:51:55	12,16,17	Yes
100	208554	213600	1412	13	00:24:36	14:24:00	03:49:49	13	No
101	209047	213835	878	13	00:37:12	26:06:00	06:56:33	14	Yes

House No.	ITM (Easting)	ITM (Northing)	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	26.6% Average Regional Sunshine applied	Proposed Turbine(s) Giving Rise to any potential Shadow Flicker impact	Mitigation Strategy Required
107	209094	213822	856	13	00:39:00	29:24:00	07:49:13	14	Yes
112	208699	213532	1343	13	00:27:36	16:12:00	04:18:33	14	No
113	210942	213596	762	15	00:38:24	52:48:00	14:02:41	14	Yes
114	204709	212974	1190	11	00:28:48	14:24:00	03:49:49	4	No
121	205786	211934	1156	4	00:27:36	23:00:00	06:07:05	5	No
124	204882	215844	1128	8	00:33:00	49:24:00	13:08:25	7,8	Yes
127	208364	212981	1367	5	00:27:36	12:36:00	03:21:06	5	No
130	210893	215986	776	17	00:46:12	86:36:00	23:02:08	12,17,18	Yes
131	211464	215037	928	13	00:39:00	70:30:00	18:45:11	15,16	Yes
137	205497	216201	783	8	00:45:36	65:06:00	17:19:00	8	Yes
142	205064	216751	1484	8	00:25:48	16:12:00	04:18:33	8	No
149	208598	217918	1509	21	00:26:24	15:54:00	04:13:46	21	No
152	204890	215870	1119	8	00:33:00	48:00:00	12:46:05	7,8	Yes

House No.	ITM (Easting)	ITM (Northing)	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	26.6% Average Regional Sunshine applied	Proposed Turbine(s) Giving Rise to any potential Shadow Flicker impact	Mitigation Strategy Required
153	204520	215280	972	10	00:36:36	72:12:00	19:12:19	7,8,10	Yes
154	204354	215048	948	10	00:39:36	69:06:00	18:22:50	7,10,11	Yes
157	205363	216322	953	8	00:37:12	46:24:00	12:20:33	8	Yes
160	206587	216244	904	8	00:56:24	71:42:00	19:04:20	1,8	Yes
162	204779	215799	1204	8	00:30:36	43:42:00	11:37:27	7,8	Yes
164	206525	216331	925	8	01:02:24	58:12:00	15:28:52	1,8	Yes
167	206428	216367	905	8	01:06:00	51:12:00	13:37:09	1,8	Yes
176	211168	215050	766	15	00:43:12	83:48:00	22:17:27	12,15,16,17	Yes
177	210942	215216	776	16	01:10:48	96:42:00	25:43:20	12,13,14,16	Yes
180	204682	215573	1287	8	00:30:00	32:00:00	08:30:43	7,8	Yes
183	204107	215554	1467	10	00:27:36	30:06:00	08:00:24	10	Yes
198	207955	214466	750	2	00:48:00	81:24:00	21:39:09	2,6	Yes

5.7.6.2 Cumulative Shadow Flicker

The cumulative assessment of shadow flicker generated by the proposed development and other existing and permitted wind farms within 1.5km was carried out based on the methodology, assumptions and criteria outlined in Section 5.7.4 and Section 5.7.5.

Table 5.8 below shows the potential cumulative shadow flicker impact of the proposed development in combination with existing and proposed wind farm developments within the 1.5km shadow flicker study area of the proposed development. Within the shadow flicker there is one constructed wind farms: Meenwaun Wind Farm (5 turbines permitted, 4 constructed, tip height 169m, Planning Reference 15/44). A 9-turbine wind farm is permitted at Cloghan (tip height 151.5m); however, an application to increase the tip height of these turbines to 169m has been submitted to Offaly County Council (Planning Reference 19/404) and this has been included in the cumulative shadow flicker assessment.

The cumulative assessment below includes for a worst-case scenario shadow flicker impact. All turbines proposed for Derrinlough Wind Farm in addition to all constructed and permitted wind turbines (including the proposed amendments to Cloghan Wind Farm) are assessed. Thus, should the proposed Cloghan amendment application be refused, the overall shadow impact will be less.

Table 5.8 indicates that of the 82 properties within 1.5km of the proposed development, 5 properties have the potential for cumulative shadow flicker impacts, as outlined in the following paragraphs, when the above wind farms within the 1.5km study area are assessed. Mitigation strategies are outlined in Section 5.9.3.3.

Property 22

Property 22 will experience just over 14 annual hours of shadow flicker from the proposed Derrinlough Wind Farm and the proposed amended Cloghan Wind Farm. The proposed Derrinlough Wind Farm contributes over 8 hours of this shadow flicker impact annually with the proposed Cloghan Wind Farm contributing just under 6 hours annually. Should the proposed amendment be refused for the Cloghan Wind Farm (Planning Reference 19/404), the cumulative shadow flicker impacts from the permitted 150m tip height Cloghan Wind Farm (Planning Reference 14/188) will be reduced.

It should be noted that the annual threshold for permitted cumulative shadow impact as per the adopted 2006 DoEHLG guidelines is not exceeded at this property.

Property 32

Property 32 will experience almost 63 annual hours of cumulative shadow flicker from the proposed Derrinlough Wind Farm and proposed amended Cloghan Wind Farm. The proposed Derrinlough Wind Farm contributes just over just over 11 hours of this shadow flicker impact while the proposed Cloghan Wind Farm contributes over 51 hours annually. Should the proposed amendment be refused for the Cloghan Wind Farm (Planning Reference 19/404), the cumulative shadow flicker impacts from the permitted 150m tip height Cloghan Wind Farm (Planning Reference 14/188) will be reduced.

It should be noted that while annual threshold for permitted cumulative shadow impact as per the adopted 2006 DoEHLG guidelines is exceeded at this property, this is not due to the proposed Derrinlough development which only contributes 11 annual hours of shadow flicker impact, under half the annual exceedance rate of 30 hours as per the 2006 DoEHLG guidelines.

Property 67

Property 67 will have almost 14 hours of annual cumulative shadow flicker from the proposed Derrinlough Wind Farm and proposed amended Cloghan Wind Farm. The proposed Derrinlough Wind Farm contributes under 8.5 hours of this shadow flicker impact annually while the proposed Cloghan Wind Farm contributes under 5.5 hours annually. Should the proposed amendment be refused for the Cloghan Wind Farm (Planning Reference 19/404), the cumulative shadow flicker impacts from the permitted 150m tip height Cloghan Wind Farm (Planning Reference 14/188) will be reduced.

It should be noted that the annual threshold for permitted cumulative shadow impact as per the adopted 2006 DoEHLG guidelines will not be not exceeded at this property.

Property 114

Property 114 will experience over 34 annual hours of shadow flicker from the proposed development and the Meenwaun Wind Farm. The proposed Derrinlough Wind Farm contributes under 4 hours of this shadow flicker impact annually while the Meenwaun Wind Farm contributes over 30 hours annually.

It should be noted that while annual threshold for permitted cumulative shadow impact as per the adopted 2006 DoEHLG guidelines is exceeded at this property, this is not due to the proposed Derrinlough development which only contributes 11 annual hours of shadow flicker impact, under half the annual exceedance rate of 30 hours as per the 2006 DoEHLG guidelines.

Property 149

Property 149 will experience over 17 annual hours of shadow flicker from the proposed development and proposed amended Cloghan Wind Farm. The proposed Derrinlough Wind Farm contributes just over 4 hours of this shadow flicker impact annually while the proposed Cloghan Wind Farm contributes over 13 hours annually. Should the proposed amendment be refused for the Cloghan Wind Farm (Planning Reference 19/404), the cumulative shadow flicker impacts from the permitted 150m tip height Cloghan Wind Farm (Planning Reference 14/188) will be reduced.

It should be noted that the annual threshold for permitted cumulative shadow impact as per the adopted 2006 DoEHLG guidelines will not be exceeded at this property.

Table 5.8 Potential Cumulative Shadow Flicker Impact from the Proposed Derrinlough Wind Farm and surrounding Wind Farms within 5km.

House No.	ITM (Easting)	ITM (Northing)	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Cumulative Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Cumulative Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max Annual Cumulative Shadow Flicker with 26.6% Average Regional Sunshine applied	Turbine(s) contributing to Cumulative Shadow Flicker impact*	Mitigation Strategy Required
22	208869	218003	1,334	21	00:58:48	53:30:36	14:14:01	21,35	Yes
32	207901	216303	1,264	1	01:41:24	236:33:56	62:55:35	1,20,28,29,30,31,32	Yes
67	208538	217827	1,494	21	01:06:00	52:12:28	13:53:14	21,35	Yes
114	204709	212974	1,190	11	01:01:48	128:48:29	34:15:47	4,24,25,26	Yes
149	208598	217918	1,509	21	01:02:24	66:31:48	17:41:49	21,35	No

**Turbines 1-21 are part of the proposed Derrinlough Wind farm. Turbines 22- 26 comprise the Meenwaun Wind Farm. Turbines 27-35 represent the 9 No. proposed 169m turbines of the Cloghan Wind Farm (Not yet constructed). Turbine 36 and 37 represent the Leabeg wind farm.*

5.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

The wind farm site is located on a site mainly consisting of cutover bog with a small portion of commercial forestry on the site. As such, the amount of people accessing the site relates mainly to those cutting peat in nearby areas. The closest occupied dwelling to the proposed development is located at 762m from the proposed Turbine 15.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise modelling have been completed as part of this EIAR (Section 5.7 above refers to shadow flicker modelling, Chapter 11 addresses noise). A comprehensive landscape and visual impact assessment have also been carried out, as presented in Chapter 12 of this EIAR. Impacts on human beings during the construction, operational and decommissioning phases of the proposed development is assessed in relation to each of these key issues and other environmental factors such as noise, traffic and dust; see Impacts in Section 5.9 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.9 Likely Significant Impacts and Associated Mitigation Measures

5.9.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. This land-use will also continue if the proposed development does proceed.

If the proposed development were not to proceed, the opportunity to capture part of Offaly's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

5.9.2 Construction Phase

5.9.2.1 Health and Safety

Pre-Mitigation Impacts

Construction of the proposed development will necessitate the presence of a construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative impact.

Proposed Mitigation Measures

The proposed development will be constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005);
- Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended;
- Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. 291 of 2013), as amended; and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared on a preliminary basis at the procurement stage and developed further at construction stage.

All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting site access during construction. Fencing will be erected in areas of the site where uncontrolled access is not permitted. Appropriate warning signs will be posted, directing all visitors to the site manager. Appropriate warning measures including 'goalposts' will be used as appropriate to prevent contact with any overheads lines that traverse the site.

The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006*'.

The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written Safety and Health Plan;
- Prepare a safety file for the completed structure and give it to the client; and
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Development of the Safety and Health Plan for the construction stage with updating where required as work progresses;
- Compile and develop safety file information
- Reporting of accidents / incidents;
- Weekly site meeting with PSCS;
- Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out:
- Induction of all site staff including any new staff enlisted for the project from time to time;
- Toolbox talks as necessary;
- Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date;
- Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance;
- Monitor the compliance of contractors and others and take corrective action where necessary; and
- Notify the Authority and the client of non-compliance with any written directions issued.

Residual Impact

With the implementation of the above, there will be a short-term potential slight negative residual impact on health and safety during the construction phase of the proposed development.

Significance of Effects

Based on the assessment above there will be no significant direct and indirect effects on health and safety during the construction phase of the proposed development.

5.9.2.2 Employment and Investment

The design, construction and operation of the wind farm will provide employment for technical consultants, contractors and maintenance staff. Up to approximately 100-120 jobs could be created during the construction, operation and maintenance phases of the proposed development. The construction phase of the wind farm will last between approximately between 24-30 months. Most construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade. This will have a short-term significant positive impact.

The injection of money in the form of salaries and wages to those employed during the construction phase of the project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive impact on their cash flow. This will have a short-term slight positive indirect impact.

The proposed development will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive impact on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term moderate positive indirect impact. According to the Irish Wind Energy Association there are over 4,400 jobs related to wind energy in Ireland in 2019, a figure which is projected to grow to over 8,000 by 2020.

Rates payments for the wind farm will contribute significant funds to Offaly County Council, which will be redirected to the provision of public services within Co. Offaly. These services include provisions such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

Proposed Community Benefit Scheme

In addition to employment during the construction and operational phases of the proposed development and annual rates that will be paid to the local authority by the developer, a range of other benefits associated with the proposed development will be provided to the local community through the annual Community Gain Scheme. The aim of this scheme is to provide financial assistance to local communities and not-for-profit organisations around the development. In order to be eligible for funding, projects must fall within the thematic areas of: Amenities, Community Facilities, Culture/Heritage, Energy Efficiency/Improvements, Education and Recreation/Health. A key criterion is that the projects and initiatives will benefit the communities surrounding the wind farm.

The Near Neighbour Scheme will offer electricity bill payers living within a prescribed distance of a wind turbine an annual contribution towards their electricity usage. In addition to the electricity contribution payment, the Scheme will also offer participants a contribution towards the completion of energy measures on the property and/or education support. This is in line with existing near neighbour schemes that are active at other Bord na Móna Powergen Wind Farms.

The value of the fund for the Community Gain and Near Neighbour Schemes will be directly proportional to the installed capacity and energy produced at the site, which based on current proposals, will be in the region of €10 million over the lifetime of the project.

Renewable Energy Support Scheme/Community Ownership

Public Consultation on the Renewable Electricity Support Scheme (RESS) 1 closed for submissions in January 2020. The consultation paper set out the high-level details for the provision of a Renewable Energy Participation Scheme (REP Scheme) in Annex C (REP Scheme) for Community Participation in renewable developments. The key element proposed is:

Providing Irish Citizens, or not for profit community entities (to be defined), to invest in renewable electricity generation projects in the Republic of Ireland - prioritising those that live in closer proximity to the Relevant Projects.

The Department of Communications, Climate Action and Environment envisage finalisation of the RESS Scheme in 2020.

If the proposed development utilises the RESS then any community benefit stipulations that are outlined in the finalised RESS will be incorporated into the operation of the wind farm and will be of enduring benefit to the local community.

5.9.2.3 Population

Those working on the construction phase of the proposed development will travel daily to the site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

5.9.2.4 Land-use

The existing land-uses of telecommunications and commercial forestry will continue on the site of the proposed development. There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to Derrinlough Briquette Factory which is located in the most western part of Drinagh bog. These rail lines will remain in operation during the construction phase of the proposed development. The proposed development will have no impact on existing land-uses as it has been designed to co-exist with these land-uses.

5.9.2.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts associated with the construction phase of the development. With regard to tourist attractions and amenity use around the site, described in Section 5.3.2, traffic management safety measures will be in place. Please see Traffic impacts below for further details on proposed mitigation measures.

5.9.2.6 Noise

Pre-Mitigation Impacts

There will be an increase in noise levels in the vicinity of the proposed development site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest the proposed development site. These impacts will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation and pouring of the turbine bases. Excavation of a base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise impacts that will occur during the construction phase of the proposed development are further described in Chapter 11: Noise and Vibration.

Proposed Mitigation Measures

Best practice measures for noise control will be adhered to onsite during the construction phase of the proposed development in order to mitigate the slight short-term negative impact associated with this phase of the development. These measures will include:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate 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 Chapter 11 using methods outlined in British Standard BS 5228-1:2014+A1:2019 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, large turbine component delivery, rotor/blade lifting) it could occasionally be necessary to work out of these hours

Residual Impact

Following the implementation of the above mitigation measures, there will be a short-term imperceptible negative residual impact due to an increase in noise levels during the construction phase of the proposed development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.7 Dust

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the proposed development include upgrading of existing access tracks and construction of new access roads, turbine foundations and substation. An increase in dust emissions has the potential to cause a nuisance to sensitive receptors in the immediate vicinity of the site. The entry and exit of construction vehicles from the site may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. These impacts will not be significant and will be relatively short-term in duration. The potential dust impacts that may occur during the construction phase of the proposed development are further described in Chapter 10: Air and Climate.

Proposed Mitigation Measures

Aggregate material for the construction of roads and turbine bases will be sourced from local quarries within the local area surrounding the site and vehicles will be inspected upon leaving any quarries. Truck wheels will be washed to remove mud and dirt before leaving the site also. All plant and materials vehicles shall be stored in the compound area or other dedicated areas. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. Construction traffic will be restricted to defined routes and a speed limit will be implemented.

In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and the temporary site compound to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

Residual Impact

Following the implementation of the above mitigation measures, there will be short-term slight negative impact due to dust emissions from the construction of the proposed development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.8 Traffic

Pre-Mitigation Impacts

It is proposed that the large wind turbine plant will be delivered via the M6 before turning south onto the N52 at Junction 5: Kilbeggan/Tullamore. The route follows the N52 south, bypassing Tullamore to the east and passing through the settlements of Blue Ball, Kilcormac and Five Alley. Deliveries will turn right onto the N62 (at the junction known as Kennedy's Cross) and will proceed northwards towards Cloghan to the proposed site entrances, immediately north of Derrinlough Briquette Factory. The proposed route is described in Chapter 4 of this EIAR. All deliveries of turbine components to the site will only be by way of the proposed turbine delivery route. Non-turbine construction traffic will be comprised of Heavy Goods Vehicle (HGV) and Light Goods Vehicle (LGV) movements involved in the delivery of construction materials to the site and the export of excess construction materials and plant from the site. A complete Traffic and Transportation Assessment (TTA) of the proposed development has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 14.1 of Chapter 14: Material Assets.

The types of vehicles that will be required to negotiate the local network represent abnormal size loads and a detailed assessment of the geometry of the proposed route was therefore undertaken. This will have a temporary slight to moderate negative impact on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

With regard to the proposed underpass beneath the N62, there is the potential for short term nuisance to local road users due to the short-term, single-lane closures required during the construction of the underpass. the section of, giving rise to a slight, temporary, negative impact.

Proposed Mitigation Measures

A traffic management plan will be developed and implemented to ensure any impact is short term in duration and slight in significance during the construction of the proposed development. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made clear. Local access to properties will also be maintained throughout any construction works and local residents will also be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum. In relation to the cable laying works, the works area in any one day will be approximately 300m in length and so the potential for significant disruption is limited.

Residual Impact

Once a traffic management plan is implemented for the construction phase of the proposed development, there will be a short-term imperceptible negative residual impact on local road users.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.9 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 5.7 of this chapter, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the proposed development.

5.9.3 Operational Phase

The effects set out below relate to the operational phase of the proposed wind farm.

5.9.3.1 Health and Safety

Pre-Mitigation Impact

It is not anticipated that the operation of the wind farm will present a danger to the public and livestock. Rigorous safety checks are conducted on the turbines during design, construction, commissioning and operation to ensure the risks posed to staff, landowners and general public are negligible.

Proposed Mitigation Measures

Notwithstanding the above, the following mitigation measures will be implemented during the operation of the proposed development to ensure that ensure the risks posed to staff, landowners and general public remain negligible throughout the operational life of the wind farm.

Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.

Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.

Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include:

- Buried cable route markers at 50m (maximum) intervals and change of cable route direction;
- Directions to relevant turbines at junctions;
- “No access to Unauthorised Personnel” at appropriate locations;
- Speed limits signs at site entrance and junctions;
- “Warning these Premises are alarmed” at appropriate locations;
- “Danger HV” at appropriate locations;
- “Warning – Keep clear of structures during electrical storms, high winds or ice conditions” at site entrance;
- “No unauthorised vehicles beyond this point” at specific site entrances; and
- Other operational signage required as per site-specific hazards.

An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the site and providing for access for emergency services at all times.

The components of a wind turbine are designed to last up to 30 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the site’s health and safety requirements.

Residual Impact

With the implementation of the above mitigation measures, there will be a long-term, imperceptible residual impact on health and safety during the operational life of the proposed development

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.3.2 Tourism

Pre-Mitigation Impacts

Currently there are no dedicated amenity walkways within the development area. As part of the proposed development design, approximately 18 km of amenity pathways including walkways and cycleways and a 15-car carpark will be provided. Sections of new site roads will be developed and promoted for walking activities in additional to dedicated amenity walkways. These dedicated areas will provide a safer visitor experience and open the site up to locals, tourists, trail runners etc. In addition to these dedicated amenity pathways, public use links into and out of the development area such as the below will be improved/created:

- Internal link to R437 allowing further access to Drinagh and Derrybrat and to facilitate potential future connection to Lough Boora Parklands.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link to the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

Proposed Mitigation Impacts

None required.

Residual Impact

The proposed development will have a long-term positive impact on tourism due to the social and recreational benefits associated with the recreational amenity walkways/ paths.

Significance of Effects

The addition of dedicated recreational and amenity routes for locals and tourists will have a significant effect on tourism in the local area.

5.9.3.3 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 34 residential properties may experience daily shadow flicker in excess of the current DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual guideline limit of 30 hours is not exceeded due the proposed development once the regional sunshine average of 26.6% is considered.

Proposed Mitigation Measures

Where daily or annual shadow flicker exceedances are experienced at buildings, a site visit will be undertaken firstly to determine the level of occurrence, existing screening and window orientation. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded.*

Screening Measures

In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

Wind Turbine Control Measures

If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented.

Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines and are not cost prohibitive.

A shadow flicker control unit allows a wind farm's turbines to be programmed and controlled using the wind farm's SCADA control system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to ensure that shadow flickers occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the wind farm site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine. This method of shadow flicker mitigation has been technically well-proven at wind farms in areas outside Ireland that experience significantly longer periods of direct sunlight.

This measure can be utilised at the site of the proposed development to prevent incidences of shadow flicker values at any house. Therefore, the Derrinlough Wind Farm could be brought in line with the requirements of the Draft Revised Wind Energy Development Guidelines 2019 should they come in to force during the planning application process for this development.

Should a complaint be received within 12 months of commissioning of the wind farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. Notwithstanding the approach set out above should shadow flicker associated with the permitted development be perceived to cause a nuisance at any home, the affected homeowner is invited to engage with the Wind Farm Developer. The homeowner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out.

Residual Impact

Shadow flicker could potentially have a long-term slight negative impact. However, as the applicant has committed to a curtailment strategy for all turbines that cause an exceedance in the existing daily and annual shadow flicker limits at residential properties up to a distance of 10 rotor diameters from the proposed development, there will be no impact from shadow flicker on human beings.

Significance of Effects

Based on the assessment above and the mitigation measures proposed there will be no significant effects related to shadow flicker.

5.9.3.4 Interference with Communication Systems

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path. This interference can be overcome by the installation of deflectors or repeaters.

As part of the scoping and consultation exercise undertaken by MKO, the national and regional broadcasters and fixed and mobile phone operators were contacted regarding potential interference from the proposed wind farm. Full details are provided in of Chapter 2: Background to the Proposed Development and Section 14.2 (Telecommunications and Aviation) of Chapter 14: Material Assets. Copies of the scoping responses received are presented in Appendix 2.1 of the EIAR.

Responses were received from BT Telecoms, Eir, Netshare, Tetra Ireland, 2RN and Viatel, all of which outlined that there will be no interference risk from any of the proposed turbines providing the design complies with recommended buffer zones. The proposed design and turbine layout do not overlap with any of the telecoms links or clearance zones requested by operators. Therefore, the proposed development will have no impact on telecommunications.

5.9.3.5 Residential Amenity

Pre-Mitigation Impacts

Potential impacts on residential amenity during the operational phase of the proposed wind farm could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the proposed development will be capable of meeting all required guidelines in relation to noise thresholds and the shadow flicker thresholds set out in the 2006 DoEHLG Wind Energy Guidelines.

The visual impact of the proposed development is addressed comprehensively in Chapter 12: Landscape and Visual. The proposed development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 750 metres of an occupied dwelling. An assessment of roadside screening was carried out for roads within 5km of the proposed turbine locations, with both the methodology and findings of this described in Section 12.7.3. Many of these roads have intermittent screening, and therefore intermittent views rather than full visibility of the site. Given the separation distance of the residential properties from the proposed turbines, and the level of existing screening in the area, the proposed development will have no significant impact on existing visual amenity at dwellings.

Proposed Mitigation Measures

There are no turbines proposed within 750 metres of any occupied dwellings. The closest dwelling to a proposed turbine location is approximately 762 metres. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and shadow flicker in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route.

Residual Impact

With the implementation of the mitigation measures outlined in relation to noise and vibration, dust, traffic, shadow flicker and visual amenity, the proposed development will have an imperceptible impact on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on residential amenity.

5.9.4 Decommissioning Phase

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the site may be decommissioned fully. The substation will remain in place as it will be under the ownership of the EirGrid.

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4: Description of the Proposed Development. Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase, however to a lesser extent.

5.9.5 Cumulative Effects

For the assessment of cumulative impacts, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered. Further information on projects considered as part of the cumulative assessment are given in Chapter 2: Background to the Proposed Development. The impacts with the potential to have cumulative effects on human beings are discussed below and in more detail in the relevant chapters: noise (Chapter 11), visual impacts (Chapter 12) and traffic (Chapter 14).

5.9.5.1 Shadow Flicker

As outlined in Table 5.8 five dwellings may be impacted by shadow flicker from the proposed Derrinlough Wind Farm in combination with permitted wind farms within 1.5km of the development site. As such, the monitoring and subsequent mitigation measures as outlined in Section 5.9.3.3 will be implemented to ensure any dwelling which may be impacted by shadow flicker as a result of the proposed Derrinlough Wind Farm will be in compliance with the thresholds set out in the 2006 DoEHLG Wind Energy Guidelines.

5.9.5.2 Residential Amenity

Pre-Mitigation Impacts

If all permitted and proposed projects as described in the cumulative assessment in Chapter 2 being constructed at the same time, there is the potential for a resulting short term, significant, cumulative, negative impact to occur on residential amenity, in relation to noise and vibration, dust, traffic, telecommunications and visual amenity.

Proposed Mitigation Measures

There are no turbines as part of the proposed development that will be located within 750 metres of any occupied dwellings. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

Residual Impact

The proposed development will have a short-term, slight negative effect on residential amenity during construction works. During the operational phase, noise and shadow flicker from the proposed and permitted projects will be limited to below guideline levels or as committed to by the developer.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

6. BIODIVERSITY

6.1 Introduction

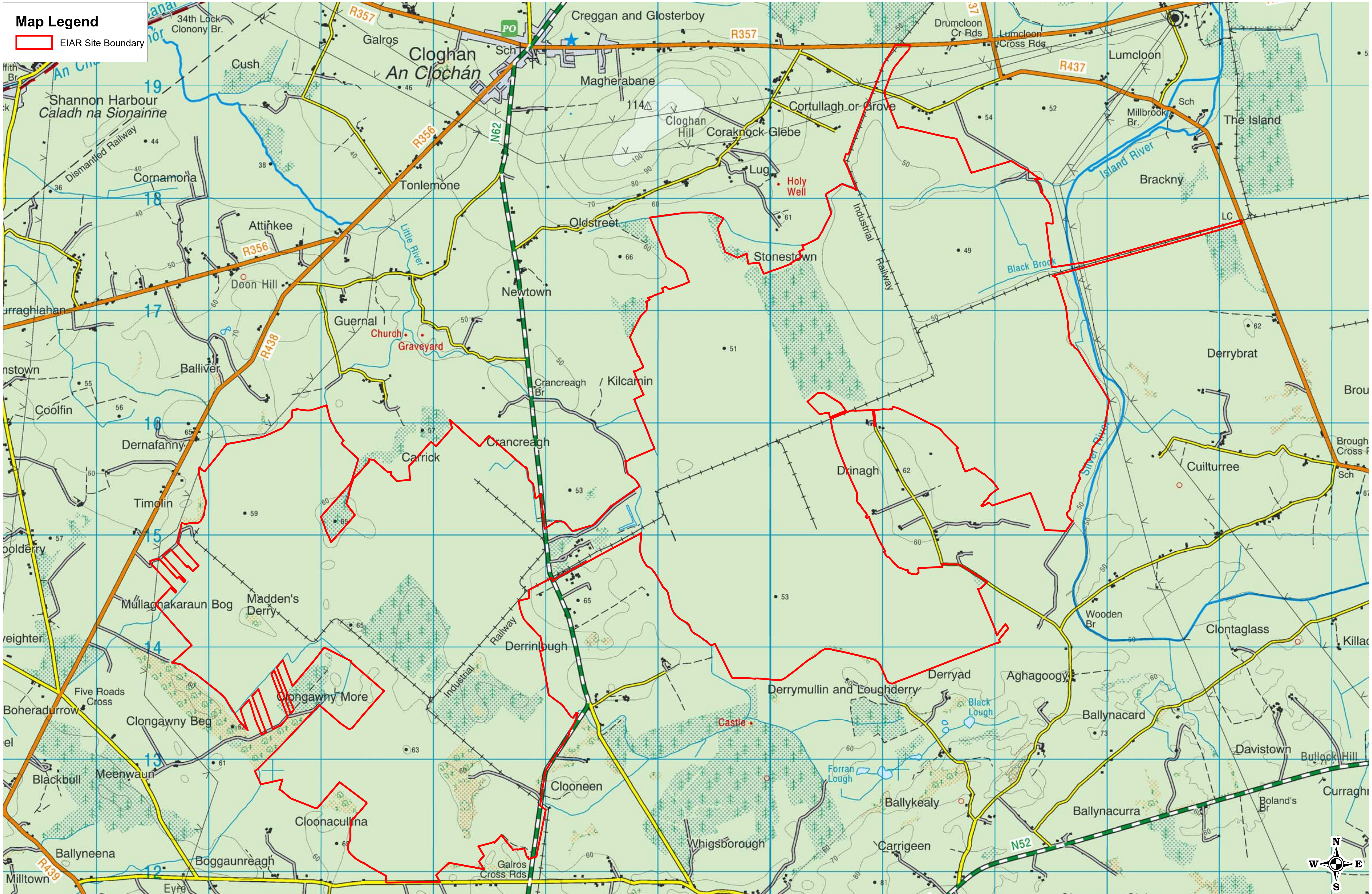
This chapter assesses the likely significant effects (both alone and cumulatively with other projects) that the proposed development may have on Biodiversity, Flora and Fauna and sets out the mitigation measures proposed to award, reduce or offset any potential significant effects that are identified. The residual impacts on biodiversity are then assessed. Particular attention has been paid to species and habitats of ecological importance. Impacts on avian receptors are considered in Chapter Seven of this EIAR. These include species and habitats with national and international protection under the Wildlife Acts 1976-2019, EU Habitats Directive 92/43/EEC. The full description of the proposed development is provided in Chapter 4 of this EIAR.

The chapter is structured as follows

- The Introduction provides a description of the legislation, guidance and policy context applicable to Biodiversity, Flora and Fauna.
- This is followed by a comprehensive description of the ecological survey and impact assessment methodologies that were followed to inform the robust assessment of likely significant effects on ecological receptors.
- A description of the Baseline Ecological Conditions and Receptor Evaluation is then provided.
- This is followed by an Assessment of Effects which are described with regard to each phase of the development: construction phase, operational phase and decommissioning phase. Potential Cumulative effects in combination with other projects are fully assessed.
- Proposed mitigation and best practice measures to avoid, reduce or offset the identified effects are described and discussed. This is followed by an assessment of residual effects taking into consideration the effect of the proposed mitigation and best practice measures.
- The conclusion provides a summary statement on the overall significance of predicted effects on Biodiversity, Flora and Fauna.

The following defines terms utilised in this chapter:

- For the purposes of this EIAR, the entire project is referred to as 'the Proposed Development'.
- For the purpose of this EIAR, the term 'EIAR Site Boundary' refers to the site red line boundary, comprising the entire area of the two Bog areas (Clongawny and Drinagh) as shown in Figure 6-1.
- "Key Ecological Receptor" (KER) is defined as a species or habitat occurring within the zone of influence of the development upon which likely significant effects are anticipated.
- "Zones of Influence" (ZOI) for individual ecological receptors refers to the zone within which potential effects are anticipated. ZOIs differ depending on the sensitivities of particular habitats and species and were assigned in accordance with best available guidance and through adoption of a precautionary approach.



MAP TITLE: **Study Area**

MAP NO.: **Figure 6.1**

SCALE: **1:30,000**

PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR**

DATE: **05-02-2020**

DRAWING BY: **DMN**

CHECKED BY: **PR**

ISSUE NO.: **171221-2020.02.05 F**

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6.2 Requirements for Ecological Impact Assessment

National Legislation

The Wildlife Act, 1976–2018, is the principal piece of legislation governing protection of wildlife in Ireland. The Wildlife Act provides strict protection for species of conservation value. The Wildlife Act conserves wildlife (including game) and protects certain wild creatures and flora. These species are therefore considered in this report as ecological receptors. Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) are heritage sites that are designated for the protection of flora, fauna, habitats and geological sites. Only NHAs are designated under the Wildlife (Amendment) Act 2017. These sites do not form part of the Natura 2000 network of European sites and the AA process, or screening for same, does not apply to NHAs or pNHAs. Proposed Natural Heritage Areas (pNHAs) were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated[1] However, these sites are considered to be of significance for wildlife and habitats as they may form statutory designated sites in the future (NPWS, 2020).

The Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) lists the species, hybrids and/or subspecies of flora protected under Section 21 of the Wildlife Acts. It provides protection to a wide variety of protected plant species in Ireland including vascular plants, mosses, liverworts, lichens and stoneworts. Under Flora Protection Order.

It illegal to cut, pick, collect, uproot or damage, injure or destroy species listed or their flowers, fruits, seeds or spores or wilfully damage, alter, destroy or interfere with their habitat (unless under licence).

National Policy

The National Biodiversity Action Plan 2017-2021 (Department of Culture, Heritage and the Gaeltacht, 2017) (the "**Plan**") demonstrates Ireland's continuing commitment to meeting and acting on its obligations to protect Ireland's biodiversity for the benefit of future generations through a series of targeted strategies and actions. The main objective of the Plan is to bring biodiversity into the mainstream of policy and decision-making. Objective 1 (*Mainstream biodiversity into decision-making across all sectors*) of the Plan identifies the following relevant measures in relation to future developments:

- "Incorporate into legislation the requirement for consideration of impacts on biodiversity to ensure that conservation and sustainable use of biodiversity are taken into account in all relevant plans and programmes and relevant new legislation;
- Public and Private Sector relevant policies will use best practice in SEA, AA and other assessment tools to ensure proper consideration of biodiversity in policies and plans;
- All Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure;
- Strengthen ecological expertise in local authorities and relevant Government Departments and agencies;
- Local Authorities will review and update their Biodiversity and Heritage Action Plans;
- Local Authorities will review and update their Development Plans and policies to include policies and objectives for the protection and restoration of biodiversity;
- Develop a Green Infrastructure at local, regional and national levels and promote the use of nature based solutions for the delivery of a coherent and integrated network;

[1] https://www.npws.ie/protected-sites/nha (accessed 23 January 2020).

- Continue to produce guidance on the protection of biodiversity in designated areas, marine and the wider countryside for Local Authorities and relevant sectors;
- Integrate Natura 2000 and Biodiversity financial expenditure tracking into Government Programmes internal paying agency management procedures including linkage to the Prioritised Action Framework and this NBAP;
- Develop a Natural Capital Asset Register and national natural capital accounts by 2020, and integrate these accounts into economic policy and decision-making;
- Initiate natural capital accounting through sectoral and small scale pilot studies, including the integration of environmental and economic statistics using the framework of the UN System of Experimental-Ecosystem Accounting (SEEA);
- Establish a national Business and Biodiversity Platform under the CBD's Global Business Partnership;
- Ensure Origin Green produces tangible benefits for biodiversity with increased emphasis on conservation and restoration of biodiversity;
- Implement actions from Ireland's Biodiversity Climate Change Sectoral Adaptation Plan;
- Identify and take measures to minimise the impact of incentives and subsidies on biodiversity loss, and develop positive incentive measures, where necessary, to assist the conservation of biodiversity;
- Establish and implement mechanisms for the payments of ecosystem services including carbon stocks, to generate increased revenue for biodiversity conservation and restoration;
- Develop and implement a National Biodiversity Finance Plan to set out in detail how the actions and targets of this NBAP will be delivered from 2017 and beyond; and
- Monitor the implementation of the Plan"

Such policies have informed the evaluation of ecological features recorded within the study area and the ecological assessment process.

European Legislation

The EU Habitats Directive (92/43/EEC) (together with the Birds Directive (79/409/EEC), as subsequently codified by Council Directive 2009/147/EC on the conservation of wild birds) forms the cornerstone of Europe's nature conservation within the EU. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. The Habitats Directive protects over 1,000 animal and plant species and over 200 "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance. The Habitats Directive and Birds Directive, which were transposed into Irish law through Part XAB of the Planning and Development Acts 2000-2019 (from a land use planning perspective) recognise the significance of protecting rare and endangered species of flora and fauna, and more importantly, their habitats.

Annex I of the Habitats Directive lists habitat types whose conservation requires the designation of Special Areas of Conservation (SAC). Priority habitats, such as Turloughs, which are in danger of disappearing within the EU territory are also listed in Annex I. Annex II of the Directive lists animal and plant species (e.g. marsh fritillary, Atlantic salmon, and Killarney fern) whose conservation also requires the designation of SAC. Annex IV lists animal and plant species in need of strict protection such as lesser horseshoe bat and otter, and Annex V lists animal and plant species whose taking in the wild and exploitation may be subject to management measures. In Ireland, species listed under Annex V include Irish hare, common frog and pine marten. Species can be listed in more than one Annex, as is the case with otter and lesser horseshoe bat which are listed on both Annex II and Annex IV. The disturbance of species under Article 12 of the Habitats Directive (and in particular avoidance of deliberate disturbance of Annex IV species, particularly during the period of breeding, rearing, hibernation and migration and avoidance of deterioration or destruction of breeding sites or resting places) has been specifically assessed in this EIAR.

Council Directive 2009/147/EC on the conservation of wild birds (the "**Birds Directive**") instructs Member States to take measures to maintain populations of all bird species naturally occurring in the wild state in the EU (Article 2). According to Recital 1 of the Birds Directive, Council Directive 79/409/EEC on the conservation of wild birds was substantially amended several times and in the interests of clarity and rationality, the Birds Directive codifies Council Directive 79/409/EEC. Such measures may include the maintenance and/or re-establishment of habitats in order to sustain these bird populations (Article 3). A subset of bird species has been identified in the Directive and are listed in Annex I as requiring special conservation measures in relation to their habitats. These species have been listed on account of inter alia: their risk of extinction; vulnerability to specific changes in their habitat; and/or due to their relatively small population size or restricted distribution. Special Protection Areas (SPAs) are to be identified and classified for these Annex I listed species and for regularly occurring migratory species, paying particular attention to the protection of wetlands (Article 4).

In summary, the species and habitats provided National and International protection under these legislative and policy documents have been considered in this Ecological Impact Assessment. A detailed assessment of the likelihood of the proposed development having either a significant effect or an adverse impact on any relevant European Sites (i.e. SACs, cSACs, SPAs or cSPAs) has been carried out in the Appropriate Assessment Screening Report and Natura Impact Statement. A separate assessment has not been carried out in this chapter, to avoid duplication of assessments. However, the relevant conclusions have been cross-referenced and incorporated.

6.3 Scoping/Review of Relevant Guidance and Sources of Consultation

The assessment methodology is based primarily upon the National Road Authority (NRA)'s Guidelines for Assessment of Ecological Impacts of National Road Schemes Rev 2 (NRA, 2009) (referred to hereafter as the NRA Ecological Impact Assessment Guidelines), and the survey methodology is based on the NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2009). Although these survey methodologies relate to road schemes, these standard guidelines are recognised survey methodologies that ensure good practice regardless of the development type.

In addition, the following guidelines were consulted in the preparation of this document to provide the scope, structure and content of the assessment:

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater and Coastal (CIEEM, 2018).

This assessment has been carried out in accordance with the Environmental Impact Assessment guidance as outlined in Chapter 1 of the EIAR.

In addition to the above, the following legislation applies with respect to habitats, fauna and water quality in Ireland and has been considered in the preparation of this report:

- The International Convention on Wetlands of International Importance especially Waterfowl Habitat (Concluded at Ramsar, Iran on 2 February 1971)
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations 2003 which give further effect to EU Water Framework Directive (2000/60/EC).
- Planning and Development Acts 2000 – 2019.

The following legislation applies with respect to non-native species:

- Regulation 49 and 50 of European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477 of 2011).

This assessment has been prepared with respect to the various planning policies and strategy guidance documents listed below:

- Offaly County Development Plan 2014 – 2020.
- Natura Impact Assessment Report on the Offaly County Development Plan, Offaly County Council, (2014).

6.3.1 Statement of Authority

This report has been prepared by David McNicholas and Pat Roberts (B.Sc. Environmental Science, MCIEEM). Pat has over 14 years' experience in ecological management and assessment. David McNicholas has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. The baseline ecological surveys were undertaken by David McNicholas (BSc., MSc., MCIEEM), Sarah Mullen (BSc., PhD), James Owens (BSc., MSc.), Dr. Úna Nealon, Laoise Kelly (B.Sc), Julie O'Sullivan (BSc, MSc), John Hehir and Paddy Manley (B.Sc). (CIEEM). Úna Nealon's primary expertise lies in bat ecology. She completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. James has over 4 years' consultancy experience and is a competent expert in undertaking ecological surveys. Sarah has over 4 years' professional ecological consultancy experience and a PhD on the plant pollinator interactions in semi-natural grasslands. Laoise Kelly, Julie O'Sullivan, Paddy Manley and John Hehir all assisted in the gathering of baseline data at the proposed development site. They have relevant academic qualifications and are competent experts in undertaking the ecological surveys in which they were involved.

The survey methodologies underlined in this EIAR chapter have been peer reviewed by Dr Tom Gittings. Dr Gittings has been trading as an independent ecological consultant since 2001. He has over 18 years' experience as a professional ecologist and is a full member of the Chartered Institute of Ecology and Environmental Management.

6.4 Methodology

The following sections describe the methodologies followed to establish the baseline ecological condition of the proposed development site and surrounding area. Assessing the impacts of any project and associated activities requires an understanding of the ecological baseline conditions prior to and at the time of the project proceeding. Ecological Baseline conditions are those existing in the absence of proposed activities (CIEEM, 2018).

6.4.1 Desk Study

The desk study undertaken for this assessment included a thorough review of available ecological data including the following:

- Review of existing information on the proposed development site provided by Bord na Móna personnel in particular the Ecology team.
- Review of online web-mappers: National Parks and Wildlife Service (NPWS), EPA (Envision), Water Framework Directive (WFD) and Inland Fisheries Ireland (IFI).

- Data on potential occurrence of protected bryophytes – as per NPWS online map viewer; Flora Protection Order Map Viewer – Bryophytes2.
- Available info from IPC licence P0500-01
- Review of the Bat Conservation Ireland (BCI) Private Database
- Review of the publicly available National Biodiversity Data Centre (NBDC) web-mapper
- Inland Fisheries Ireland (IFI) Reports, where available.
- Records from the NPWS web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectads in which the Proposed development is located.

6.4.2 Scoping and Consultation

MKO undertook a scoping exercise during preparation of this EIAR, as described in Chapter 2, Section 2.6 of this EIAR.

Copies of all scoping responses are included in Appendix 2.1 of this EIAR. The recommendations of the consultees have informed the EIAR preparation process and the contents of this chapter. Table 2.3 in Chapter 2 of this EIAR describes where the comments raised in the scoping responses received have been addressed in this assessment.

Table 6.1 provides a list of the organisations consulted with regard to biodiversity during the scoping process, and notes where scoping responses were received.

Table 6.1 Organisations consulted with regard to biodiversity

Consultee	Response
Butterfly Conservation Ireland (BCI)	Butterfly Conservation Ireland (BCI) were consulted during the preparation of this report. The findings of all surveys and measures for the avoidance of impact on marsh fritillary were discussed. The advice and considerations of BCI were fully taken into account in the design of the proposed development and in the design of mitigation and enhancement measures that are included in the Lepidoptera Management Plan prepared for this project.
Irish Peatland Conservation Council	Requested a Bord na Móna Rehabilitation Plan

6.4.3 Field Surveys

A comprehensive survey of the biodiversity of the entire site was undertaken on various dates throughout 2018 and 2019. The following sections fully describe the ecological surveys that have been undertaken and provide details of the methodologies, dates of survey and guidance followed.

[2] NPWS, 2019, Online map viewer; Flora Protection Order Map Viewer – Bryophytes. Online, Available at: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Accessed: 26/06/2019.

6.4.3.1 Multi-disciplinary Walkover Surveys (as per NRA Guidelines, 2009)

Multidisciplinary walkover surveys were undertaken on the 21st June 2018, 28th September 2018, 21st and 22nd August 2019, 18th and 19th September 2019 and 5th December 2019. The majority of the survey timings fall within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith *et al.*, 2011). A comprehensive walkover of the entire site was completed.

The walkover surveys were also designed to detect the presence, or likely presence, of a range of protected species. The survey included a search for badger setts and areas of suitable habitat, potential features likely to be of significance to bats and additional habitat features for the full range of other protected species that are likely to occur in the vicinity of the proposed development (e.g. otter etc.). In addition, an inventory of other species of local biodiversity interest was compiled including invertebrates (butterflies, dragonflies, damselflies, beetles), plants, fungi etc.

The multi-disciplinary walkover surveys comprehensively covered the entire study area and based on the survey findings, further detailed targeted surveys were carried out for features and locations of ecological significance. These surveys were carried out in accordance with NRA *Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna* on National Road Schemes (NRA, 2009).

During the multidisciplinary surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted.

Other targeted survey methodologies undertaken at the site are described in the following subsections.

6.4.3.2 Dedicated Habitat and Vegetation Composition Surveys

The walkover surveys were undertaken in order to ground truth the information provided in previous ecological surveys of the bog that were undertaken by the Bord na Móna ecology team in 2014. The Bord na Móna ecology team originally classified the habitats on site according to the Bord na Móna habitat classification system, provided in Appendix 6.1. Correspondence with the Heritage Council's *'Guide to Habitats in Ireland'* (Fossitt, 2000) is also described in Appendix 6.1. Detailed habitat classification and assessment was undertaken by MKO at targeted locations within the development footprint, with relevés undertaken within representative habitats at each turbine base, substation, borrow pits etc. Relevés were 2x2 metres for all habitats except for woodland which were 20x20 metres. Where linear sections of woodland were assessed, two 10x10 metre relevés were taken as sufficient woodland width would not allow for a 20x20 metre relevé. The extent of each habitat on site was mapped on site using aerial photography, hand held GPS and smartphone technology. A representative photograph was also taken for each of the habitats recorded on site, including all relevés.

All habitats recorded on site and described in this EIAR chapter have been classified in accordance Fossitt (2000). In addition, peatland and woodland habitats outside of the proposed infrastructure footprint but within the study area are described in detail in this chapter. Full details of all the botanical surveys and results are provided in Appendix 6.4 and an assessment of the potential for the site to support Annex I habitats is also provided in this Appendix.

Botanical surveys for all turbine, road infrastructure, sub stations, grid connections and all other infrastructure were undertaken on 21st and 22nd of August and 18th - 19th of September 2019. Additional surveys of some areas of cutover bog were also undertaken on the 05 December 2019. Botanical surveys of the site were also undertaken on the 21st June 2018 and 28th September 2018. These surveys provided an understanding of the baseline and informed further survey work following finalisation of the proposed infrastructure layout. The habitat assessment surveys described in this report have been undertaken with reference to the following guidelines and interpretation documents:

- Perrin, P.M, Martin, J.R., Barron, J.R., Roche & O'Hanrahan, B. (2014) *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland.* Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service.
- 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.
- Fernandez, F., Connolly K., Crowley W., Denyer J., Duff K. & Smith G. (2014) Raised Bog Monitoring and Assessment Survey 2013. Irish Wildlife Manuals, No. 81. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.
- Commission of the European Communities (2007) Interpretation manual of European Union habitats. Eur 27. European Commission DG Environment.
- Foss, P.J. & Crushell, P. 2008, *Guidelines for a National Fen Survey of Ireland, Survey Manual.* Report for the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.
- NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks and Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: *Habitat Assessments*. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill

Habitats considered to be of ecological significance and in particular having the potential to correspond to those listed in Annex I of the EU Habitats Directive 92/43/EEC were identified and classified as Key Ecological Receptors (KERs).

Plant nomenclature for vascular plants follows '*New Flora of the British Isles*' (Stace, 2010), while mosses and liverworts nomenclature follows '*Mosses and Liverworts of Britain and Ireland - a field guide'* (British Bryological Society, 2010).

6.4.3.3 Terrestrial Fauna Surveys

The results of the desk study, scoping replies, incidental records of protected species during ecological survey work and multidisciplinary walkover surveys were used to inform the scope of targeted ecological surveys required. Dedicated surveys for bats, otter and badger were undertaken at the times set out below with the methodologies followed also provided below. Following the completion of ecological walkover surveys, no requirement for further dedicated faunal surveys was identified. During the multidisciplinary walkover surveys, records of invertebrates including butterflies, damselflies, dragonflies, moths, beetles etc. were recorded. Given the known occurrence of the marsh fritillary butterfly in the area, this species was also focused on during the site visits with dedicated surveys undertaken in October 2018 and September 2019 to determine the occurrence, distribution and likely size of the population within the study area.

6.4.3.3.1 *Badger Survey*

Areas identified as providing potential habitat for badger were subject to specialist targeted survey. Dedicated badger surveys were conducted on the 21st June 2018, 28th September 2018, 4th February 2019, 21st and 22nd August 2019, 18th and 19th September 2019 and 5th December 2019. The badger surveys covered the entire development footprint and surrounding suitable habitats in the study area. Targeted surveys were also undertaken in areas where incidental badger signs, setts or sightings were recorded during walkover bird surveys of the site. The badger survey was not constrained by vegetation given the nature of the habitats within the site and the timing of the surveys (NRA 2006a).

The badger surveys were conducted in order to determine the presence or absence of badger signs within and outside (areas of identified suitable habitat) the development footprint and study area. This involved a search for all potential badger signs as per NRA (2009) (latrines, badger paths and setts). If encountered, setts would be classified as per the convention set out in NRA (2009) (i.e. main, annexe, subsidiary, outlier).

The badger survey was conducted adhering to best practice guidance (NRA, 2009) and followed the *'Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes'* (NRA, 2006a) and CIEEM best practice competencies for species surveys (CIEEM, 2013[3]).

6.4.3.3.2 Otter Survey

Following a review of the previously completed ecological surveys and the results of the multi-disciplinary walkover survey; areas identified as providing potential habitat for otter were subject to specialist targeted survey. The otter survey of watercourses was conducted in 21st and 22nd August 2019, 18th and 19th September 2019 and 5th December 2019. Additional otter surveys were undertaken during a fisheries assessment of the watercourses both within and downstream of the study area on the 22nd and 23rd October 2019.

The otter survey was conducted as per NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes). This involved a search for all otter signs e.g. spraints, scat, prints, slides, trails, couches and holts. In addition to the width of the rivers/watercourses, a 10m riparian buffer (both banks) was considered to comprise part of the otter habitat (NPWS 2009). The dedicated otter survey also followed the guidance as set out in NRA (2008) *'Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes'* and following CIEEM best practice competencies for species surveys (CIEEM, 2013).

6.4.3.3.3 Marsh fritillary Surveys

Following the identification of suitable habitat for marsh fritillary within the site during habitat surveys, targeted surveys for the species were undertaken by MKO on the 28th September 2018 and 18th and 19th September 2019. The survey methodology followed that described in the NRA (2009) best practice guidance document. This involved walked surveys to identify suitable areas of marsh fritillary habitat within or adjacent to the development footprint. Where suitable habitat did occur, detailed surveys to locate larval webs were undertaken. In addition, habitat suitability assessments were undertaken within areas of suitable habitat for the species following those developed by the NBDC[4].

6.4.3.3.4 Bat Surveys

A detailed bat survey report is provided in Appendix 6.2 of this EIAR. This document provides a detailed description of survey methodologies undertaken at the site during the survey period 2018-2019. Full details of the survey times and dates and the methodologies followed are provided in Appendix 6.2 along with details of all the surveyors.

Survey design and effort in 2018 was created in accordance with the best practice guidelines available at the time, '*Bat Surveys: Good Practice Guidelines'* prepared by the Bat Conservation Trust (Hundt, 2012). Surveys undertaken in 2019 were undertaken in strict accordance with those prescribed in SNH (2019) '*Bats and onshore wind turbines: survey, Assessment and mitigation*'. This is in line with standard best practice industry guidelines.

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[3] CIEEM, 2013, Technical Guidance Series – Competencies for Species Survey, Online, Available at: https://cieem.net/resource/competencies-for-species-survey-css/ Accessed: 20.06.2019

[4] NBDC, 2019, Habitat Condition Assessment for Marsh Fritillary, Online, Available at: http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Marsh-Fritillary-Habitat-Condition-Form.pdf, Accessed, 20 March 2019

6.4.3.3.5 *Aquatic surveys*

Habitat suitability for protected aquatic species of conservation interest which are known or suspected to occur within the study area (e.g. fish species, otter etc.) were conducted. Aquatic habitats and species were assessed during the multi-disciplinary walkover surveys and where appropriate dedicated aquatic habitat and fisheries surveys were undertaken. A dedicated fisheries assessment was undertaken at the site for targeted species groups including salmon, trout and lamprey on the 22nd and 23rd October 2019. A full description of the survey methodologies is provided in the standalone report available in Appendix 6.3. Aquatic plant species protected under Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) were searched for during all aquatic surveys.

6.4.3.3.6 *Invasive species survey*

During the multi-disciplinary walkover surveys, a search for non-native invasive species was undertaken. The survey focused on the identification of invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (As Amended) (S.I. 477 of 2015).

6.4.3.3.7 *Survey limitations*

Seasonal factors that affect distribution patterns and habits of species were taken into account when conducting the surveys. The potential of the site to support certain populations (in particular those of conservation importance that may not have been recorded during the field survey due to their seasonal absence or nocturnal/cryptic habits) was assessed.

6.4.4 Methodology for Assessment of Impacts and Effects

6.4.4.1 Identification of Target Receptors and Key Ecological Receptors

The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ecological Receptors (KERs). Following a comprehensive desk study, initial site visits (main ecological surveys of the site undertaken 21st June 2018, 28th September 2018, 21st and 22nd August 2019, 18th and 19th September 2019 and 5th December 2019, not including bat surveys) and stakeholder consultation; "Target receptors" likely to occur in the zone of influence of the development were identified. The target receptors included habitats and species that were protected under the following legislation:

- Annexes of the EU Habitats Directive
- Qualifying Interests (QI) of Special Areas of Conservation (SAC) within the likely zone of impact.
- Species protected under the Wildlife Acts 1976-2019
- Species protected under the Flora Protection Order 2015

6.4.4.2 Determining Importance of Ecological Receptors

The importance of the ecological features identified within the study area was determined with reference to a defined geographical context. This was undertaken following a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular receptor is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The Guidelines clearly set out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of any importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna. Specific criteria for assigning each of the other levels of importance are set out in the guidelines and have been followed in this assessment. Where appropriate, the geographic frame of reference set out above was adapted to suit local circumstances. In addition, and where appropriate, the conservation status of habitats and species is considered when determining the significance of ecological receptors.

Any ecological receptors that are determined to be of National or International, County or Local importance (Higher Value) following the criteria set out in NRA (2009) are considered to be Key Ecological Receptors (KERs) for the purposes of ecological impact assessment if there is a pathway for effects thereon. Any receptors that are determined to be of Local Importance (Lower Value) are not considered to be Key Ecological Receptors.

6.4.4.3 Characterisation of Impacts and Effects

The proposed development will result in a number of impacts. The ecological effects of these impacts are characterised as per the CIEEM 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (2018). These guidelines are the industry standard for the completion of Ecological Impact Assessment in the UK and Ireland. This chapter has also been prepared in accordance with the corresponding EPA guidance (EPA 2017). The headings under which the impacts are characterised follow those listed in the guidance document and are applied where relevant. A summary of the impact characteristics considered in the assessment is provided below:

- **Positive or Negative.** Assessment of whether the proposed development results in a positive or negative effect on the ecological receptor.
- **Extent.** Description of the spatial area over which the effect has the potential to occur.
- **Magnitude** Refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. the amount of habitat lost, percentage change to habitat area, percentage decline in a species population.
- **Duration** is defined in relation to ecological characteristics (such as the lifecycle of a species) as well as human timeframes. For example, five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species.
- **Frequency and Timing.** This relates to the number of times that an impact occurs and its frequency. A small-scale impact can have a significant effect if it is repeated on numerous occasions over a long period.
- **Reversibility.** This is a consideration of whether an effect is reversible within a 'reasonable' timescale. What is considered to be a reasonable timescale can vary between receptors and is justified where appropriate in the impact assessment section of this report.

6.4.4.4 Determining the Significance of Effects

The ecological significance of the effects of the proposed development are determined following the precautionary principle and in accordance with the methodology set out in Section 5 of CIEEM (2018).

For the purpose of Ecological Impact Assessment (EcIA), 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local (CIEEM, 2018).

When determining significance, consideration is given to whether:

- Any processes or key characteristics of key ecological receptors will be removed or changed
- There will be an effect on the nature, extent, structure and function of important ecological features
- There is an effect on the average population size and viability of ecologically important species.
- There is an effect on the conservation status of important ecological habitats and species.

The EPA draft Guidelines on information to be included in Environmental Impact Assessment Reports (EPA, 2017) and the *Guidelines for assessment of Ecological Impacts of National Road Schemes*, (NRA, 2009) were also considered when determining significance and the assessment is in accordance with those guidelines.

The terminology used in the determination of significance follows the suggested language set out in the Draft EPA Guidelines (2017) as shown in

Table 6.2.

Table 6.2 Criteria for determining significance of effect, based on (EPA, 2017) guidelines

Effect Magnitude	Definition
No change	No discernible change in the ecology of the affected feature.
Imperceptible effect	An effect capable of measurement but without noticeable consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effect	An effect that alters the character of the environment that is consistent with existing and emerging trends.
Significant effect	An effect which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effect	An effect which obliterates sensitive characteristics.

As per TII (NRA, 2009) and CIEEM (2018) best practice guidelines, the following key elements should also be examined when determining the significance of effects:

- The likely effects on 'integrity' should be used as a measure to determine whether an impact on a site is likely to be significant (NRA, 2009).
- A 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives (CIEEM, 2018).

Integrity

In the context of EcIA, 'integrity' refers to the coherence of the ecological structure and function, across the entirety of a site, that enables it to sustain all of the ecological resources for which it has been valued (NRA, 2009). Impacts resulting in adverse changes to the nature, extent, structure and function of component habitats and effects on the average population size and viability of component species, would affect the integrity of a site, if it changes the condition of the ecosystem to unfavourable.

Conservation status

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status. According to CIEEM (2018) guidelines the definition for conservation status in relation to habitats and species are as follows:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area
- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

As defined in the EU Habitats Directive 92/43/EEC, the conservation of a habitat is favourable when:

- Its natural range, and areas it covers within that range, are stable or increasing
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future
- The conservation status of its typical species is favourable.

The conservation of a species is favourable when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future
- There is and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

According to the NRA/CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international).

6.4.4.5 Incorporation of Mitigation

Section 6.5 of this EIAR assesses the potential effects of the proposed development to ensure that all effects on sensitive ecological receptors are adequately addressed. Where significant effects on sensitive ecological receptors are predicted, mitigation is incorporated into the project design or layout to address such impacts. The implemented mitigation measures avoid or reduce or offset potential significant residual effects, post mitigation.

6.4.4.6 Limitations

The information provided in this assessment accurately and comprehensively describes the baseline ecological environment following surveys on numerous dates during all seasons and over 2 years; provides an accurate prediction of the likely ecological effects of the proposed development; prescribes best practice and mitigation as necessary; and, describes the residual ecological impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines. The habitats and species on the site were readily identifiable and comprehensive assessments were made during the field visit. No significant limitations in the scope, scale or context of the assessment have been identified.

6.5 Establishing the Ecological Baseline

6.5.1 Desk Study

The following sections describe the results of a survey of published material that was consulted as part of the desk study for the purposes of the ecological assessment. It provides a baseline of the ecology known to occur in the existing environment. Material reviewed includes the Site Synopses for designated sites within the zone of influence, as compiled by the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht, bird and plant distribution atlases and other research publications.

6.5.1.1 Designated Sites

6.5.1.1.1 *Identification of the Designated Sites within the Likely Zone of Influence of the Proposed Development*

The potential for the proposed development to impact on sites that are designated for nature conservation was considered in this Ecological Impact Assessment.

Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs) are designated under the EU Habitats Directive and EU Birds Directive, respectively and are collectively known as 'European Sites'. The potential for significant effects and/or adverse impacts on the integrity of European Sites is fully assessed in the AA Screening Report and Natura Impact Statement that accompanies this application. As per EPA draft Guidance 2017, *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement"* but should *"incorporate their key findings as available and appropriate"*. Section 6.6.2 of this EIAR provides a summary of the key assessment findings with regard to European Designated Sites.

Natural Heritage Areas (NHAs) are designated under Section 18 the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this EcIA.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA.

The following methodology was used to establish which sites that are designated for nature conservation have the potential to be impacted by the proposed development:

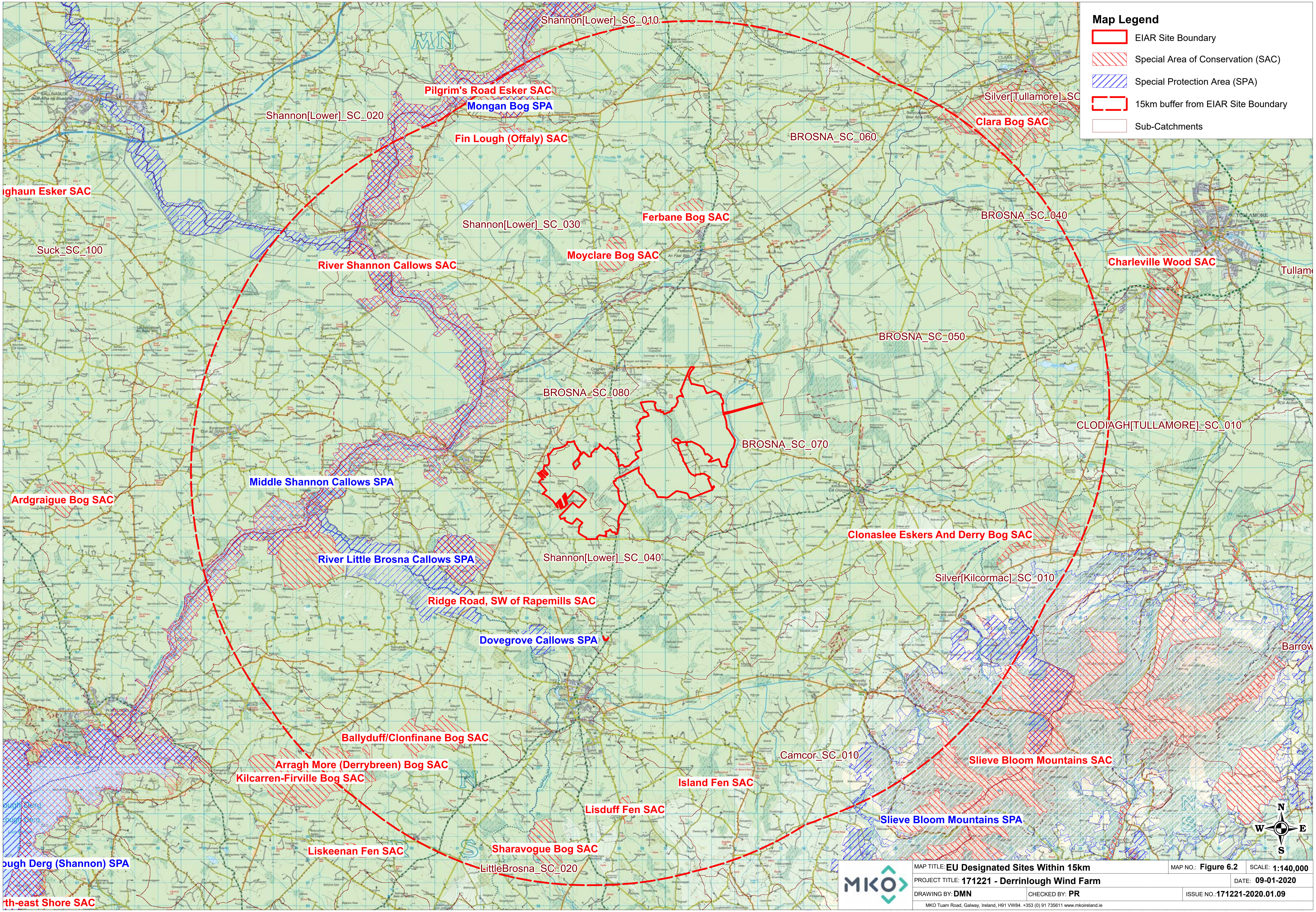
- Initially the most up to date GIS spatial datasets for European and Nationally designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 06/12/2019. The datasets were utilised to identify Designated Sites which could feasibly be affected by the proposed development.

- All designated sites within a distance of 15km surrounding the development site were identified. In addition, the potential for connectivity with European or Nationally designated sites at distances of greater than 15km from the proposed development was also considered in this initial assessment.
- A map of all the European Sites within 15km is provided in Figure 6.2 with all Nationally designated sites shown in Figure 6.3.
-
- Table 6.3 provides details of all relevant Nationally designated sites as identified in the preceding steps and assesses which are within the likely Zone of Impact. All European Designated Sites are fully described and assessed in the Screening for Appropriate Assessment and Natura Impact Statement reports submitted as part of this planning application.
- The designation features of these sites, as per the NPWS website (www.npws.ie), were consulted and reviewed at the time of preparing this report 30/01/2020.

Where potential pathways for Significant Effect are identified, the site is included within the Likely Zone of Impact and further assessment is required.

Table 6.3 Identification of Nationally designated sites within the Likely Zone of Impact

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Natural Heritage Areas		
Little Brosna Callows NHA	4.5km	This NHA is in a separate water catchment with no hydrological connectivity to the development site. As this site is also designated as a SPA for a variety of bird species, impacts on this designated site are fully considered under the European designation within the NIS. It is not within the Likely Zone of Impact.
Kilnaborris Bog NHA	7.1km	These NHAs are in a separate water catchment with no hydrological connectivity to the development site. They are not within the Likely Zone of Impact.
Kileen Bog NHA	8.5km	
Ballymacegan Bog NHA	11.1km	
Suck River Callows NHA	12.4km	
Arragh More Bog NHA	12.4km	
Lorrha Bog NHA	12.7km	
Moneen Bog NHA	13.2km	
Clonydonnin Bog NHA	14.5km	
Proposed Natural Heritage Area (pNHA)		



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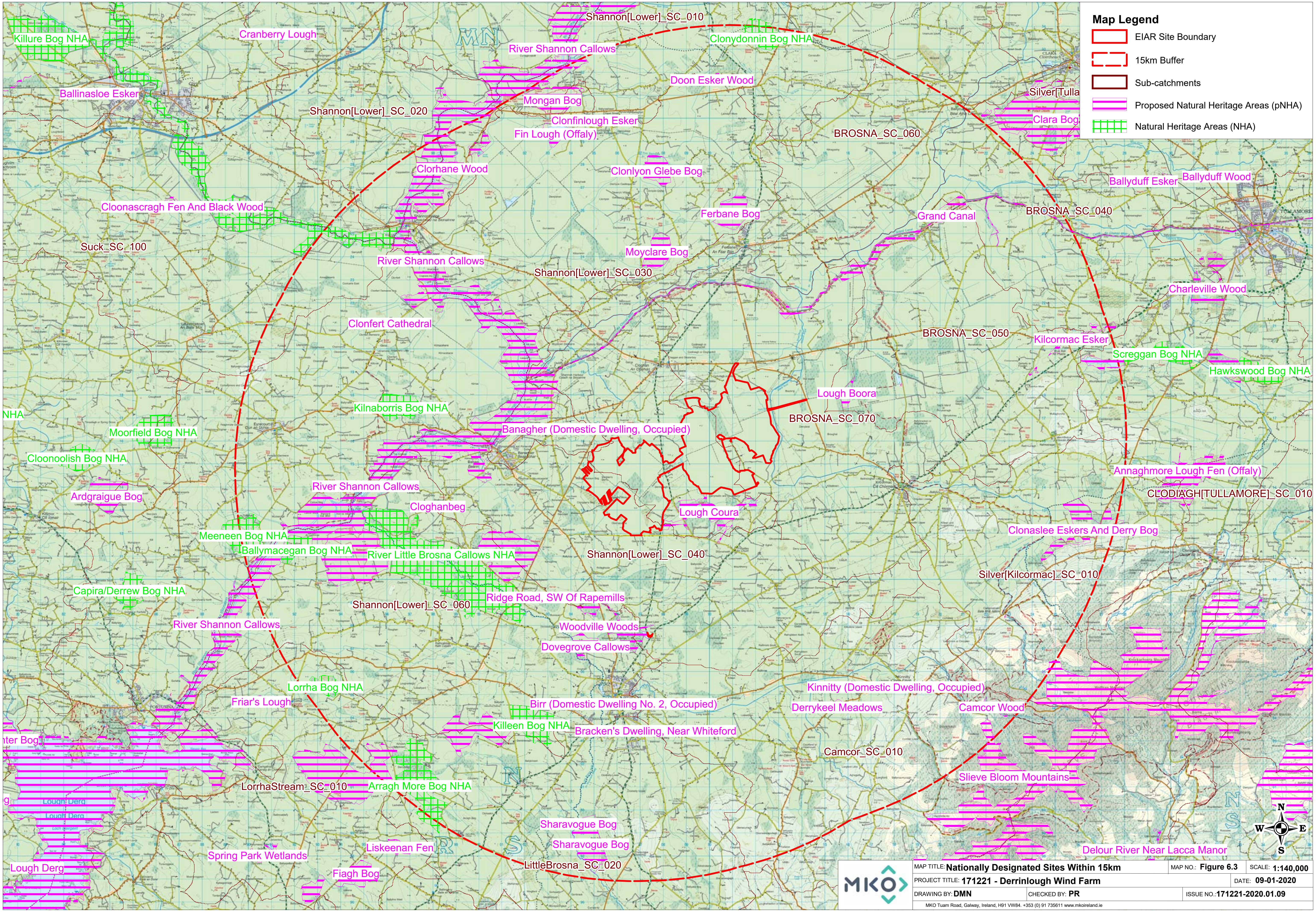

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Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Lough Coura	Located adjacent to the south of the site.	This designated Site is located adjacent to the proposed development site. On a precautionary basis, it is included within the Likely Zone of Impact.
Banagher (Domestic Dwelling, Occupied)	0.7km	This site is designated for roosting bats although is located outside of the required survey distance from the proposed development. This site is assessed in the bat report prepared for the proposed development, see Appendix 6.2. No potential for impact on this site has been identified and it is not within the Zone of likely Impact.
River Shannon Callows	2.3km	There is hydrological connectivity between the proposed development and this pNHA via watercourses within the site boundary which discharge to the River Shannon, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun bog, Feeghroe/ Mountcarteret stream and several small tributary streams of the Little Cloghan river. This site is also designated as a SAC and SPA for a variety of habitats and species. As such it is within the Likely Zone of Impact but impacts on this designated site are fully considered under the European designation within the NIS.
Lough Boora	3.1km	These pNHAs are in a separate water catchment with no hydrological connectivity to the proposed development site. They are not within the Zone of Likely Impact.
Woodville Woods	3.1km	
Ross And Glenns Eskers	3.1km	
All Saints Bog And Esker	3.1km	
Grand Canal	3.2km	
Ridge Road, SW Of Rapemills	4.0km	
Dovegrove Callows	4.7km	
Moyclare Bog	5.4km	
Ferbane Bog	6.1km	
Cloghanbeg	6.4km	

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Birr (Domestic Dwelling No.1, Occupied)	7.2km	The proposed development is outside of the designated site boundaries and over 7km away. No potential for impact on these sites has been identified and they are not within the Zone of likely Impact.
Birr (Domestic Dwelling No.2, Occupied)	7.3km	
Bracken's Dwelling, Near Whiteford	8.5km	
Clonlyon Glebe Bog	8.5km	These pNHAs are in a separate water catchment with no hydrological connectivity to the development site. They are not within the Zone of likely Impact.
Redwood Bog	8.9km	
Ballyduff/Clonfinane Bog	9.8km	
Derrykeel Meadows	9.9km	
Clonfert Cathedral	10.3km	The proposed development is outside of the designated site boundaries and over 10km away. No potential for impact on these sites has been identified and they are not within the Zone of likely Impact.
Kinnitty (Domestic Dwelling, Occupied)	10.6km	
Kilcormac Esker	11.1km	These sites are in a separate hydrological catchment. No potential for impact on these sites has been identified and it is not within the Zone of likely Impact.
Clonfinlough Esker	12.1km	
Sharavogue Bog	12.2km	
Fin Lough (Offaly)	12.2km	
Clonaslee Eskers And Derry Bog	12.4km	
Doon Esker Wood	12.4km	
Clorhane Wood	13.2km	
Mongan Bog	13.3km	
Pallas Lough	13.4km	
Lough Nanag Esker	13.5km	
Camcor Wood	13.5km	
Kilcarren-Firville Bog	13.6km	
Pilgrim's Road Esker	13.6km	
Slieve Bloom Mountains	14.1km	

Lough Coura pNHA is located adjacent to the proposed development site. On a precautionary basis, it is included within the Likely Zone of Impact.

Surface water connectivity was identified between the proposed development and River Shannon Callows pNHA approximately 2.3km downstream. As this pNHA has also been designated as both a River Shannon Callows SAC and Middle Shannon Callows SPA, impacts on this designated site are fully considered under the European designation within the NIS. This is further described in Section 6.6.2 of this Chapter.

The AA Screening that accompanies this application identifies the following European Sites as being within the Likely Zone of Impact:

- River Shannon Callows SAC (located 2.3km downstream and contiguous with the River Shannon Callows pNHA).
- Lough Derg North East Shore SAC (located over 29km downstream but included on a precautionary basis).

6.5.1.2 NPWS Article 17 Reporting

A review of the Irish Reports for Article 17 of the Habitats Directive (92/42/EEC), including the Heath, Bogs and Mires, Irish Semi-Natural Grassland Survey datasets, National Survey of Native Woodlands and Ancient and Long Established Woodland datasets were conducted prior to undertaking the multi-disciplinary walkover survey.

Available NPWS datasets were downloaded and overlain on the proposed development study area. None of the NPWS GIS datasets contain polygon or point data within the EIAR Study Area. The National Survey of Native Woodlands recorded bog woodland within All Saints Bog and Esker SAC, located 4km to the west of the site. There are no records for Annex I bog or heath habitats within these datasets in close proximity to the proposed development. The nearest Transition Mire occurs 1.7km to the southeast of the site, however its Annex I status has not been assessed. The nearest ancient and long established woodland in the study area occurs outside the southwest of the site at Clooneen and is separated from the site by the N62. This area of woodland comprises of a number of small areas within an area now largely planted in conifers. An area of ancient and long-established woodland was also identified to the west of the N62 at Kennedy's cross. Although there are proposed junction modifications at Kennedy's Cross associated with the proposed delivery route, all proposed works are located to the east of the N62 entirely outside of the proposed woodland area. The nearest mapped grasslands surveyed are located along the River Shannon 2.3km to the northwest of the site. The nearest mapped distribution of both wet and dry heath habitats is over 13km to the southeast within the Slieve Blooms.

6.5.1.3 Vascular plants

A search was made in the New Atlas of the British and Irish Flora (Preston *et al*, 2002) to investigate whether any rare or unusual plant species listed under Annex I of the EU Habitats Directive, The Irish Red Data Book, 1, Vascular Plants (Curtis, 1988) or the Flora (Protection) Order (1999, as amended 2015) had been recorded in the relevant 10km squares in which the study site is situated (N01). Each hectad contains 100 whole one kilometre squares containing terrestrial habitats. Species of conservation concern are given in

Table 6.4.

Table 6.4 Species listed designated under the Flora Protection Order or the Irish Red Data Book within Hectad N01

Common Name	Scientific Name	Hectad	Status
Meadow barley	*Hordeum secalinum*	N01	FPO, VU

Opposite-leaved pondweed	*Groenlandia densa*	N01	FPO, NT
Red hemp-nettle	*Galeopsis angustifolia*	N01	FPO, VU

6.5.1.4 Bryophytes

A search of the NPWS online data map for bryophytes (NPWS, 2018) was also undertaken with no protected bryophytes recorded within or adjacent to the proposed development site.

6.5.1.5 National Biodiversity Data Centre (NBDC) Records

A search of the National Biodiversity Data Centre (NBDC) website was conducted prior to the commencement of site surveys, on the 12/02/2020. This helped to inform survey effort and provide a baseline of likely species composition in the area. Records of protected fauna recorded from hectads N01 and N11 are provided in

Table 6.5.

Table 6.5 NBDC records for species of conservation interest in hectads N01 and N11

Common name	Scientific name	Designation	Hectad
Large white-moss	*Leucobryum glaucum*	HD Annex IV	N01, N11
Marsh fritillary	*Euphydryas aurinia*	HD Annex II	N01, N11
Common frog	*Rana temporaria*	HD Annex V, WA	N01, N11
Common lizard	*Zootoca vivipara*	WA	N01
Leisler's bat	*Nyctalus leisleri*	HD Annex IV, WA	N01
Daubenton's bat	*Myotis daubentonii*	HD Annex IV, WA	N01, N11
Common pipistrelle	*Pipistrelle (Pipistrellus pipistrellus sensu lato)*	HD Annex IV, WA	N01, N11
Soprano pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA	N01
Otter	*Lutra lutra*	HD Annex II, IV, WA	N01, N11
Pine marten	*Martes martes*	HD Annex V, WA	N01, N11
Freshwater white-clawed crayfish	*Austropotamobius pallipes*	HD Annex II, WA	N11
Brook lamprey	*Lampetra planeri*	HD Annex II	N11
Reindeer lichen	*Cladonia portentosa*	HD Annex V	N11
Reindeer moss	*Cladonia rangiferina*	HD Annex V	N11

Desmoulin's whorl snail	*Vertigo (Vertigo) moulinsiana*	HD Annex II, WA	N11
Smooth newt	*Lissotriton vulgaris*	WA	N01,N11
Red deer	*Cervus elaphus*	WA	N01, N11
Atlantic salmon	*Salmo salar*	HD Annex II, V	N11
Badger	*Meles meles*	WA	N01, N11
Red squirrel	*Scuirus vulgaris*	WA	N01, N11
Eurasian pygmy shrew	*Sorex minutus*	WA	N01, N11
European hedgehog	*Erinaceus europaeus*	WA	N01, N11
Fir clubmoss	*Huperzia selago*	Annex V	N01, N11
Meadow barley	*Hordeum secalinum*	FPO; EN	N01

HD = EU Habitats Directive; WA = Wildlife Acts (Ireland).

6.5.1.6 Bat Records

The National Bat Database of Ireland was searched for records of bat activity and roosts within a 10 km radius of the proposed site (IG Ref: E208260 N214907; last search 29/11/2019). A number of observations have been recorded (Table 6.6). At least four of Ireland's nine resident bat species were recorded within 10 km of the proposed works including common and soprano pipistrelle, Leisler's bat and Daubenton's bat. The results of the database search are provided in Table 6.6.

Table 6.6 National Bat Database of Ireland records within 10km

Grid Square	Species	Record Count	Latest Record	Dataset
N01	Daubenton's bat	36	26/08/2014	National Bat Database of Ireland
N01	Lesser Noctule	2	18/05/2012	Ireland's BioBlitz
N01	Pipistrelle sp.	2	18/05/2012	Ireland's BioBlitz
N01	Soprano pipistrelle	2	18/05/2012	Ireland's BioBlitz
N11	Daubenton's bat	4	18/05/2012	Ireland's BioBlitz
N11	Pipistrelle sp.	2	18/05/2012	Ireland's BioBlitz
N11	Soprano pipistrelle	2	18/05/2012	Ireland's BioBlitz
N02	Daubenton's bat	9	02/09/2014	National Bat Database of Ireland
N02	Soprano pipistrelle	1	26/05/2009	National Bat Database of Ireland
N12	Daubenton's bat	2	26/05/2009	National Bat Database of Ireland
N12	Lesser Noctule	1	26/05/2009	National Bat Database of Ireland
N12	Soprano pipistrelle	2	26/05/2009	National Bat Database of Ireland

6.5.1.7 NPWS

National Parks and Wildlife Service (NPWS) online records were searched to see if any rare or protected species of flora or fauna have been recorded from hectads N01 and N11. An information request was also sent to the NPWS scientific data unit requesting records from the Rare and Protected Species Database on the 14th February 2019. A response was received on the 28th February 2019. Table 6.7 lists rare and protected species records obtained from NPWS.

Table 6.7 NPWS records for rare and protected species

Common name	Scientific name	Designation	Hectad
Marsh fritillary	*Euphydryas aurinia*	HD Annex II	N01
Common frog	*Rana temporaria*	HD Annex V, WA	N01, N11
Common lizard	*Zootoca vivipara*	WA	N01
Soprano pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA	N11
Otter	*Lutra lutra*	HD Annex II, IV, WA	N01, N11
Pine marten	*Martes martes*	HD Annex V, WA	N01, N11
Freshwater white-clawed Crayfish	*Austropotamobius pallipes*	HD Annex II, WA	N01, N11
Reindeer moss	*Cladonia rangiferina*	HD Annex V	N01
Fallow Deer	*Dama dama*	WA	N01, N11
Ephemerum hibernicum	*Ephemerum hibernicum*		N01
Blue fleabane	*Erigeron acer*		N01, N11
Opposite-leaved pondweed	*Groenlandia densa*	FPO, VU	N01
Smooth newt	*Lissotriton vulgaris*	WA	N01
Badger	*Meles meles*	WA	N01, N11
Irish Hare	*Lepus timidus subsp. hibernicus*	Annex V, WA	N01, N11
Irish Stoat	*Mustela erminea subsp. hibernica*	WA	N01, N11
Red squirrel	*Scuirus vulgaris*	WA	N11
Hedgehog	*Erinaceus europaeus*	WA	N01, N11
Fir Clubmoss	*Huperzia selago*	Annex V	N11
Red Hemp-nettle	*Galeopsis angustifolia*	FPO, VU	N01
Meadow barley	*Hordeum secalinum*	FPO, EN	N01
Green-winged orchid	*Orchis morio*	VU	N01, N11

Common name	Scientific name	Designation	Hectad
Shepherd's-needle	*Scandix pecten-veneris*	RE	N01, N11
Weissia controversa var. densifolia			N01

FPO = Flora Protection Order; RL = Red List, VU = Vulnerable.

6.5.1.8 Freshwater Pearl Mussel (*Margaritifera margaritifera*)

The NPWS *Margaritifera* Sensitive Area map (Version 8, 2017) was consulted during the desk study. There is no surface water connectivity between the proposed development site and any *Margaritifera* catchment. The proposed development site boundary is located 18.7km northwest of the Nore Upper *Margaritifera* Sensitive Area and 21.4km northwest of the Barrow *Margaritifera* Sensitive Area, with no connectivity to either.

6.5.1.9 Marsh Fritillary (*Euphydryas aurinia*)

The closest NBDC records for marsh fritillary were located in the hectad (N11). The Bord Na Móna Biodiversity Action Plan 2016-2021 states that marsh fritillary, listed in Annex II of the EU Habitats Directive, are known to occur on '*marginal areas of regenerating cutaway*' of Clongawny bog (Bord na Móna, 2016).

6.5.1.10 Inland Fisheries Ireland Data

The Little and Silver rivers both feed into the River Shannon. A search of the Inland Fisheries Ireland (IFI) online database was carried out to determine the species richness of both rivers. The results are presented in

Table 6.8. European eel (*Anguilla Anguilla*), is classified as 'critically endangered' in '*Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish'* (King *et al.,* 2011). Lamprey (*Lampetra* sp.) are classified as 'near threatened' in '*Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish'* (King *et al.,* 2011) and all three species of Irelands lamprey are protected under Annex II of the EU habitats directive, with River Lamprey classified under Annex II and Annex V. Salmon (in freshwater) is listed on Annexes II and V of the EU Habitats Directive, and is listed as "Vulnerable," on King *et al.*'s Red list (2011).

Brown trout (*Salmo trutta*) and salmon (*Salmo salar*) were recorded in both the Little River and the Silver River, signifying their importance for salmonid species.

Table 6.8 Water quality monitoring stations and associated Q values

Station Name	Species	Status	Assessment Year
Little River	Brown trout; European eel; lamprey sp.; minnow	Moderate	2011
Silver (Kilcormac)	Brown Trout; gudgeon; minnow; salmon; stone loach; three-spined stickleback	Moderate	2011
Shannon (Upper)	European eel; lamprey sp.; perch; pike; roach	Moderate	2010

6.5.1.11 Invasive Species

The NBDC database also contains records of invasive species identified within the relevant hectad. Records of 'high impact' invasive species for hectads N01 and N11 are provided in Table 6.9.

Table 6.9 NBDC records for invasive species (hectads N01 and N11)

Common Name	Scientific Name	Hectad
Canadian waterweed	*Elodea canadensis*	N01, N11
Parrot's feather	*Myriophyllum aquaticum*	N11
Indian Balsam	*Impatiens glandulifera*	N01
Japanese knotweed	*Fallopia japonica*	N01
Nuttall's waterweed	*Elodea nuttallii*	N01
Rhododendron	*Rhododendron ponticum*	N01, N11

Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011) include legislative measures to deal with the introduction, dispersal, dealing in and keeping of non-native species. Japanese knotweed (*fallopian japonica*) and Rhododendron (*rhododendron ponticum*) are two species subject to restrictions under Regulations 49 and 50 and are included in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011).

6.5.1.12 Baseline Hydrology

Regionally, the proposed wind farm development site is located in the River Shannon surface water catchment (IE25_01) within Hydrometric Area 25 of the Shannon River Basin District. A regional hydrology map is shown in Figure 9.2, Chapter 9 of this EIAR.

On a more local scale, the majority of the site is located in the Brosna river sub-catchment (Brosna_SC_080). The Little River flows in a northwesterly direction through the centre of the site and crosses the N62 ~1.5km north of the Derrinlough Briquette factory. The Little River discharges to the Brosna River at the confluence in the townland of Moytown Demense, ~5.5km northwest of the site. The Brosna then flows west, where it meets the River Shannon near Shannon Harbour.

The eastern side of the Drinagh bog is mapped within the Brosna_SC_070 sub-catchment. The Silver River flows north through this catchment, along the eastern boundary of the site. It flows north before joining the Brosna river ~3km southeast of Ferbane. The western edge of the site, within the Clongawny bog, is drained by the Shannon lower sub-catchment (Shannon [Lower]_SC_040). A number of small tributaries flow west/southwest before joining the Rapemills River, which drains the sub-catchment. The Rapemills River then flows north for ~5.5km before entering the Shannon River just west of Banagher. A local hydrology map is shown as Error! Reference source not found., Chapter 9 of this EIAR.

There are 3 no. pumping stations across the two bogs (P15/006, P15/007, and P15/008). These are identified on the site drainage map (Error! Reference source not found.) in Chapter 9 of this EIAR. Surface water draining/pumped from the site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers (i.e. Little River and Silver River).

The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values are assigned using a combination of habitat characteristics and structure of the macro-invertebrate community within the waterbody. Individual macro-invertebrate families are classified according to their sensitivity to organic pollution and the Q-value is assessed based primarily on their relative abundance within a sample.

6.5.1.12.1 Water Quality

River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The online EPA Envision map viewer provides access to water quality information at individual waterbody status for all the River Basin Districts in Ireland. The EPA Envision map viewer was consulted on 30th January 2020 regarding the water quality status of the rivers which run within and directly adjacent to the Study Area. The WFD River Waterbody Status 2013 – 2018 for the watercourses which flow through the site have been assessed in Table 6.10.

Table 6.10. Watercourses on site with relevant water quality statuses

Name	Location	Status	Risk
Little River	Branches between both portions of the site, flowing north-west	Moderate	At risk
Silver (Kilcormac)	Flows in a north-easterly direction at the eastern portion of the site	Moderate	At risk
Shannon (Lower)	Is the recipient watercourse for the Little River and Silver River	Unassigned	Unassigned

Status– WFD River Waterbody Status 2010-2015 Risk – WFD River Waterbodies Risk

Table 6.11 illustrates the respective Q-value status results from monitoring stations located along rivers which flow through the site (as is the case with the Little River) or along rivers which are fed directly by watercourses which flow through or around the site (in the case of the Silver River, for example).

Table 6.11 Water quality monitoring stations and associated Q values

Name	Location	Status	Risk
Little River- SW of Cloghan	E206296, N217769	4-5 (Good)	2017
Silver (Kilcormac) - Lumcloon Br	E213921, N219777	4-5 (Good)	2017
Incherky Quay (d/s Banagher)	E195270, N214307	3-4 (Moderate)	2017
Bellmount d/s Ferbane	E207399, N222269	3-4 (Moderate)	2017

6.5.1.13 Existing Baseline Habitat Mapping

The habitats within the entire study area of Derrinlough has been mapped in detail by the Bord Na Móna Ecology team since 2014. This information has been reviewed as part of the baseline ecological data. Detailed GIS shapefiles of all habitat mapping prepared was received from Bord Na Móna and ground truthed by MKO when undertaking detailed habitat assessments and relevés of the proposed infrastructure footprint. Detailed habitat maps of the study area are provided in Section 5.6.2 of this EIAR.

In addition to detailed habitat mapping of the study area by Bord na Móna, the following documents were also reviewed:

- Bord na Móna Biodiversity Action Plan 2010-2015 (Bord na Móna, 2010)
- Bord na Móna Biodiversity Action Plan 2016-2021(Bord na Móna, 2016)

The Bord na Móna, (2010) document states that 'examples of valuable sites are mineral islands found within larger bog areas such as those in Clongowney (the western parcel of the study area) .... These mineral islands are refuges for Old Woodland habitat and represent precious remnants of a woodland cover that once extended across the island of Ireland'. In addition, small areas of oak woodland have been planted within Clongowney as part of a native woodland scheme. The Bord na Móna (2016) document also referred to the large waterbodies within the Drinagh part of the study area (eastern parcel of the study area) and states that these have been created through drain blocking as part of rewetting of this part of the site.

6.5.1.14 Conclusions of the Desktop Study

The desktop study has provided information about the existing environment in Hectad N11, within which the proposed development site is located. The site is situated within the River Shannon surface water catchment (IE25_01) within Hydrometric Area 25 of the Shannon River Basin District. On a more local scale, the majority of the site is located in the Brosna river sub-catchment (Brosna_SC_080). Surface water draining/pumped from the site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers (i.e. Little River and Silver river). A number of watercourses that drain the study area, leads to the following downstream EU designated sites. The desktop study has provided information about the existing environment in Hectad N11, within which the proposed development site is located.

A number of watercourses that drain the study area, lead to the following downstream EU Designated Sites, and are further considered in the Natura Impact Statement prepared for the proposed development:

- River Shannon Callows SAC (2.3km downstream),
- Lough Derg, North-east Shore SAC (29.2km downstream).

The desk study identified that a variety of protected faunal species are known to occur within the study area, including bats, marsh fritillary, otter, freshwater white-clawed crayfish, brook lamprey, Atlantic salmon, badger and red squirrel. A review of bat roost records for the area did not identify any roosts within or immediately adjacent to the proposed development. The mammal species recorded during the desk study informed the survey methodologies undertaken during the site visits.

The desk study also provided useful information to inform the ecological surveys undertaken on site as well as the identification of pathways for potential impact on sensitive ecological receptors.

6.5.2 Ecological Walkover Survey Results

6.5.2.1 Description of Habitats and Flora within the Ecological Survey Area

The habitats on the site of the proposed development were the subject of a detailed survey and assessment by Bord na Móna ecologists and a habitat map was produced of the entire landholding at proposed development. This habitat mapping and assessment was undertaken following the Bord na Móna habitat classification scheme and was cross referenced with '*A Guide to Habitats in Ireland*' (Fossitt, 2000). The proposed development covers only a section of the overall area of Clongawny and Drinagh bogs but the habitats of the entire area are described in this section. The habitat descriptions in this section are based on the Bord na Móna habitat assessments undertaken in 2014 (that were ground truthed during 2018 and 2019) and detailed vegetation surveys undertaken by MKO in 2018 and 2019. Detailed botanical quadrat data is provided in Appendix 6.4 of this EIAR.

The study area comprises two large cutover raised bogs. Some areas of the site have been out of commercial peat production by Bord na Móna for a significant period of time and thus vegetation, dominated primarily by birch scrub, common cottongrass and marsh arrowgrass, has regenerated over much of these areas. Other large areas within the southwest, northwest and southeast remain in active peat extraction, see Figure 6.4 'Habitat map'. Small areas/remnant of uncut raised bog occur at various locations at its edges of the site, although these areas occur outside of the development footprint.

The main habitat types on the site included woodlands and scrub (dominated by birch), cutover bog habitats with a vegetative composition that is similar to degraded dry and wet heath type communities (dominated by Ling heather), poor fen, bare peat communities and small areas of grasslands (occurring alongside railway tracks). These habitats occur in intimate mosaics throughout the study area as is shown in Figure 6.4a and 6.4b. Areas of open water occur where peat extraction has ceased and the water levels in these areas are no longer managed through the onsite pumping and drainage infrastructure. The largest area of open water and reed swamp occurs to the east of the study area within an area known as the Drinagh wetlands. This area was deliberately avoided by Bord na Mona in the design of the development and will not be negatively affected by it. Another large wetland also occurs within the south-eastern portion of the Clongawny peatland, adjacent to the N62. Small mineral islands/derries occur within the study area and are dominated by native oak woodlands. These areas were also constrained out as part of the proposed development design.

Habitat maps (Figures 6.4a and 6.4b, as prepared by Bord na Mόna ecologists, show the location and relative cover of the habitats recorded within the proposed development site at a high level. Figures 6.4c and 6.4d show the habitats that occur beneath the proposed development footprint.

6.5.2.1.1 *Cutover Bog (PB4)*

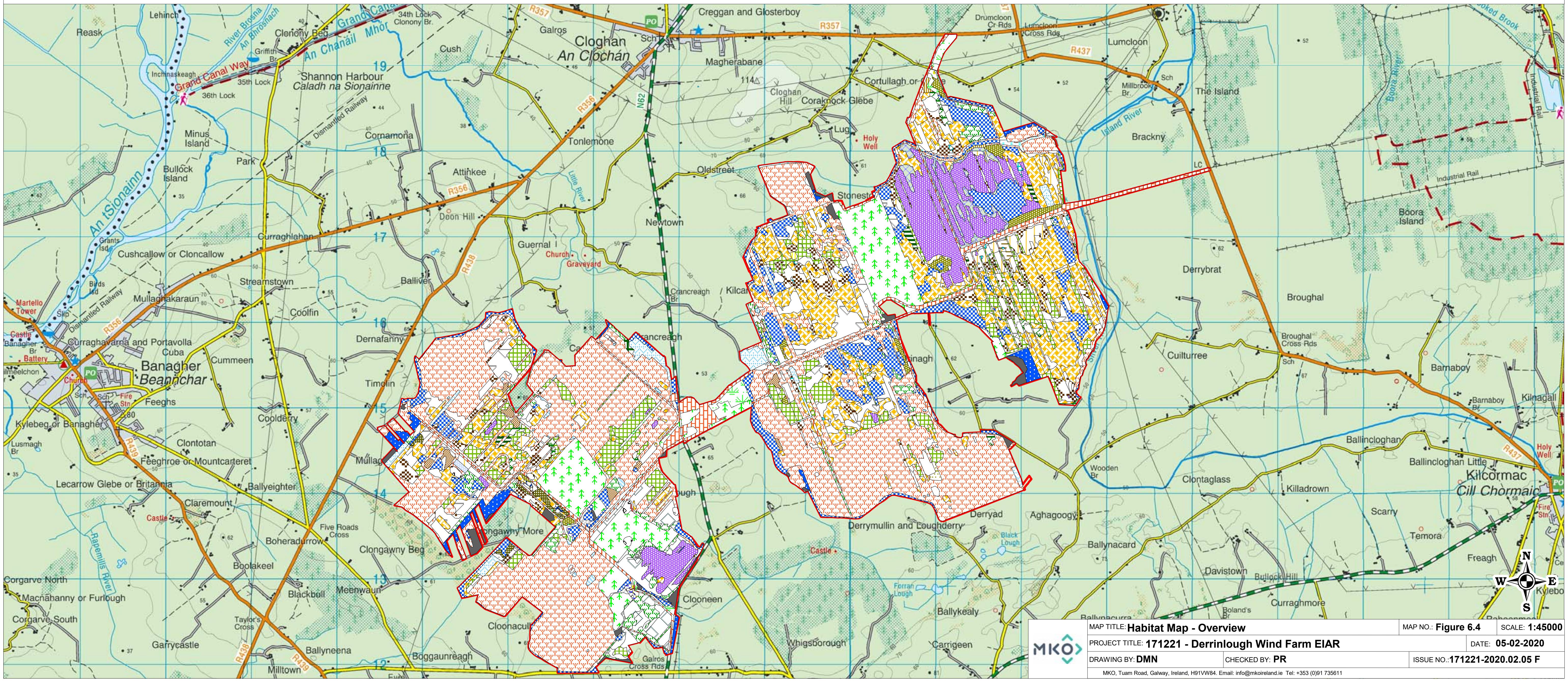
The vast majority of the site, with the exception of small remnant sections of raised bog around the peripheries of the site, comprise of cutover or cutaway peat. Large areas of the study area were in active peat production in 2019 or have recently ceased to be in active production. These areas are dominated by bare peat with little growth of vegetation, see Plate 6.1. Where peat production/ extraction has ceased for some time, these areas have begun to revegetate, predominantly by poor fen and birch dominated scrub/woodland. The following subsections provide a description of the secondary habitats that have begun to form on the cutover bog following cessation of peat extraction/milling.

Habitat Map

Vegetation communities occurring on Cutover Bog (PB4)

- Acid oligotrophic lakes (FL2)
- Acid oligotrophic lakes (FL2), Poor fen and flush (PF2) mosaic
- Acid oligotrophic lakes (FL2), Reed and large sedge swamp (FS1) mosaic
- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Exposed sand, gravel or till (ED1) mosaic
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), Pioneering Dry Heath (HH), Dry grassland (GS1) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Dry grassland (GS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Reed and large sedge swamps (FS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Cutover bog (PB4), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Dense bracken (HD1)
- Depositing/lowland rivers (FW2)
- Dry calcareous and neutral grassland (GS1)
- Dry calcareous and neutral grassland (GS1), Poor fen and flush (PF2) mosaic
- Dry calcareous and neutral grassland (GS1), Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Dry-humid acid grassland (GS3)
- Hedgerow (WL1)
- Improved grassland (GA1)
- Mixed broad-leaved woodland (WD1)
- Oak-Ash-Hazel woodland (WN2)
- Other artificial lakes and ponds (FL8)
- Poor fen and flush (PF2)
- Raised bog (PB1)
- Recently-planted woodland (WS2)
- Recolonising bare ground (ED3)
- Reed and large sedge swamps (FS1)
- Reed and large sedge swamps (FS1), Poor fen and flush (PF2) mosaic
- Refuse and other waste (ED5)
- Rich fen and flush (PF1)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH1)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Scrub (WS1), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Wet grassland (GS4)
- Wet grassland (GS4), Poor fen and flush (PF2) mosaic

EIAR Site Boundary

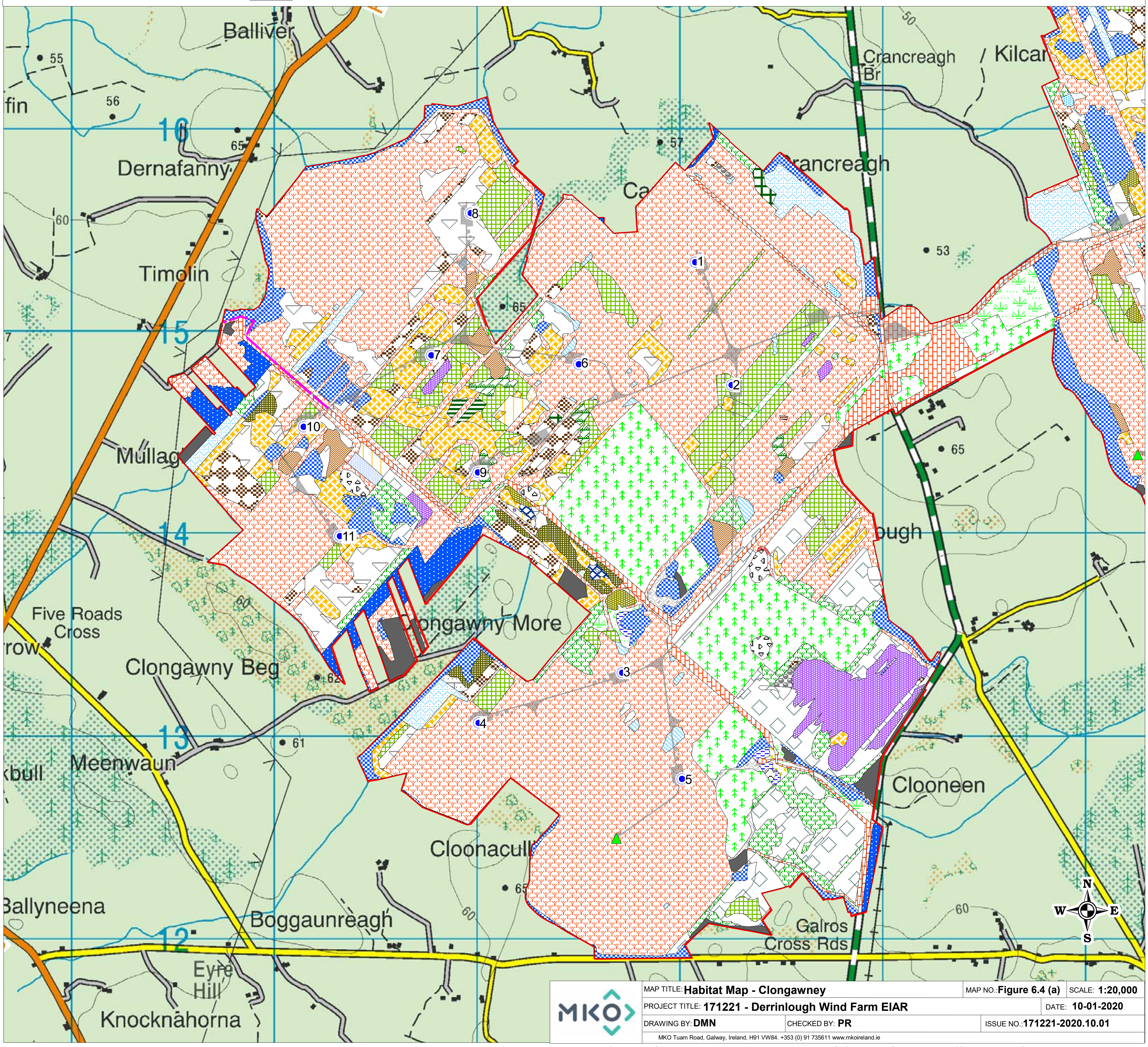


Habitat Map

Vegetation communities occurring on Cutover Bog (PB4)

- Acid oligotrophic lakes (FL2)
- Acid oligotrophic lakes (FL2), Poor fen and flush (PF2) mosaic
- Acid oligotrophic lakes (FL2), Reed and large sedge swamp (FS1) mosaic
- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Exposed sand, gravel or till (ED1) mosaic
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), Pioneering Dry Heath (HH), Dry grassland (GS1) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Dry grassland (GS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Reed and large sedge swamps (FS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Cutover bog (PB4), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Dense bracken (HD1)
- Depositing/lowland rivers (FW2)
- Dry calcareous and neutral grassland (GS1)
- Dry calcareous and neutral grassland (GS1), Poor fen and flush (PF2) mosaic
- Dry calcareous and neutral grassland (GS1), Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Dry-humid acid grassland (GS3)
- Hedgerow (WL1)
- Improved grassland (GA1)
- Mixed broad-leaved woodland (WD1)
- Oak-Ash-Hazel woodland (WN2)
- Other artificial lakes and ponds (FL8)
- Poor fen and flush (PF2)
- Raised bog (PB1)
- Recently-planted woodland (WS2)
- Recolonising bare ground (ED3)
- Reed and large sedge swamps (FS1)
- Reed and large sedge swamps (FS1), Poor fen and flush (PF2) mosaic
- Refuse and other waste (ED5)
- Rich fen and flush (PF1)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH1)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Scrub (WS1), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Wet grassland (GS4)
- Wet grassland (GS4), Poor fen and flush (PF2) mosaic

EIAR Site Boundary | Proposed Site Infrastructure | Proposed Anemometry Mast Location | Proposed Amenity Pathways



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	PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR		DATE: 10-01-2020
	DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.: 171221-2020.10.01

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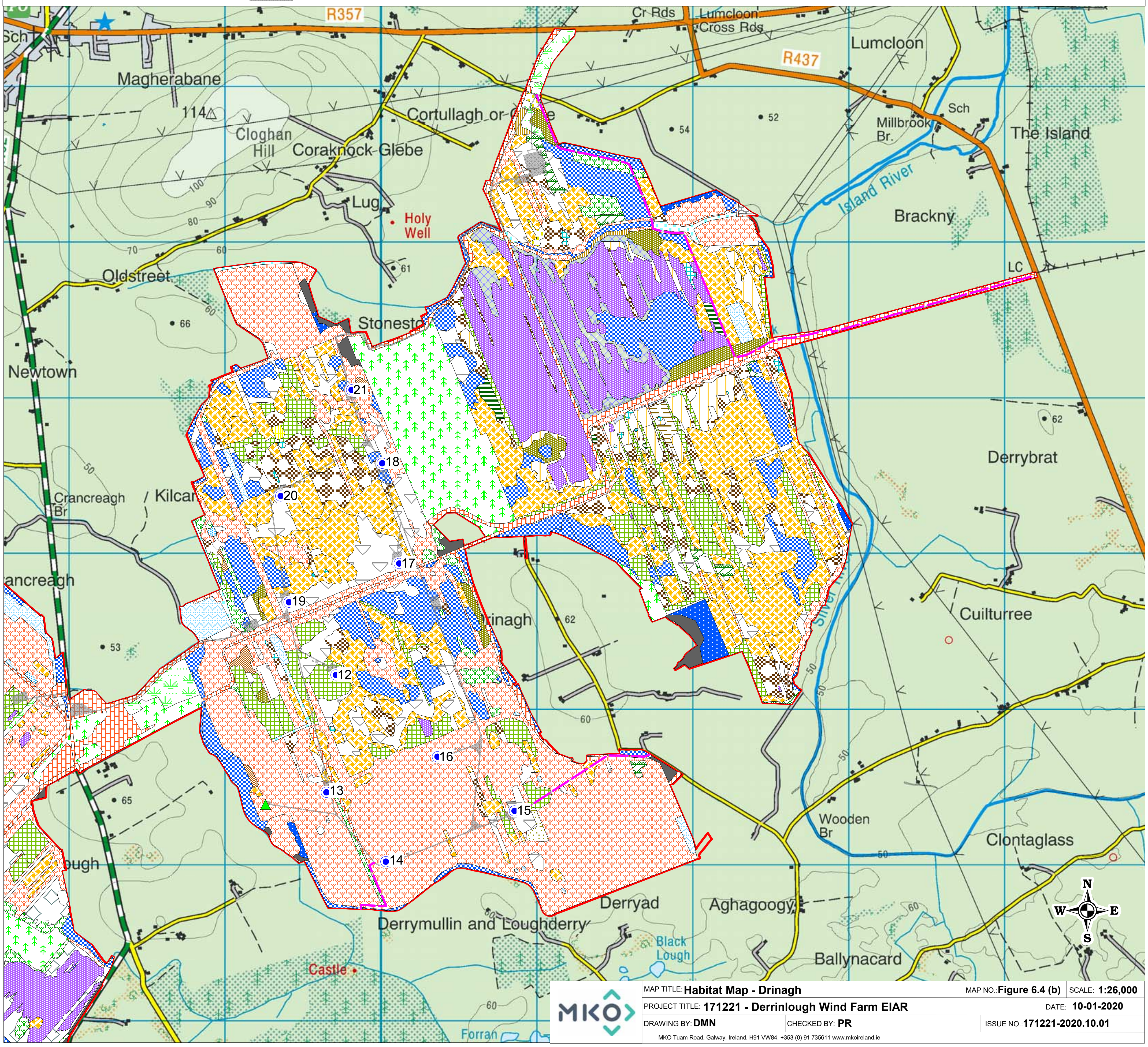
Habitat Map

Vegetation communities occurring on Cutover Bog (PB4)

- Acid oligotrophic lakes (FL2)
- Acid oligotrophic lakes (FL2), Poor fen and flush (PF2) mosaic
- Acid oligotrophic lakes (FL2), Reed and large sedge swamp (FS1) mosaic
- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Exposed sand, gravel or till (ED1) mosaic
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), Pioneering Dry Heath (HH), Dry grassland (GS1) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Dry grassland (GS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Reed and large sedge swamps (FS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Cutover bog (PB4), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Dense bracken (HD1)
- Depositing/lowland rivers (FW2)
- Dry calcareous and neutral grassland (GS1)
- Dry calcareous and neutral grassland (GS1), Poor fen and flush (PF2) mosaic
- Dry calcareous and neutral grassland (GS1), Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Dry-humid acid grassland (GS3)
- Hedgerow (WL1)
- Improved grassland (GA1)
- Mixed broad-leaved woodland (WD1)
- Oak-Ash-Hazel woodland (WN2)
- Other artificial lakes and ponds (FL8)
- Poor fen and flush (PF2)
- Raised bog (PB1)
- Recently-planted woodland (WS2)
- Recolonising bare ground (ED3)
- Reed and large sedge swamps (FS1)
- Reed and large sedge swamps (FS1), Poor fen and flush (PF2) mosaic
- Refuse and other waste (ED5)
- Rich fen and flush (PF1)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH1)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Scrub (WS1), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Wet grassland (GS4)
- Wet grassland (GS4), Poor fen and flush (PF2) mosaic

EIAR Site Boundary | Proposed Site Infrastructure | Proposed Anemometry Mast Location | Proposed Amenity Pathways



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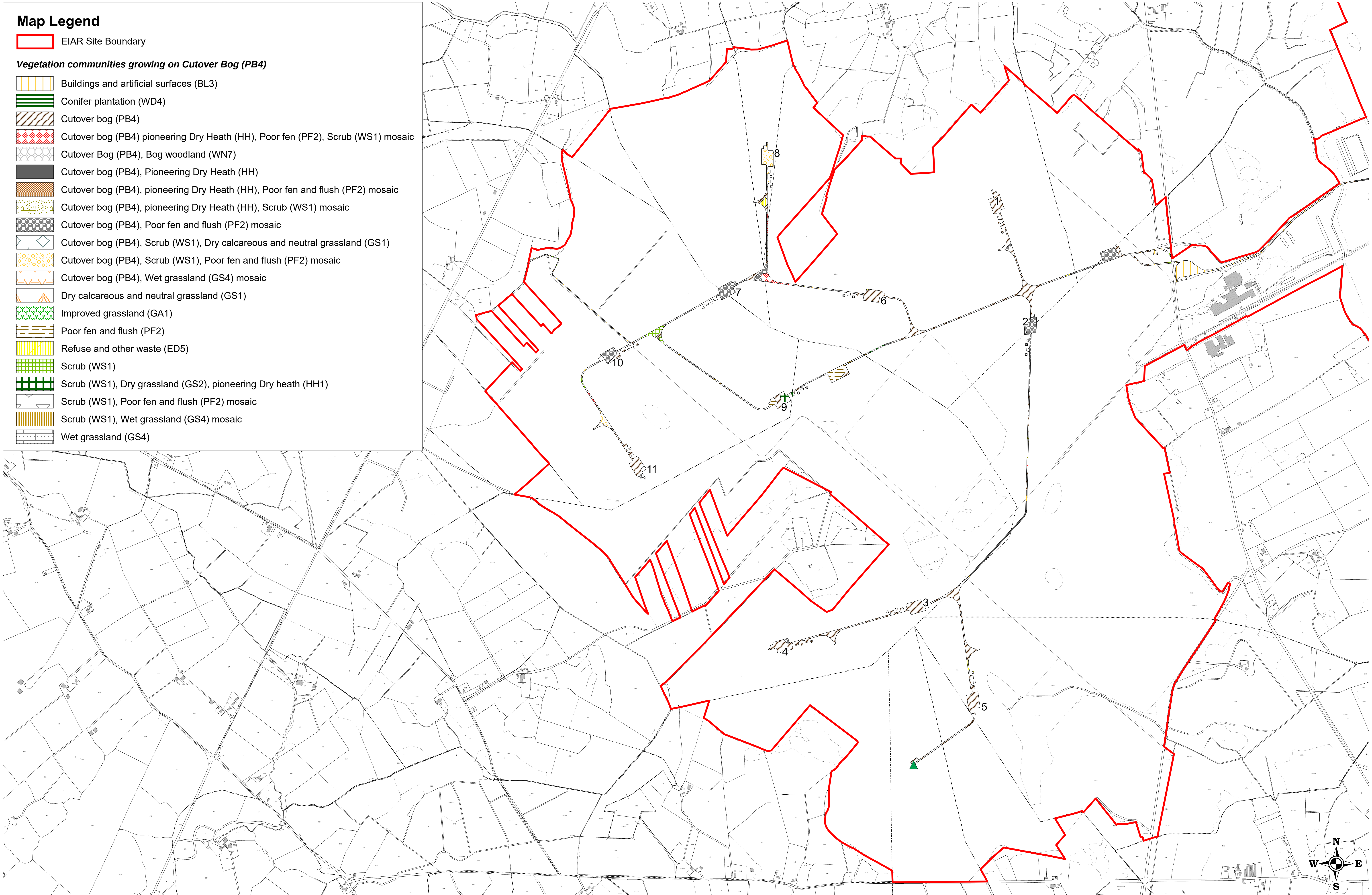

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	DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.:171221-2020.02.05
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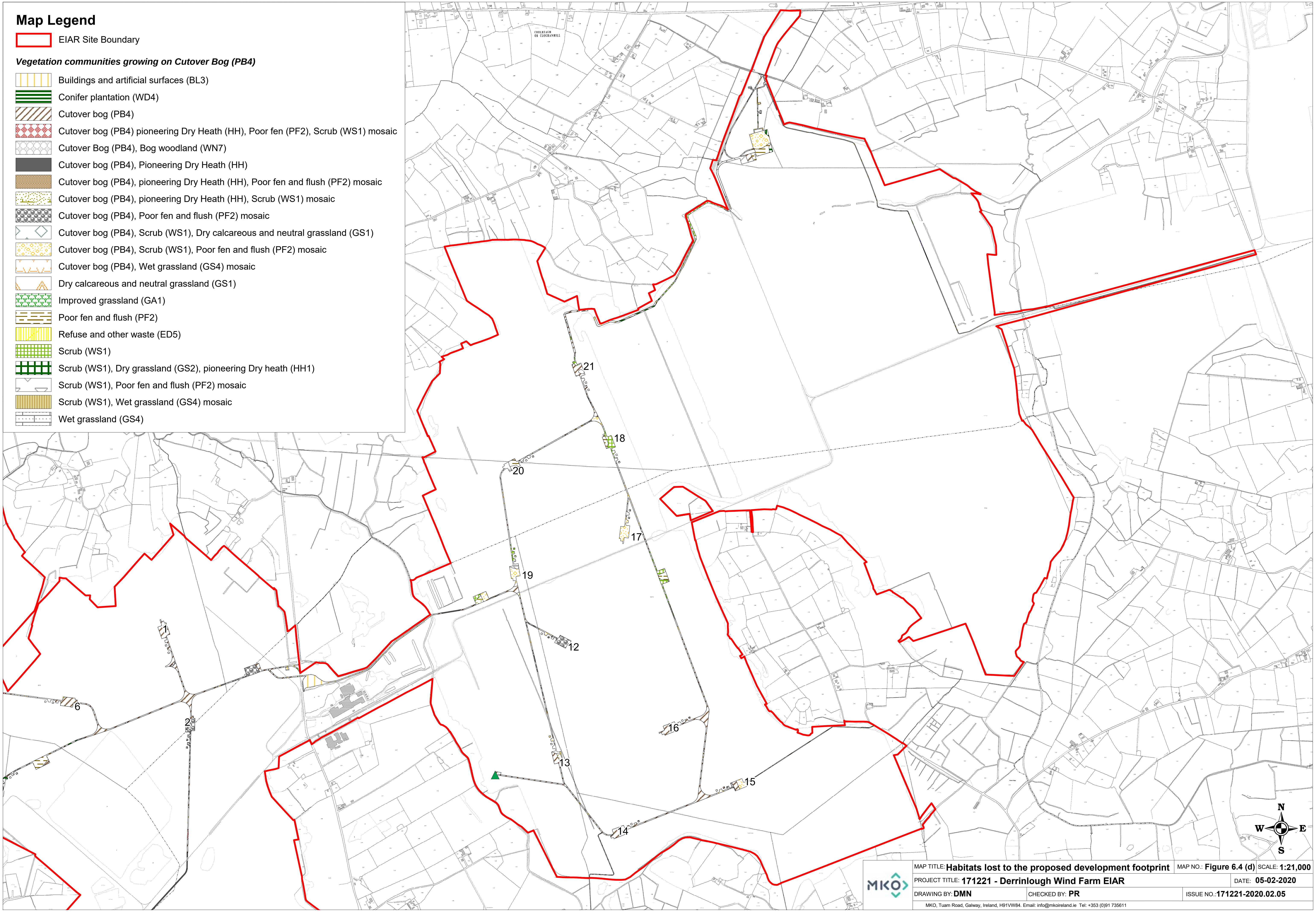

Map Legend

EIAR Site Boundary

Vegetation communities growing on Cutover Bog (PB4)

- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Dry calcareous and neutral grassland (GS1)
- Improved grassland (GA1)
- Poor fen and flush (PF2)
- Refuse and other waste (ED5)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH1)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Wet grassland (GS4)

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	PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR**		DATE: **05-02-2020**
	DRAWING BY: **DMN**	CHECKED BY: **PR**	ISSUE NO.: **171221-2020.02.05**

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Plate 6.1 Cutover bog with sparse vegetation

Bog Woodland/Scrub (WN7/WS1)

The habitats on the site have developed as birch dominated scrub and woodland in the areas where the peat production has ceased for the longest periods, along unmaintained drainage channels and where the cutaway is relatively dry. A mosaic of these habitats dominates large sections of the study area. The woodlands and scrub are often well developed alongside the drains that run throughout the site. The woodlands and scrub have in many areas colonized outward from the drains and act as boundaries to the old peat cutting fields. They provide separation, cover and shelter throughout the site. In general, the woodlands and scrub are relatively recently colonized and have a poorly developed layer structure and ground flora. Typically, they are dominated by birch (*Betula pubescens*) with some willows (*Salix spp.*). Some Sitka spruce (*Picea sitchensis*) and Lodgepole pines (*Pinus contorta*) has started to establish as a result of natural seed dispersal from nearby conifer plantations. The ground flora was commonly dominated by brambles (*Rubus fruiticosus agg.*). In more established areas, ivy (*Hedera helix*) dominate the understory with bracken (*Pteridium aquilinum*) and other fern species also a regular component of the ground flora. In some areas where the woodlands and scrub were colonizing the cutover bog, the ground flora was often dominated by ling (*Calluna vulgaris*) heather and in places purple moor grass (*Molinia caerulea*). Both birch scrub and birch dominated woodland occur throughout much of the site where peat production has ceased. Where scrub was greater than 4 metres in height, it was classified as Bog Woodland (as per Fossitt, 2000). The Annex I Bog Woodland habitat (91DO) was not recorded on the site during the Bord na Móna habitat surveys or the detailed habitat surveys undertaken by MKO. The woodlands were predominantly very dry and none of the woodland areas had developed on *Sphagnum* rich substrates.

Plate 6.2 shows a typical section of birch dominated bog woodland within the study area with small trees, low structural diversity and dry ground dominant bramble. Plate 6.3 shows the woodlands and scrub forming.

Plate 6.2 Typical Bog Woodland found throughout the study area

Plate 6.3 Example of bog woodland forming on cutover bog with the understory dominated by ling heather (Calluna vulgaris)

Poor Fen (PF2)/Reedswamp (FS1)

Many sections of the study area supported cutaway bog that was dominated by common cottongrass and was wet underfoot (though with little open water except after prolonged wet weather) or dry. Species frequently recorded included purple moor grass, soft rush (*Juncus effuses*), marsh arrowgrass (*Triglochin palustris*) and hummocks of the moss *Polytrichum commune.* This habitat was quite variable but was widespread within the study area. It formed mosaics with heath and woodland habitats and was classified by as Poor Fen (Plate 6.4).

There are also small areas with Poor fen vegetation associated with open water pools within the study area. These areas are dominated by common cottongrass, although also containing species such as marsh arrowgrass, reedmace (*Typha latifolia*) and common reed (*Phragmites australis*).

In addition, there were some areas of open water within the study area and were fringed by Poor Fen and Reedbeds (Plate 6.6).

Plate 6.4 Poor Fen within the study area with encroaching birch scrub

Plate 6.5 Bog cotton dominated Poor Fen habitat

Plate 6.6 Poor Fen Habitat surrounding open water outside of the development footprint

Rich fen (PF1)

A number of small areas of rich fen habitat have been mapped within the study area. These areas occur primarily on shallower peat where peat extraction has resulted in more subsoil being exposed and thus more calcareous conditions occurring locally. The habitat occurred in close association with willow scrub and revegetating bare peat which has resulted in a mix of species recorded. Species recorded within these areas include common cottongrass (*Eriophorum angustifolium*), devil's-bit scabious (*Succisa pratensis*), purple more-grass (*Molinia caerulea*), bog asphodel (*Narthecium ossifragum*), bogbean (*Menyanthes trifoliata*), cross-leaved heath (*Erica tetralix*), heather (*Calluna vulgaris*), bulrush (*Typha latifolia*), round-leaved sundew (*Drosera rotundifolia*), bottle sedge (*Carex rostrata*), and other *Carex* species. The ground was predominantly bare beneath much of the taller vegetation and no *Sphagnum* mosses, or significant cover of other moss species was recorded.

Plate 6.7 Example of Rich fen (PF1) recorded within the study area.

Cutover bog supporting Secondary heath type communities

Secondary heath type communities were dominated by tall ling heather (*Calluna vulgaris*), some cross-leaved heath (*Erica tetralix*), purple moor grass (*Molinia caerulea*) and common cottongrass (*Eriophorum angustifolium*) on dry peats with no Sphagnum present. It is likely that the dry heath areas would, if left undisturbed, colonize to form bog woodland (Dry Birch Woodland – Non-Annex I). The wetter heath communities supported higher abundance of purple moor grasses and common cottongrass. This habitat type covers a broad range of conditions from bare peat (Plate 6.8) and dry but vegetated (Plate 6.9and Plate 6.11) to much wetter areas that grade into poor fen (Plate 6.10). In more vegetated areas, dominated by cotton grasses (see Plate 6.13), orchid species were present including; heath spotted orchid (*Dactylorhiza maculata*), twayblade (*Listera ovata*) and marsh helleborine (*Epipactis palustris*). This was mostly associated with the area of revegetated bare peat occurring within the north-western boundary of the Drinagh (eastern) parcel of the study area. Detailed botanical surveys were undertaken at a representative sample of secondary heath type habitats throughout the site and provide a comprehensive species composition and associated percentage cover, see Appendix

6.4. The species composition, hydrological and geomorphological characteristics of the heath type habitat on site was assessed with reference to best practice guidance[2,5] and professional judgement, and was found not to conform to the EU Habitats Directive Annex I listed habitat European Dry Heaths [4030].

The cutover bog habitats on the site do not correspond to either Active Raised Bog (7110) or Degraded Raised Bog still capable of Natural Regeneration (7120). The NPWS Article 17 Report from 2013, states:

> *The actual definition of the habitat (still capable of regeneration), indicates that the habitat can be restored to Active Raised Bog habitat (7110). In the Irish context, the habitat does not include secondary degraded raised bog which relates to highly drained high bog devoid of vegetation, cutover, and cutover bog.*

The NPWS Article 17 Reporting for 2019 has been published and states:

> *In an Irish context, ARB (which is currently defined as occurring only on the high bog) encompasses active peat --forming ecotopes (central and sub--central) as defined by Kelly (1993) and Kelly & Schouten (2002), and actively peat --forming flushes*

In addition, the definition of Degraded Raised Bog has also been changed in the 2019 Article 17 Reporting. Whilst previously (from the 2013 Reporting), the habitat previously pertained to all vegetated areas of uncut Raised Bog that did not meet the criteria to be classified as Active Raised Bog, it is now recognised that the extent is much narrower and dependant on specific hydrological conditions. This habitat still does not occur on cutover bog in the Irish context and is more limited in its extent on uncut bogs.

These habitats do not occur on the cutover habitats upon which the proposed development is located.

They do not conform to Annex I heath habitats. They are secondary, cutover raised bog habitats that are located on deep peat and level ground. They do not conform to Annex I Wet Heath habitat as defined by the Irish Wildlife Manual (Perrin et.al. 2014). Neither do they conform to Annex I Raised Bog habitats or any other Annex I habitat.

Further details of the evaluation of the peatland habitats on the site are provided in Appendix 6.4.

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[5] *Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland*

Plate 6.8 Pioneering heath vegetation forming on areas of dry milled peat

Plate 6.9 Heath vegetation forming in areas of pioneering birch woodland within the development footprint

Plate 6.10 Pioneering Dry Heath with bare Peat in low-lying area adjacent to drainage ditch

Plate 6.11 Larger area of heath vegetation within the east of the site, within the Drinagh study area. This habitat occurs outside of the proposed development footprint.

Grasslands (GS2 and GS1)

The grasslands that are present within the study area are primarily limited to the sides of old trackways and railway lines. Many of the verge areas are classified as Dry Meadows and Grassy Verges with rank grasses including false oat grass (*Arrhenatherum elatius*), Yorkshire fog (*Holcus lanatus*), cocks foot (*Dactylis glomerata*) and encroaching scrub with nettle (*Urtica dioica*), bramble and rosebay (*Epilobium angustifolium*). Other areas are less rank and support more calcareous grasslands with species such as knapweed (*Centaurea nigra*), sweet vernal grass (*Anthoxanthum odoratum*), lady's bedstraw (*Galium verum*), dandelion (*Taraxicum officinalis agg.*) and bird's foot trefoil (*Lotus corniculatus*). Many of the tracks and grasslands were surrounded by willow scrub and woodlands making them sheltered. Other areas grassland habitats comprised of a mix of species typical of both calcareous and peatland habitats. This diversity in species recorded has resulted from the importing of stone for the construction of railway tracks throughout the peatland.

Plate 6.12 Example of rank grassland habitat within of the study area

Open waterbodies

The large open waterbodies occurring within the study area have formed following the use of these areas for active peat extraction. The large waterbodies occurring within the eastern portion of the study area (Drinagh) have been created by drain blocking (Bord na Móna, 2015) and have been assessed as artificially created Acid oligotrophic lake (FL2). The waterbodies are generally shallow and fringed by reedbeds, poor fen and birch dominated woodland. Plate 6.13 provides an example of the large waterbody occurring within the northeast of the study area.

Plate 6.13. Example of open water Acid oligotrophic lake occurring within the eastern portion of the study area (Drinagh)

Drainage Channels (FW4)

The study area is extensively drained with deep channels that run through the site. The majority of the drains within the site, subject to the most recent industrial harvesting, are devoid of vegetation and have a poor structure (Plate 6.14). In the areas where the drains are surrounded by dense woodland and scrub, the vegetation within them is sparse and the substrate comprises of bare silt. In the areas where there is less cover of trees, many of the drains support dense macrophytes including reedmace, horsetails (*Equisetum spp.*) and common reed (*Phragmites australis*) (Plate 6.15). In other areas, the drains are large and hold deep water with floating vegetation such as Pondweeds (*Potamogeton spp.*) (Plate 6.15).

Plate 6.14 Example of artificial drainage ditches that occur throughout the site, with little vegetation, dominated mainly by marsh arrowgrass and bog cottongrass.

Plate 6.15 Derelict drain vegetated with reedmace (Typha latifolia). Areas of revegetating bare peat occur in the background, dominated by cottengrasses, as well as birch dominated scrub and woodland.

6.5.2.1.2 Lowland depositing streams (FW2)

The site is drained by a number of watercourses that surround the study area. As described in Chapter 9: Hydrology and Hydrogeology, the majority of the site is located in the Brosna River sub-catchment (Brosna_SC_080). The Little River flows in a northwesterly direction through the centre of the site. The eastern side of the Drinagh bog is mapped within the Brosna_SC_070 sub-catchment. The Silver River flows north through this catchment, along the eastern boundary of the site. The western edge of the site, within the Clongawny bog, is drained by the Shannon lower sub-catchment (Shannon

[Lower]_SC_040). A number of small tributaries flow west/southwest before joining the Rapemills River, which drains the sub-catchment. The Rapemills River then flows north for ~5.5km before entering the Shannon River just west of Banagher.

Plate 6.16 – Example of Lowland depositing stream (FW2), the upper reaches of the Silver River, occurring along the northeast boundary of the study area.

6.5.2.1.3 Uncut raised bog

There are some remnant uncut raised bog habitats at the site of the proposed development, see Figure 6.5 and have been avoided in the design of the proposed development. The areas of raised bog recorded within the site are typically small in area, have been historically drained, are relatively dry and in some areas, subject to ongoing peat extraction at the facebank, see Plate 6.17. The vegetation comprises predominantly of tall ling heather with some purple moor grass and cottongrasses. Some wetter areas were also found to contain cross-leaved heath (*Eriac tetralix*) and bog asphodel (*Narthecium ossifragum*). In general, the bog remnants did not contain significant areas of Sphagnum mosses. This is possibly due to the historic draining of these small fragmented remnant areas of raised bog.

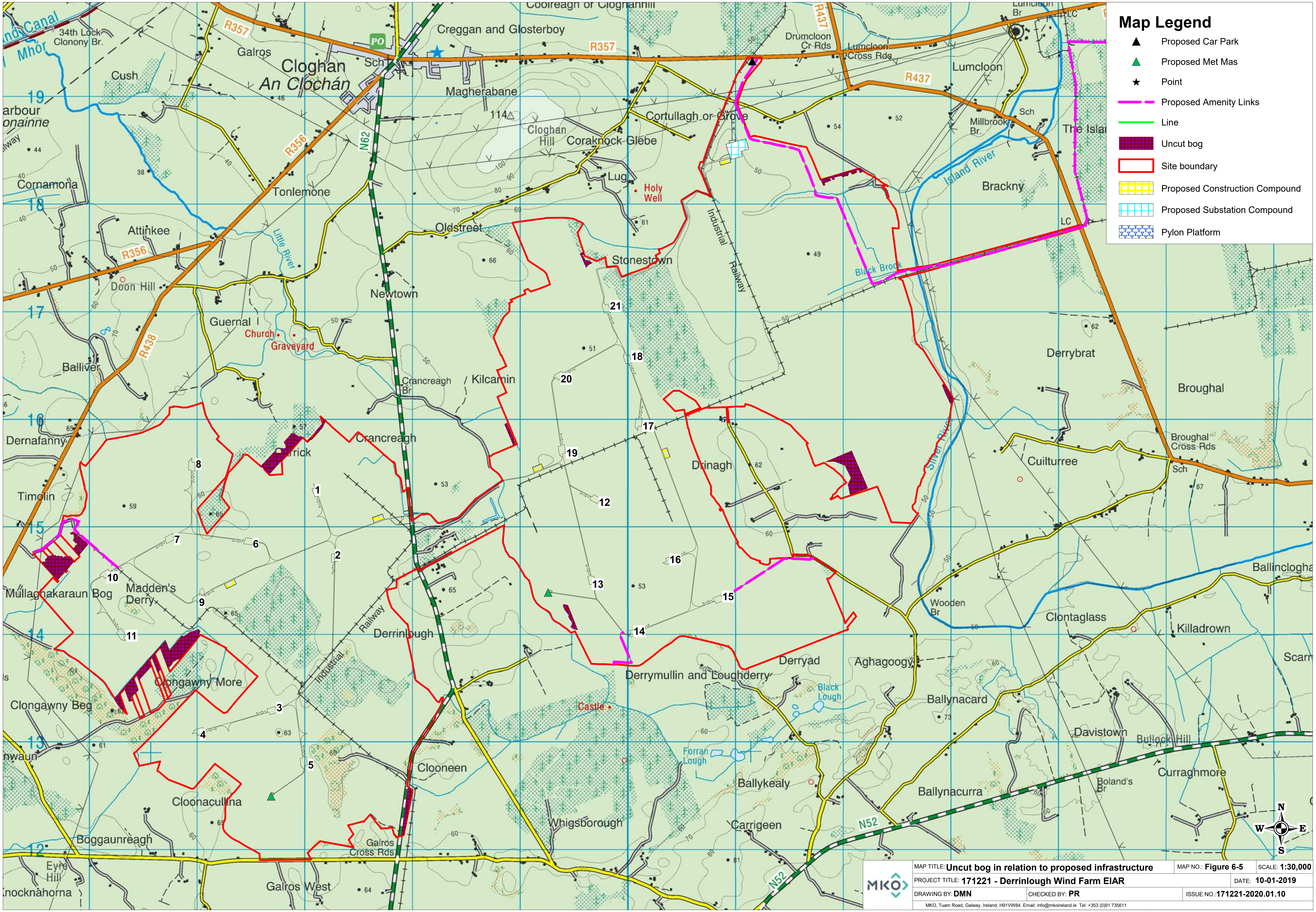

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Plate 6.17 Example of intact raised bog recorded within the study area. Some areas are subject to ongoing peat extraction to the northwest.

6.5.2.1.4 Plantation forestry (WD4)

Areas of coniferous plantation forestry (WD4) were recorded within the study area. These plantations predominantly comprise of Sitka spruce and lodgepole pine. An example of the coniferous plantation forestry is provided in Plate 6.18.

6.5.2.1.5 Plantation broadleaved woodland

A small section of the study area has been planted with ash trees alongside coniferous plantation forestry. All trees are of the same growth stage and the area lacks structural diversity. This area of woodland has therefore been assessed as Mixed broadleaved/conifer (WD2). There was also a poor ground flora diversity within this area of ash woodland. An example of the plantation ash woodland is provided in Plate 6.18.

Plate 6.18 Example of coniferous plantation forestry (WD4) in the background and plantation ash forestry in the foreground.

6.5.2.1.6 Oak-ash-hazel woodland

Small mineral islands/'derries' occur within the study area and are dominated by native oak and ash woodlands. These areas have also been avoided as part of the proposed development design.

Plate 6.19 Example of oak-ash-hazel woodland (in background of photo), occurring on mineral islands, within the study area

6.5.2.1.7 Habitats within proposed junction modification (Kennedy's cross)

In order to facilitate turbine delivery, it is proposed to modify an existing road junction at Kennedy's cross. The junction is between the N62 and the N52 located approximately 4.7km to the south of the site. The proposed junction modifications will occur completely within an area of improved agricultural grassland (GA1) dominated by perennial ryegrass (*Lolium perenne*), see Plate 6.20. The agricultural grassland is surrounded by a highly-managed hawthorn dominated hedgerow with an understory dominated by brambles and nettle. Although an area of wet woodland occurs adjacent to the south of the proposed junction modification, the works will completely avoid this habitat.

Plate 6.20 Example of improved agricultural grassland through which the proposed junction modification.

6.5.2.1.8 Habitats within the proposed grid connection route and substation infrastructure

The proposed grid connection route, substation and associated infrastructure is located fully within the proposed development boundary and study area. The habitats within the proposed infrastructure footprint is dominated by cutover bog and associated secondary habitats, including birch/willow scrub and recolonising bare ground, see Plate 6.21.

Plate 6.21 Example of recolonised bare peat and scrub occurring within the proposed substation and grid connection infrastructure footprint

6.5.2.1.9 *Habitats within the proposed amenity links*

The proposed amenity pathways will predominantly use the new internal site roads. Additional links are proposed to provide connectivity between the internal roads and local/regional roads around the site. These links will primarily use existing machinery passes, see Plate 6.22.

Plate 6.22 Example of machinery pass through birch dominated scrub and woodland.

Plate 6.23 Example of location of proposed amenity link occurring along the existing railway infrastructure to the east of the site

6.5.2.1.10 Buildings and artificial surfaces within the study area

There are some areas of buildings and artificial surfaces (BL3). The majority of the artificial surfaces are associated with existing briquette factory and the railway infrastructure, see Plate 6.23 above. Other small areas of hardcore occur within the study area that are used for informal parking in close proximity to main roads as shown in Plate 6.24.

Plate 6.24 Example of areas of hardcore within the study area used as informal parking areas.

6.5.2.1.11 Invasive species

No invasive species, listed on the Third Schedule of the S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011, were recorded within the study area. The only non-native invasive species recorded on site include butterfly bush (*Buddleja davidii*) and bearberry (*Cotoneaster dammeri*). Although invasive species, these are not listed on the Third Schedule.

No botanical species protected under the Flora (protection) Order (1999, as amended 2015) were recorded during the survey.

6.5.2.2 Significance of Habitats

Ecological evaluation follows a methodology that is set out in Chapter 3 of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009). The habitats within and adjacent to the development site were evaluated in accordance with the criteria developed by the NRA (2009b), which classifies sites in terms of their ecological importance, *i.e.* '*international importance*', '*national importance*', '*county importance*', '*local importance (higher value)*' or '*local importance (lower value)*'.

Following the extensive surveys that were undertaken, it is concluded that the habitats of highest ecological significance within the study are those that are most closely associated with the remnant fragmented areas of Raised Bog habitat. This habitat would have dominated the entire site prior to the commencement of the industrial peat cutting operations. As such, the remnant Raised Bog habitat, as shown in Figure 6.5 located outside the development footprint, have been assigned **County** significance as they contain the only remaining examples of Raised Bog habitat in the area. These areas are only a small remnant of the raised bog that would have dominated the site. They are avoided by the proposed development footprint and are highly degraded but are nonetheless of high ecological significance.

The secondary habitats recorded on the cutaway sections of the site vary in their ecological significance with large areas of broadleaved woodland and scrub present along with a diverse mosaic of Dry Heath type vegetation and Poor Fen with some open water habitats. The habitats listed above are assigned **Local importance (Higher Value)**. This is on the basis that they consist of a large area of semi-natural habitats with a high biodiversity value in the local context but do not correspond to habitats that are listed on Annex I of the EU Habitats Directive (See Appendix 6.4).

The Cutover Bog and bare peat habitats are of low ecological significance in their current state and have been assigned **Local Importance (Lower Value).** However, it is noted that if peat extraction ceased, these habitats would inevitably revegetate in a similar manner to the rest of the site.

Following the detailed studies undertaken and provided in Appendix 6.4, it is concluded that there are no Annex I habitats listed under the EU Habitats Directive present within the Proposed Development footprint.

No botanical species protected under the Flora (protection) Order (1999, as amended 2015), listed in the EU Habitats Directive (92/43/EEC), or listed in the Irish Red Data Books were recorded on the site and no suitable habitat occurs within the site. All species recorded are common in the Irish landscape.

6.5.2.3 Fauna

Dedicated faunal walkover surveys were undertaken at the site on the following dates:

- 21st June 2018
- 28th September 2018
- 15th March 2019
- 21st August 2019
- 18th September 2019
- 19th September 2019
- 5th December 2019

In addition to the above targeted surveys, additional faunal signs/sightings were also recorded during other surveys including habitat assessments, bat surveys and bird surveys. The site was also visited on numerous additional occasions during the undertaking of bat surveys throughout 2018 and 2019. Details of these survey dates are provided in Appendix 6.2.

6.5.2.3.1 *Badger*

Dedicated surveys for this species were undertaken on the above dates between 2018 and 2019, in addition to incidental records recorded during other species-specific surveys. A total of 4 main setts and 4 outlier setts (comprising numerous entrances) were recorded within and adjacent to the study area. The location of all badger setts (including each annex, subsidiary or outlier sett entrance) are shown on Figures 6.6 and 6.6a to 6.6c, Confidential Appendix 6.5[6] of this EIAR. During dedicated badger surveys of the site, signs of badger i.e. badger foraging signs, latrines etc. were predominantly restricted to the margins of the site. Due to the nature of the cutover peatland habitats recorded within the site, these habitats do not provide optimal foraging habitat or badger. The setts recorded on the peripheries showed signs of commuting trails to the agricultural grasslands that surround the site. Such habitat provides suitable foraging habitat for the species surrounding the site. All badger setts were located entirely outside of the proposed development footprint. However, one main sett, containing 7 entrances, does occur within approximately 35 metres of the proposed grid connection route and associated access track, see Figure 6.6b.

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[6] *Following standard best practice, the location of breeding or resting places of protected species should be provided as a confidential appendix for review by the competent authority and not made available to the public in order to avoid potential for persecution.*

Plate 6.25 Example of badger sett entrance recorded within the study area.

6.5.2.3.2 Otter

Signs, predominantly sightings of individual animals, of otter were recorded within the study area and downstream of the site of the proposed development. The location of all otter records is provided on Figure 6.7. The main watercourse/larger artificial drainage channels were assessed as providing suitable commuting and foraging habitat for the species. The majority of the drainage ditches within the study area are small and are thus not suitable for otter, see Plate 6.14. These peat drainage ditches were assessed as having no - low suitability for commuting or foraging otter as they are small, highly modified channels of low fisheries value. Some of the larger waterbodies recorded within the site were identified as providing suitable habitat for the species. No signs of otter were recorded during the dedicated fisheries assessment or kick sampling of the watercourses surrounding the study area (Triturus Environmental Ltd, 2019).

6.5.2.3.3 Bats

Bat surveys undertaken in 2019, in accordance with Scottish Natural Heritage Guidance (SNH 2019), form the core dataset for the assessment of effects on bats at the proposed development site. It is supplemented by additional data derived from surveys undertaken on the site in 2018 which were designed in accordance with the Bat Conservation Trust's guidelines for wind turbine developments (Hundt, 2012). Bat surveys included roost survey, manual transect surveys and ground-level static surveys.

Roost surveys

One structure, (IG Ref: N 08042 14688) first identified in 2018, was resurveyed in 2019 and was subject to a roost assessment, including a detailed inspection of the exterior to assess for evidence of bat use (Table 6.12). The building is being retained, therefore no likely significant effects on bats are predicted.

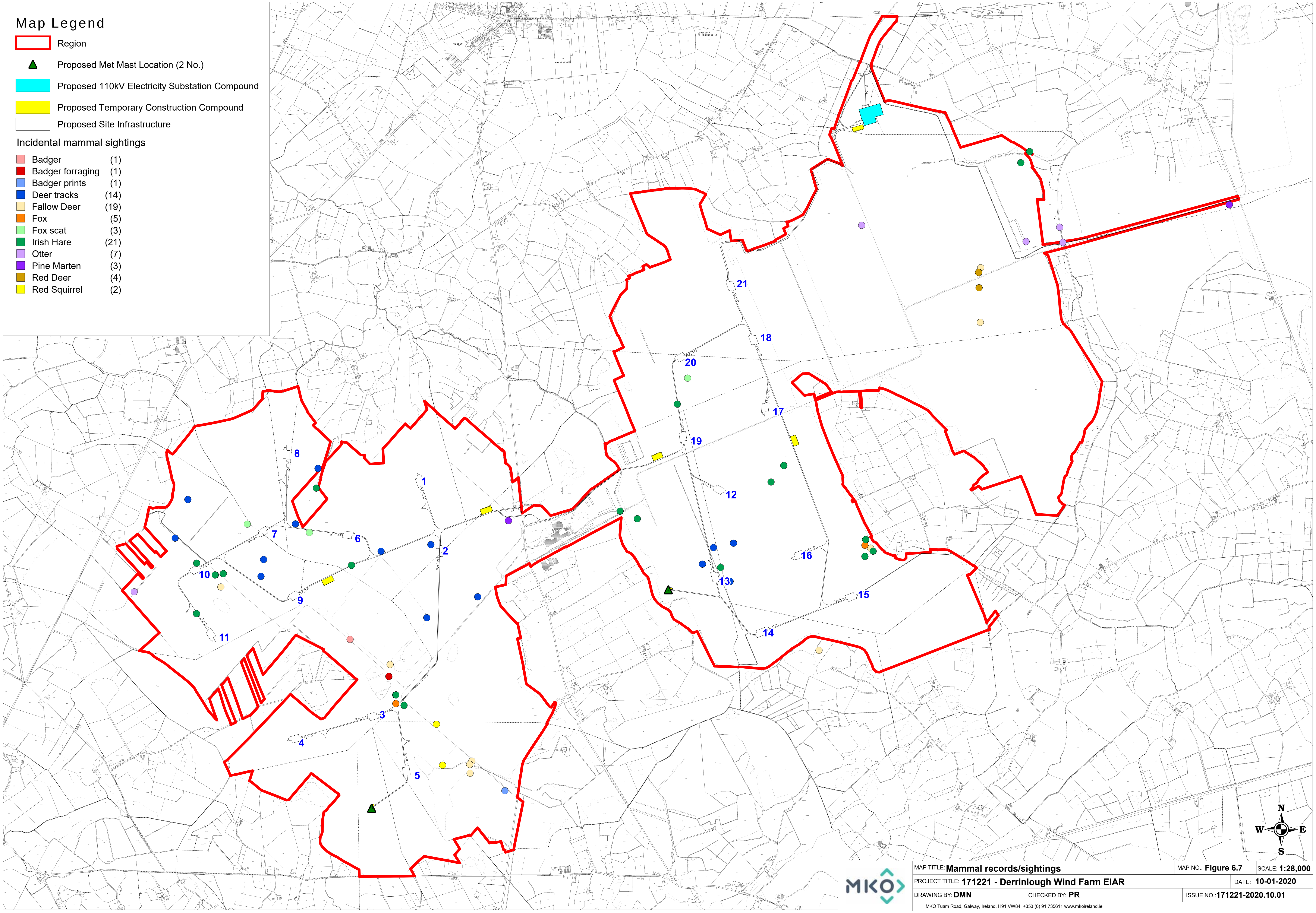

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Table 6.12: Bat Survey Effort 2018 and 2019

Description	Survey	Date	Results
Unoccupied Cottage	Dawn	29/05/2018	6 Soprano pipistrelles
Unoccupied Cottage	Dusk and Dawn	23/08/2018 - 24/08/2018	Soprano pipistrelle; 5 emerging, 2 re-entering
Unoccupied Cottage	Dusk	06/06/2019	7 Common pipistrelle, 1 Soprano pipistrelle
Unoccupied Cottage	Dusk	22/07/2019	4 Soprano pipistrelle

No potential tree roosts were identified during the roost surveys and no evidence of bat use was recorded elsewhere during the roost assessment.

Manual transects 2019

Manual transects were undertaken in spring, summer and autumn 2019. Bat activity was recorded on all surveys. A total of 482 bat passes were recorded during the manual transects. In general, Soprano pipistrelle was recorded most frequently, followed by common pipistrelle, Leisler's bat and *Myotis* sp. Instances of brown long-eared bat were rare. However, species composition and activity levels varied significantly between surveys. Plate 4.3, Appendix 2 of the EIAR 'bat report' presents results for individual species per survey period. Bat activity was concentrated along the track beside the briquette factory (linear, mature forestry edge habitats).

Ground-level Static Surveys 2019

In total, 34,557 bat passes were recorded across all deployments. In general, common pipistrelle, Leisler's bat and soprano pipistrelle occurred most frequently, while instances of *Myotis* sp. and brown long-eared bat were significantly less.

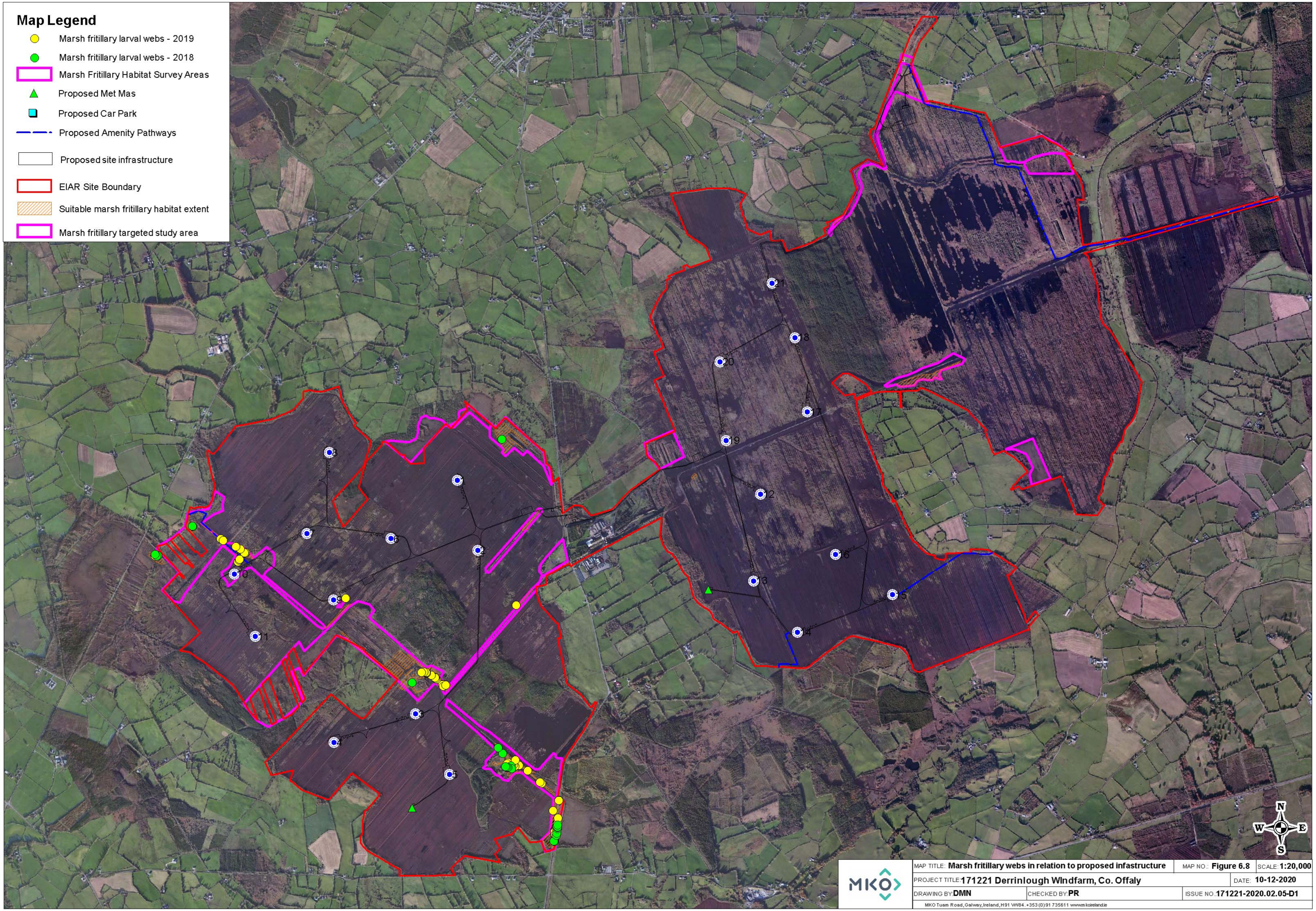
Bat activity was dominated by common pipistrelle and Leisler's bat in spring. In addition, Leisler's bat, common and soprano pipistrelle occurred frequently in summer. Activity was variable between survey nights. Therefore, the median Nightly Pass Rate including absences was used as the most appropriate measure of bat activity (Lintott & Mathews, 2018). Results for each species can be found in Section 4.6 of the bat report, Appendix 6.2 of the EIAR.

6.5.2.3.4 Marsh Fritillary

The desk study identified that marsh fritillary is known to occur in the wider area surrounding the proposed development.

Dedicated surveys were undertaken within the study area to identify areas of suitable marsh fritillary habitat. Suitable habitat was recorded in small areas scattered throughout the study area as shown in Figure 6.8. There is little suitable habitat on the Drinagh side due to the wetter and scrubbier habitats. The suitable habitat was mainly associated with areas where stone material has been brought into the site for the construction of railway tracks, construction of access roads etc.

During dedicated larval web surveys of the study area, a total of 24 webs were recorded within the study area during targeted marsh fritillary surveys undertaken in 2018. Follow-up surveys undertaken in 2019 located a total of 80 webs within the study area, see Figure 6.8. Marsh fritillary populations often vary from year to year and the reproductive success of the species can be highly dependent on weather



Map Legend
Marsh fritillary larval webs - 2019
Marsh fritillary larval webs - 2018
Marsh Fritillary Habitat Survey Areas
Proposed Met Mas
Proposed Car Park
Proposed Amenity Pathways
Proposed site infrastructure
EIAR Site Boundary
Suitable marsh fritillary habitat extent
Marsh fritillary targeted study area
N
W
E
S
MKO
MAP TITLE: Marsh fritillary webs in relation to proposed infastructure
MAP NO.: Figure 6.8
SCALE: 1:20,000
PROJECT TITLE: 171221 Derrinlough WIndfarm, Co. Offaly
DATE: 10-12-2020
DRAWING BY: DMN
CHECKED BY: PR
ISSUE NO.: 171221-2020.02.05-D1
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conditions. Adult marsh fritillary were also recorded within the site on the 6th June 2019. The adults were recorded within the southwestern section of the site in areas identified as providing suitable supporting habitat for the species.

None of the marsh fritillary colonies recorded within the proposed development site occur within the infrastructure footprint. An example of the linear strips of suitable marsh fritillary habitat recorded at the site, in relation to the proposed site access track, is shown in Plate 6.27.

In addition, habitat suitability assessments were undertaken during larval web searches within areas of suitable habitat for the species. This followed methods set out in National Biodiversity Data Centre (NBDC) best practice guidance. The results of the condition assessment are provided in Appendix 6.6 'Lepidoptera Management Plan' and were focused on assessing the quality of the marsh fritillary habitat where webs were recorded on site only7. The condition assessment indicates that the habitat where the most marsh fritillary colonies were recorded was primarily 'Good Condition'. However, in some areas, the narrow strips of this suitable habitat are becoming encroached by scrub (generally birch and some birch). Where the species was more sparsely distributed, due to the fragmented and small size nature of the habitat, the suitability assessments indicated that the habitat was 'unsuitable'. This was largely due to the low occurrence of devils-bit scabious.

Plate 6.26 Marsh fritillary larval web recorded within the study area

[7] This was due to its limited recorded distribution of suitable habitat within the study area and will allow for a long-term comparison in habitat monitoring and management.

Plate 6.27 Example of narrow strip of suitable marsh fritillary habitat (outlined in red)

6.5.2.3.5 *Aquatic Fauna*

In addition to the multidisciplinary walkover surveys and targeted species surveys, additional targeted surveys were also undertaken for a number of target species including fish and aquatic invertebrates. A detailed aquatic survey was undertaken in 2019 and is provided in Appendix 6.3 (Triturus Environmental Ltd, 2019). The location of all survey sites is provided in Figure 2.1, Appendix 6.3. The below subsections provide an assessment of the targeted surveys of aquatic species within the study area.

Salmonid habitat assessment

Salmonid habitat ranged from poor to moderate value across the majority of survey sites surveyed. This largely reflected the peat-based nature and heavily silted substrata of many sites. Only the Silver River offered good salmonid habitat according to life Cycle Unit scores. The Whigsborough Stream, Derrinlough Stream and the Madden's Derry Stream offered poor quality habitat overall. Unnamed wetlands at Clooneen and Stonestown were lacustrine habitats but nevertheless provided some moderate nursery value for brown trout, as did a settlement pond with outflow at Derrinlough. The Grants Island Stream was dry at the time of survey and did not support fish (Triturus Environmental Ltd, 2019).

Lamprey habitat assessment

Lamprey habitat was poor across the majority of survey sites, with poor spawning and poor nursery habitat present throughout all but one site. Primarily this was due to limited (or absent) clean, unbedded gravel substrata and the predominance of humic, flocculent sediment. The Silver River at Millbrook Bridge offered moderate quality spawning and nursery habitat. Unnamed wetlands at Clooneen and Stonestown, being lacustrine habitats with no flow, were not considered suitable for lamprey. A settlement pond with outflow at Derrinlough, although more representative of a lacustrine habitat, featured some flowing water at the outflow but this offered poor quality lamprey habitat (Triturus Environmental Ltd, 2019).

White-clawed crayfish habitat assessment

White-clawed crayfish were recorded from a single site during the survey; sweep netting resulted in the capture of a single crayfish on the Feeghroe Stream (immediately below the R468 road culvert). Despite some moderate to good suitability for the species at certain sites (e.g. the Little Cloghan River, a settlement pond at Derrinlough and the Silver River), no live crayfish were recorded from any other site via sweep netting or hand searching. However, crayfish are known locally (Bord na Móna pers. comm.) from the Little Cloghan River and the connected settlement pond at Derrinlough, both in the vicinity of the Derrinlough briquette factory. Walkover surveys failed to identify remains of crayfish in mustelid spraint.

6.5.2.3.6 *Other Fauna*

During the walkover survey, signs of the following mammal species were recorded:

- Fox (*Vulpes vulpes*) scat was recorded at various locations throughout the study area. However, no dens or other signs of the species were recorded during the survey and no dedicated survey for the species was required. As signs of fox were regularly recorded throughout the site, the distribution of the species has not been mapped.
- Hare (*Lepus timidus hibernicus*) was frequently recorded throughout the study area along with its droppings and footprints. The species is widespread throughout the habitats present and no dedicated survey for the species was required. The distribution of Irish hare records is provided in Figure 6.7.
- Scat that was likely to be that of pine marten (*Martes martes*) was recorded infrequently throughout the site. The scats were primarily located on fallen trees in areas of coniferous plantation woodland, which is typical of the species. No dens were recorded and no requirement for additional survey was identified.
- Deer prints were recorded throughout the site and Fallow Deer (*Dama dama*) were seen on occasion during the surveys. This is an invasive species listed on the Third Schedule of the Birds and Natural Habitats Regulations and no significant populations were recorded. No dedicated survey for this species was considered necessary on the basis that this is an invasive species and it was recorded infrequently.
- Two squirrel dreys were recorded within a small area of willow carr woodland located outside the south of the site. The small area of woodland is located to the east of the proposed junction modification at Kennedy's cross. Despite dedicated surveys for squirrel species, no dreys was recorded within the site. A small number of red squirrel records were recorded within the study area. However, these were predominantly record in association with plantation forestry which will not be affected. The surveys concluded that the site of the proposed development does not provide significant areas of suitable habitat for the species.

In addition to the above mammal species (or signs thereof) that were recorded, it is likely that other species also occur on or around the site but were not recorded during the site surveys that were undertaken. These include small mammal species such as pygmy shrew (*Sorex minutus*) and wood mouse (*Apodemus sylvaticus*) but also larger mammals such as stoat (*Mustela ermina*) and mink (*Mustela vison*). No signs of any of these species were recorded during the walkover surveys and no requirement for dedicated surveys was identified.

In general, given the highly modified and bare nature of the exposed peat, limited suitable habitat occurs on site for protected faunal species. No signs of any additional protected fauna were recorded within the study area during the field survey.

The study area provides habitat for a range of other faunal species as described in the preceding sections. No records of common lizard were recorded within the site. However, the species is likely to occur in the area. No evidence of populations of species such as common frog, Irish hare, pine marten or deer species being significant at more than a local level was recorded. These species have been assessed as of local importance (higher value). However, due to the small footprint and nature of the proposed development, they are unlikely to be significantly affected by the proposed development. For this reason, these species are not considered further in this EIAR.

Incidental records of invertebrate were recorded during the walkover surveys of the site. In addition to the aquatic invertebrates identified during kick samples of the watercourses on site, the following include the species commonly recorded within the study area:

- Common hawker dragonfly (*Aeshna juncea*)
- Common darter damselfly (*Sympetrum striolatum*)
- Ruddy darter damselfly (*Sympetrum sanguineum*)
- Peacock butterfly (*Inachis io*)
- Speckled wood butterfly (*Pararge aegeria*)
- Green veined white (*Pieris napi*)
- Common blue damselfly (*Polyommatus icarus*)
- Small copper butterfly (*Lycaena phlaeas*)
- Painted lady butterfly (*Cynthia cardui*)
- Brimstone butterfly (*Gonepteryx rhamni*)
- Small tortoiseshell butterfly (*Aglais urticae*)
- Dingy Skipper Butterfly (*Erynnis tages*)
- Emperor moth (*Saturnia pavonia*)
- Cinnabar moth (*Tyria jacobaeae*)
- Garden tiger moth (*Arctia caja*)
- Common carder bee (*Bombus pascuorum*)
- Buff-tailed bumblebee (*Bombus terrestris*)
- Garden spider (Araneus diadematus)
- Crane fly (*Tipulidae sp*)
- Field grasshopper (*Chorthippus brunneus*)
- Common green grasshopper (*Omocestus viridulus*)

In addition to the above, the following species were recorded during kick sampling undertaken at five sample locations as shown in Figure 2.1, Appendix 6.3 (Triturus Environmental Ltd, 2019):

- Large dark olive (Baetis rhodani)
- Cassidflies (Limnephilus sp.)
- Seracostoma personatum
- Agapetus fuscipes
- Hydropsyche angustipennis
- Blue-tailed damselfly (Ischnura elegans)
- Common backswimmer (Notonecta glauca)
- Great diving beetle (Dytiscus marginalis)
- Haliplus confinus
- Limnius volckmari
- Elmis aenea
- Wandering snail (Radix balthica)
- Jenkins' spire snail (Potamopyrgus antipodarum)
- Waterlouse (Asellus aquaticus)
- Gammarus duebenii
- White-clawed crayfish Austropotamobious pallipes
- Dicranota sp.
- Chironomini tribe
- Chironomus sp.
- Simulium sp.
- Glossiphonia complanata

6.5.2.4 Significance of Fauna

6.5.2.4.1 *Badger*

Badger as an ecological receptor has been assigned Local Importance (Higher value) on the basis that the habitats within and adjacent to the study area are likely to be utilised by a locally occurring badger population of Local Importance. As an active sett has been identified in close proximity to the proposed internal cable and access road route, further assessment of impact is required.

6.5.2.4.2 *Otter*

Although otter were recorded within the study area on a number of occasions, no evidence of populations of otter being significant at more than a local level was recorded. Based on the low number of otter records for the site and the low suitability of the aquatic habitats to support fish species, otter has been assessed as of Local Importance (Higher value).

6.5.2.4.3 *Bats*

The habitats surrounding the proposed works location are likely to be utilised by a bat population of Local Importance (higher value). All bat species in Ireland are protected under both national legislation – (Wildlife Act, 1976, as amended in 2017) and European legislation – (Habitats Directive (92/43/EEC). Bats are likely to forage and commute within the vicinity of the proposed development. No potential bat roosting features were identified within or adjacent to the development footprint.

6.5.2.4.4 *Marsh fritillary*

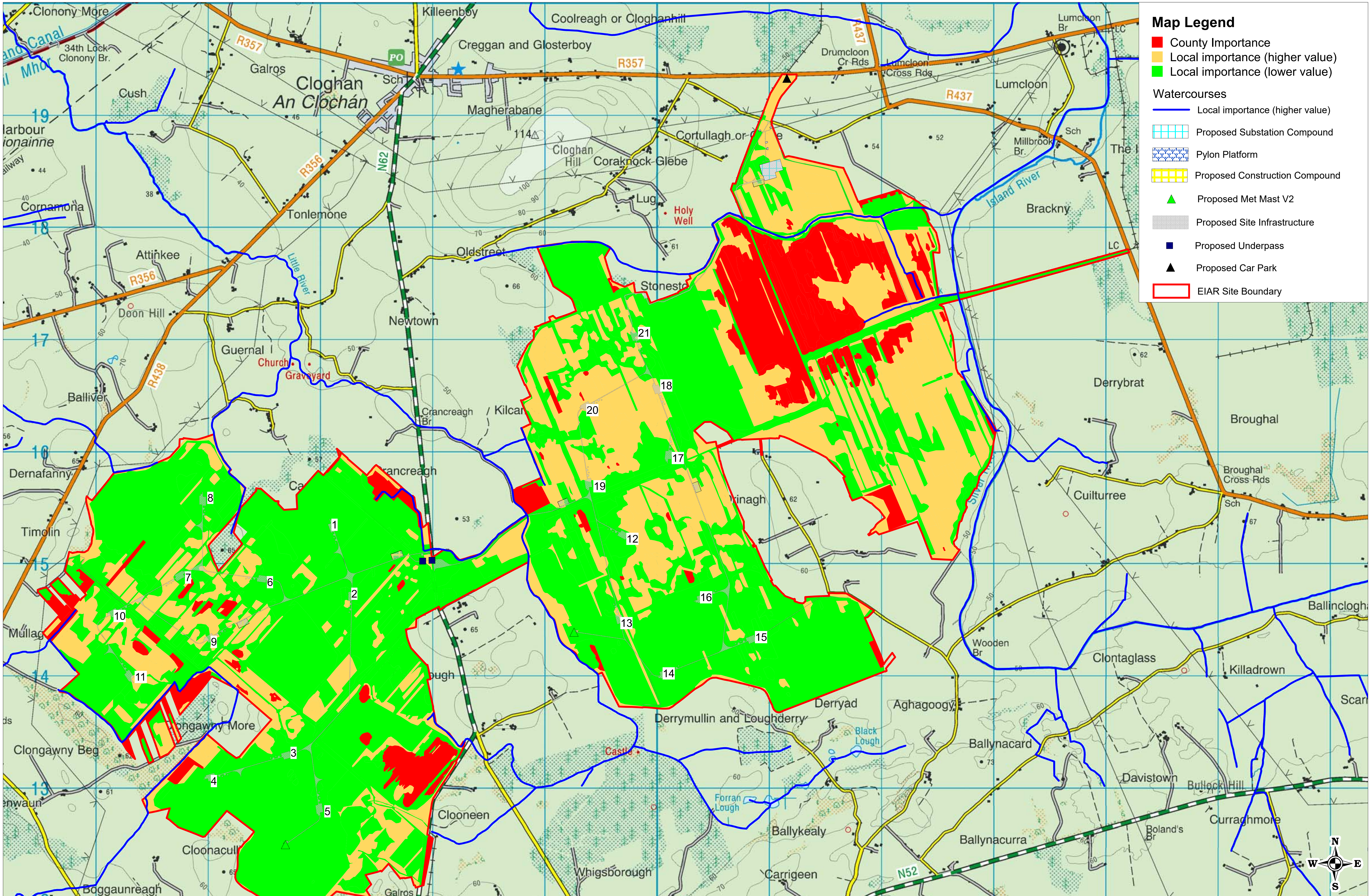
Marsh fritillary have been recorded within the site (but outside the construction footprint) during dedicated field surveys undertaken in 2018 and 2019. The species was recorded within discontinuous areas of suitable habitat along an existing railway line/site access track and within areas of poor fen/wet grassland. Although some of the areas of suitable habitat are small and fragmented, the species was widely distributed across the western half of the site. Due to the distribution of the suitable habitat occurring within the study area as well as the wide distribution of the species within the western part of the site, the species has been assessed as of Local importance (higher value).

6.5.2.4.5 *Fisheries and Aquatic fauna*

The aquatic fauna within the study area is assigned Local Importance (Lower Value) due to the highly modified and silty aquatic habitats that are present. The downstream watercourses and fauna within them is assigned Local Importance (Higher Value) due to the known populations of salmon, trout and lamprey species along with otter.

6.5.2.5 Identification of Key Ecological Receptors

Table 6.13 lists all identified receptors and assigns them an ecological importance in accordance with the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009). This table also provides the rationale for this determination and identifies the habitats that are Key Ecological Receptors. These ecological receptors are considered in Section 6.7 of this report and mitigation/ measures will be incorporated into the proposed development where required, to avoid potential significant impacts on the features. The significance attributed to each of the habitats on site is provided in Figure 6.9 and includes the proposed infrastructure overlain.



MAP TITLE: Habitat Significance Map	MAP NO.: Figure 6.9	SCALE: 1:30,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR	DATE: 05-02-2020	
DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.:171221-2020.02.05

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Table 6.13 Key Ecological Receptors identified during the assessment

Ecological feature or species	Reason for inclusion as a KER	KER
Designated sites	**Nationally Designated Sites** The following Nationally designated site is located downstream of the proposed development and has been identified as being within the likely Zone of Impact: - River Shannon Callows pNHA - Lough Coura pNHA	Yes
	European Designated Sites The following SACs are identified in the AA Screening as being within the Likely Zone of Impact and are assessed fully in the NIS that accompanies this application: - River Shannon Callows SAC. - Lough Derg North East Shore SAC. These sites are assigned **International** importance and included as a KER as there is potential for indirect effects on them via water pollution. **Note: SPAs within the Likely Zone of Impact are considered in Chapter 7, Ornithology and in the NIS.**	Yes
Aquatic Habitats and related species	**Drainage Ditches** The site of the proposed development is drained by numerous drainage ditches. These are small man-made channels that are often devoid of vegetation and regularly maintained or choked with vegetation and are slow flowing. These drains are assigned **Local Importance (Lower Value)**.	No
	Rivers and Streams A number of larger natural or slightly modified watercourses are located either within or at the perimeter of the site. These watercourses include: - The Stonestown Stream, Silver River Little Cloghan River, Madden's Derry Stream and Derrinlough Stream that primarily drain the eastern section of the site and ultimately discharge to the River Brosna. - The Grant's Island Stream, the Feeghroe Stream and the Mullaghkaraun Stream, which drain the western section of the site and ultimately discharge to the River Shannon. These Rivers and Streams have been assigned **Local importance (Higher Value)** in that whilst many are highly modified where they adjoin the site, they are conduits to waterbodies with a high biodiversity value in the local area. They also provide a conduit to downstream SACs of international importance.	Yes

Ecological feature or species	Reason for inclusion as a KER	KER
	Open Waterbodies and Wetlands The site of the proposed development includes large areas of open water in the form of Acid Oligotrophic Lakes and associated wetlands and reedswamps. There is a small area of Rich Fen and Flush, which is included as a wetland for the purposes of this assessment. These areas have been assigned **County Importance** in that they support semi-natural (although artificial) habitats that are of high biodiversity in the County context.	Yes
	Aquatic and Fisheries Species The aquatic species that are associated with the rivers, streams and wetlands that are located within and surrounding the site assigned **Local Importance (Higher Value)** in that they have a high biodiversity value in the local context. There is potential for indirect effect on these features. These species include salmonid and coarse fish, lamprey species, white clawed crayfish (*Austropotamobius pallipes*), European eel (*Anguila anguila*), aquatic invertebrates and other aquatic species.	Yes
Uncut Raised Bog	The small areas of uncut raised bog that are located in fragmented locations at the edges of the site are assigned **County Importance** on a highly precautionary basis. This is because they could potentially contain some highly degraded and non-viable areas of the Annex I Habitat 'Degraded Raised Bog still Capable of Natural Regeneration (7120)'. These areas have been entirely avoided in the design of the proposed development and the proposed wind farm infrastructure does not come within 240 m of them. While a proposed amenity trail occurs adjacent to this habitat, it is located on an existing railway track and will thus not impact upon this habitat. In addition, the nature and scale of the works associated with the amenity pathways are such that there is no potential for significant effect.	No
Natural Oak Ash Hazel Woodland	The natural woodlands within the site that are located on the mineral islands within the bog are assigned **County importance** on the basis that they represent semi-natural habitats of a size and type such that they provide high biodiversity and are unusual and important in a County context. However, these features have been entirely avoided in the design of the proposed development and no potential for any direct or indirect effect on them is identified.	Yes
Cutover bog and associated secondary habitats	**Bare peat habitats** The cutover bog and bare peat habitats are of low ecological importance in their current state and have been assigned **Local Importance (Lower Value).**	No
	Bog Woodland and pioneering Scrub The habitats listed above are assigned **Local Importance (Higher Value)**. This is on the basis that they consist of semi-natural (although artificial) habitats with a high biodiversity value in the local area but do not correspond to habitats that are listed on Annex I of the EU Habitats Directive (see appendix 6.4).	Yes

Ecological feature or species	Reason for inclusion as a KER	KER
	Note: The bog woodland does not correspond to the Annex I Habitat Bog Woodland 91D0. See classification in Appendix 6.4	
	Poor fen This habitat is assigned **Local Importance (Higher Value)**. This is on the basis that it consists of semi-natural (although artificial) habitats with a high biodiversity value in the local area but do not correspond to habitats that are listed on Annex I of the EU Habitats Directive.	Yes
	Heath type Communities This habitat is assigned **Local Importance (Higher Value)**. This is on the basis that it consists of semi-natural (although artificial) habitats with a high biodiversity value in the local area but do not correspond to habitats that are listed on Annex I of the EU Habitats Directive (See Appendix 6.4).	Yes
	Wet grassland The habitat is common and widespread in the wider area. However, the habitat that is of some local importance to local wildlife (NRA, 2009). The small area of this habitat occurring within the proposed development area is small in area and is assigned **Local Importance (Lower Value)**.	No
Plantation forestry (WD4) and plantation broadleaved woodland (WD2)	Plantation forestry is of low ecological importance due to the dominance by coniferous species (Sitka spruce and lodgepole pine). A small area within the study area has also been planted by ash and corresponds to Mixed broadleaved/conifer (WD2). Plantation forestry/woodland has been assigned **Local Importance (lower value)** as it provides cover for some local wildlife. The proposed development footprint will not result in any loss of this habitat.	No
Otter	Otter is assigned **Local Importance (Higher Value)** as there is likely to be a regularly occurring population of local importance in the wetlands within the site and the watercourses at its periphery and in the surrounding area. No evidence of a more ecologically important population was recorded during any of the site surveys undertaken.	Yes
Marsh fritillary	The species has been assessed as of **County** importance as they are listed in Annex II of the EU Habitats Directive and it is likely that the population on site may represent 1% of the County population of the species.	Yes
Bats	Bat species has been assessed as of **Local Importance (Higher Value)** as they represent a resident or regularly occurring populations assessed to be important at the Local level and are listed in Annex IV of the EU Habitats Directive.	Yes
Badger	Due to the occurrence of a number of badger setts within and adjacent to the site, the species has been assessed as of **Local Importance (Higher Value)** as there is a regularly occurring populations assessed to be important at the local level.	Yes
Additional protected fauna	The site surveys did not identify any other protected faunal species with the potential to be significantly affected by the proposed development at the population level	No

6.6 Ecological Impact Assessment

6.6.1 Do-Nothing Effect

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases. The biodiversity on the site would likely remain similar to its current state as activity levels and land use would not change significantly.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas. This rehabilitation plan is designed to result in an overall increase in biodiversity on the site when compared to the existing situation, following cessation of peat extraction.

6.6.2 Effects on Designated Sites

None of the elements of the proposed development are located within the boundaries of any Nationally or European designated sites important for nature conservation (Figure 6.1a and Figure 6.1b). There will be no direct effects on any designated site as a result of the construction, operation and decommissioning of the wind farm project or the Substation and Grid Connection.

Two nationally designated sites were identified as being within the zone of influence and as KERs. These are listed below:

- Lough Coura pNHA is located adjacent to the southern boundary of the proposed development site but is over 310m from the construction footprint at closest. It is a site that contains peatland and fen habitats and the potential for hydrological connection was considered as a pathway for effect. This potential was fully assessed in Chapter 9 of this EIAR, which concluded in Table 9.12 of the hydrological assessment that there is no potential for impact on this pNHA.
- The River Shannon Callows pNHA is also designated as an SAC and SPA and any potential effects on this nationally designated site are fully considered in the AA Screening and NIS in relation to the European designation. There are no additional features in the pNHA, which are not also considered in relation to the SAC or SPA.

No NHAs or pNHAs that are not also designated as European Sites were identified as KERs. In situations where pNHAs are contiguous with SACs or SPAs, they have been assessed as those designations within the AA Screening Report and NIS, and the relevant conclusions are recorded and referenced in this chapter.

In relation to European sites, an Appropriate Assessment Screening Report and Natura Impact Statement (NIS) have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the Proposed development in compliance with Article 6(3) of the Habitats Directive.

As per the aforementioned EPA draft Guidance (2017), *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement"* but should *"incorporate their key findings as available and appropriate"*. This section provides a summary of the key assessment findings with regard to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

The Screening for Appropriate Assessment concluded as follows:

> *"It cannot be concluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would not be likely to have a significant effect on the following sites:*
>
> - River Shannon Callows SAC
> - Lough Derg, North-east Shore SAC
> - Middle Shannon Callows SPA
> - River Little Brosna Callows SPA
> - Lough Derg (Shannon) SPA

As a result, an Appropriate Assessment is required, and a Natura Impact Statement shall be prepared in respect of the proposed development'.

The findings presented in the NIS are that, *it can be objectively concluded that the proposed development, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site.*

6.6.3 Likely Significant Effects During Construction Phase

6.6.3.1 Effects on Habitats During Construction

Table 6.14 below provides details of the extent of the recorded habitats on the site, the extent of the habitat that will be lost to facilitate the proposed development and the percentage of the total area of that habitat on the site that it represents.

Table 6.14 Extent of habitat lost to the proposed development and the percentage of the total area of that habitat on site

Habitat	Total area on the site	Area to be lost	Percentage of total to be lost
Cutover bog (PB4)	822.9	14.89	1.81
Cutover bog (PB4), Poor fen and flush (PF2) mosaic	145.63	3.79	2.60
Buildings and artificial surfaces (BL3)	67.62	3.09	4.57
Scrub (WS1), Poor fen and flush (PF2) mosaic	16.4	2.94	17.93
Scrub (WS1)	182.6	2.55	1.40
Poor fen and flush (PF2)	97.9	2.27	2.32
Scrub (WS1), Dry calcareous and neutral grassland (GS2), Poor fen and flush (PF2) mosaic	8.22	0.75	9.12
Dry Heath (HH), Scrub (WS1) mosaic	40.21	0.5	1.24
Dry Heath (HH), Poor fen and flush (PF2), Scrub (WS1) mosaic	9.44	0.4	4.24
Cutover bog (PB4), Dry Heath (HH) mosaic	28.72	0.26	0.91
Wet grassland (GS4)	16.12	0.26	1.61
Conifer plantation (WD4)	171.45	0.2	0.12
Refuse and other waste (ED5)	4.72	0.2	4.24
Cutover bog (PB4), Dry Heath (HH), Wet grassland (GS4) mosaic	0.8	0.08	10.00
Dry calcareous and neutral grassland (GS1)	2.26	0.07	3.10

Scrub (WS1), Wet grassland (GS4) mosaic	16.4	0.07	0.43
Bog woodland (WN7)	19.68	0.03	0.15
Dry Heath (HH)	10.23	0.03	0.29
Total	1,661.3	32.38	1.95%

The proposed development will result in the loss of areas of habitat that are of Local Importance (Lower Value) and are not identified as KERs. This mainly involves the loss of bare peat that was in active production until recently and is of very low ecological value. Any direct or indirect impacts on these habitats are not significant.

The effects on habitats that are identified as KERs are described in the below tables.

6.6.3.1.1 Assessment of Potential Effects on Rivers and Streams, Open Waterbodies and Sensitive Aquatic Faunal Species

Table 6.15 Potential for impact on rivers, streams, Open Waterbodies and Sensitive Aquatic Species

Description of Effect	The footprint of the Proposed development has been specifically designed to avoid the large waterbodies and watercourses within the study area. The proposed internal road network only crosses one large watercourse and will utilise an existing bridge with no instream works proposed. Similarly, the proposed amenity trail to the east of the site will cross the Island River, using an existing railway track and associated crossing. There will be no direct effects on these habitats or the species that are associated with them. There is no potential for the proposed development to result in any barrier to the movement of aquatic species. There is potential for the construction activity to result in the run off of silt, nutrients and other pollutants such as hydrocarbons and cementitious material into these watercourses. This could result from the removal of scrub and woodland, culverting of drainage ditches, large-scale movement of peat or the use of concrete and other construction materials. The proposed development will cross numerous small drainage ditches, which are not themselves ecologically sensitive but do provide connectivity to the larger watercourses that surround the site. This represents a potential indirect effect on the identified aquatic receptors in the form of habitat degradation through water pollution. These effects on water quality are fully described in Chapter 9 of this EIAR and are described here in relation specifically to ecology. Note: Whilst this impact assessment is in the habitats section, it also assesses the impact on the proposed development on aquatic species including salmonids, lamprey, coarse fish, white-clawed crayfish, European eel, aquatic invertebrates and other aquatic species. The proposed development will have no direct impact on the aquatic habitat of these species and there is no potential for disturbance. The only pathway for effect to occur is as a result of water pollution and this is discussed in this section in relation to habitats and species.
Characterisation of unmitigated effect	In the absence of mitigation, the indirect effect of water pollution on aquatic receptors during construction has the potential be a short-term reversible impact on watercourses which act as a conduit to downstream habitats. The magnitude of any such impact is likely to be at worst moderate, given that the all major infrastructure such as turbine bases and substation etc. are located over 50 metres from any significant watercourse.
Assessment of Significance prior to mitigation	In the absence of mitigation and following the precautionary principle, there is potential for the proposed development to result in significant indirect effects on the identified aquatic habitats and species at a local geographic scale in the form of pollution during the construction phase of the proposed development.

Mitigation	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development. In addition to this, specific mitigation is provided in relation to water quality in Chapter 9: Hydrology and Hydrogeology of this EIAR. In addition, the Construction Environmental Management Plan (CEMP) that is provided as Appendix 4.3 provides the details of exactly how the measures will be implemented during construction.
Residual Effect following Mitigation	Following the implementation of mitigation, there will be no significant residual effect on aquatic habitats or species as a result of the proposed development.
Potential for Cumulative Effect	The proposed development will not result in any significant effect on aquatic habitats or species of biodiversity value. It therefore cannot contribute to any cumulative effect in this regard.

6.6.3.1.2 Assessment of Potential Effects on Revegetated Cutover Bog Habitats and Woodlands

Table 6.16 Loss of Revegetated Cutover Bog Habitats

Description of Effect	The construction of the proposed windfarm and associated infrastructure will result in the direct loss of approximately 32.38 hectares (1.95% of the total study area) of revegetated cutover bog which is developing as pioneer poor fen, heath type habitats, bog woodlands and scrub. The areas of uncut raised bog and natural oak ash hazel woodland habitats have been entirely avoided in the design of the project with no potential for any effect thereon. There is the potential to result in indirect effects on the habitat immediately adjoining the footprint through drainage.
Characterisation of unmitigated effect	This is a permanent and irreversible impact on habitats of Local Importance (Higher Value). The magnitude of this impact is Slight as it only affects a tiny percentage of the overall habitat type, which is widespread throughout the site.
Assessment of Significance prior to mitigation	The loss or degradation of these Cutover Bog habitats is not a significant effect as it covers a very small percentage of the overall habitat mosaic on the site and has deliberately avoided the most natural and sensitive habitats on the site such as natural woodland and uncut raised bog.
Mitigation	The Proposed development has been deliberately designed to avoid loss of uncut raised bog and natural woodlands. In addition, the proposed development provides for the replacement of the bog woodland and scrub habitat that will be lost in other parts of the site to ensure that there will be no net loss of woodland/Scrub. It also provides for the ecological enhancement of areas of cutover bog through rewetting to promote the development of wetland vegetation. These measures are fully described in the Biodiversity Management Plan that is provided as Appendix 6.7 to this EIAR. The habitat replacement and enhancement areas are also mapped in this management plan.
Residual Effect following Mitigation	Following the implementation of mitigation and the arising effect of the mitigation measures, there will be no significant residual effect on these cutover bog habitats. There may be a short-term slight negative effect in the early stages of implementation of the Biodiversity Management Plan in the form of habitat loss but as the woodland and wetland habitats develop as a result of the proposed enhancement measures, there is potential for the proposed development to result in an overall long-term positive effect on the habitats within the study area.

Potential for Cumulative Effect	The proposed development will not result in any significant negative effect on the cutover bog habitats on the site. It therefore cannot contribute to any cumulative effect in this regard.

6.6.3.2 Effects on Protected Fauna During Construction

The proposed development has the potential to result in habitat loss and disturbance impacts on faunal species that were recorded on the site but were not included as KERs. Given the extensive area of habitat that will remain undisturbed throughout the site and the avoidance of the most significant areas of faunal habitat (wetlands, natural woodlands and watercourses), no significant effects on non-KER faunal biodiversity is anticipated as a result of the proposed development.

It should be noted that no significant habitat for salmonids, lamprey, coarse fish, white-clawed crayfish, European eel, aquatic invertebrates or other aquatic species was recorded within the footprint of the proposed development and all major infrastructure is located over 50 metres from the watercourses and wetlands within the site. The potential for significant effects on the above aquatic species is restricted to indirect effects on their habitat resulting from water pollution. This has been assessed in Section 6.6.3.1.1 above and is not repeated below.

6.6.3.2.1 *Assessment of Potential Effects on Otter*

Table 6.17 Assessment of Potential Impacts on Otter

Description of Effect	As described above in relation to aquatic habitats and species, the proposed development has been deliberately designed such that all major infrastructure avoids significant watercourses and wetland habitats with no instream works in these habitats proposed. There is no potential for direct effect on habitat that is significant for otter. Minor infrastructure such as roads are proposed in close proximity to some of the watercourses and wetlands on the site and this has the potential for indirect effects in the form of disturbance to otter. The proposed development also has the potential to result in indirect effects on otter habitat in the form of water pollution resulting from construction activity as described above
Characterisation of unmitigated effect	There is no potential for direct loss or fragmentation of significant otter habitat Given that the site is at present in active peat production and all major infrastructure is located over 50 metres from any significant watercourse or wetland, any potential disturbance to otter will be a short-term, slight negative effect. In the absence of mitigation, the indirect effect of water pollution on otter during construction has the potential be a short-term reversible impact. The magnitude of any such impact is likely to be at worst moderate, given that the all major infrastructure such as turbine bases, substation and construction compounds are located over 50metres from any significant watercourse.
Assessment of Significance prior to mitigation	There is no potential for the construction phase of the proposed development to result in significant disturbance, displacement or habitat fragmentation for otter. In the absence of mitigation and following the precautionary principle, there is potential for the proposed development to result in significant indirect effects on otter at a local geographic scale in the form of habitat deterioration resulting from pollution.
Mitigation	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7 of this EIAR. This plan provides details of how water quality will be

	protected during the construction of the proposed development. In addition to this, specific mitigation is provided in relation to water quality in Chapter 9: Hydrology and Hydrogeology of this EIAR. In addition, the Construction Environmental Management Plan (CEMP) that is provided as Appendix 4.3 provides the details of exactly how the measures will be implemented during construction.
Residual Effect following Mitigation	Following the implementation of mitigation, there will be no significant residual effect on otter as a result of the proposed development.
Potential for Cumulative Effect	The proposed development will not result in any significant effect on otter. It therefore cannot contribute to any cumulative effect in this regard.

6.6.3.2.2 Assessment of Potential Effects on Marsh fritillary

Table 6.18 Assessment of Potential Impacts on Marsh fritillary

Description of Effect	**Habitat Loss/ Fragmentation** Suitable habitat for the species within the site is restricted to a number of small areas within the study area boundary. These areas are shown in Figure 6.7 above. The proposed development has been deliberately designed to entirely avoid all recorded marsh fritillary colonies and all identified suitable habitat for the species within the study area boundary. There are however some works proposed close to identified marsh fritillary habitat. This creates the potential for some habitat loss if the works area is not suitably curtailed to ensure that there was no encroachment onto the areas of suitable habitat. There is also the potential for disturbance to the species if construction activity encroaches into their habitat.
Characterisation of unmitigated effect	In the absence of mitigation/best practice, potential for Long-term Slight Negative Effect through the loss of potentially suitable supporting habitat for this receptor of County importance was identified where it occurs in close proximity to the proposed development. There could also be Short-Term Slight Negative Effects in the form of disturbance. The effects would be slight at worst as the entire development has been designed to avoid these areas and any encroachment would cover a very small percentage of the habitat within the study area.
Assessment of Significance prior to mitigation	Given the design of the scheme, there is no potential for the construction of the proposed development to result in significant effects on marsh fritillary as the permanent footprint of the development avoids all suitable habitat. However, mitigation will be employed to ensure that there is no temporary habitat loss and disturbance there are no negative effects on this species at all.
Mitigation	Whilst it is highly unlikely that the onsite population of marsh fritillary will be impacted during construction, due to the avoidance of all recorded colonies on site, measures that have been put in place to protect the species and its supporting habitat locally and thereby avoiding any remote potential for effects on the population. Best practice measures for the protection and enhancement of the supporting habitat within the proposed development site are fully described in a Lepidoptera Management Plan (provided in Appendix 6.6). The measures have been prepared in consultation with Butterfly Conservation Ireland (BCI). These measures, in summary, include: › **Avoidance Measures:** The entire proposed development, including all proposed tree-planting, has been designed to avoid marsh fritillary and supporting habitat on site, see Figure 6.7. › **Pre-construction Measures:** Areas of suitable marsh fritillary habitat will be fenced off or clearly marked prior to the commencement of any site works

	under the guidance and supervision of a suitably qualified Ecological Clerk of Works (ECoW). - Pre-commencement surveys will be undertaken for marsh fritillary to determine long term trends of the population within the site. - Vegetation structure and suitability will be monitored following the NBDC survey methodology (NBDC, 2019). - Proposed tree-planting that is proposed as part of the Biodiversity Management Plan will avoid areas of suitable marsh fritillary habitat. - Pollinator enhancement measures through habitat creation. - Habitat condition monitoring will be undertaken to ensure that there are no negative effects on marsh fritillary habitat.
Residual Effect following Mitigation	Following the incorporation of the above avoidance and mitigation measures, there is the potential for the proposed development to increase the extent of available habitat on the site for marsh fritillary and also to increase the quality of the habitat on the site.
Potential for Cumulative Effect	As there will be no negative residual effect on the species at any geographic scale as a result the proposed development, it can be concluded that there is no potential for it to contribute in any cumulative negative effect in this regard. There is potential for the proposed development to result in a positive residual effect on marsh fritillary.

6.6.3.2.3 Assessment of Potential Effects on Badger

Table 6.19 Assessment of Potential Impacts on Badger

Description of Effect	Whilst badger setts and foraging activity were recorded within the study area, the proposed development has been specifically designed to avoid all identified setts. There is some potential for small scale loss of foraging habitat to facilitate the construction footprint. In addition, the proposed internal underground cable route and site access track will pass close to an identified badger sett located within the north-eastern section of the study area (see Figure 6.6b, confidential Appendix 6.6). In the absence of mitigation/best practice, this has the potential to result in disturbance/displacement, and potentially mortality, during the construction phase of the proposed development. In addition, construction works in close proximity to the sett could prevent badgers from occupying the sett.
Characterisation of unmitigated effect	Given the small scale of the development footprint in comparison to the size of the study area, the loss of foraging habitat to the footprint of the proposed development constitutes a Permanent Slight Negative Effect. This would not be reversible as it is within the construction footprint. The proposed development will not result in any fragmentation of badger habitat, as there will be no barriers to movement throughout the site as a result of the proposed works Although the works that are proposed close to the badger sett involve only the construction of an access track and underground cabling, following the precautionary approach, there is potential for short term moderate negative effects on the local badger population in terms of disturbance, displacement and potentially mortality.
Assessment of Significance prior to mitigation	There is no potential for significant loss of badger habitat as a result of the proposed development. In the absence of mitigation, there is potential for significant disturbance/displacement and/or mortality on the local badger population as a result of the proposed development. There is no potential for significant effects the county, national or international scale.

Mitigation	The following measures will be undertaken for the avoidance of disturbance/displacement and direct mortality will be implemented during the construction phase of the proposed development: - On a precautionary basis, prior to the commencement of any site works, a badger sett disturbance licence will be sought from the National Parks and Wildlife Service. - An exclusion zone around the sett will be maintained for the duration of the construction works. No works will be undertaken within 30m of the sett. - Following best practice, the proposed works within 50 metres of the sett will be undertaken outside of the badger breeding season (December to June) (NRA, 2005). - All of the above works will be undertaken or supervised by an appropriately qualified ecologist. In addition to the above, the proposed access track construction in close proximity to the sett will be constructed as a 'floating road' construction, see Section 4.9.2 of the Chapter 4: Description of the Proposed Development. This will avoid the requirements for the excavation of materials and therefore reduce both the construction time and intensity of the proposed construction works in this area. To protect individual badgers during the construction phase of the proposed development, all open excavations on site will be covered when not in use and backfilled as soon as possible. Excavations will also be covered at night and any deep excavations left open will have appropriate egress ramps in place to allow mammals to safely exit excavations should they fall in.
Residual Effect following Mitigation	Following the implementation of the mitigation as described above, there is no potential for any significant negative effect on badger at geographic scale.
Potential for Cumulative Effect	There will be no significant residual effect at any geographic scale, it can therefore be concluded that there is no potential for the proposed development to contribute in a cumulative effect in this regard.

6.6.3.2.4 Assessment of Potential Effects on Bats

Table 6.20 Assessment of Potential Impacts on Bats

Description of Effect	Whilst the study area was utilised by foraging and commuting bats, the proposed development will not result in any significant reduction or loss of the available habitat on the site given the size of the site and nature and small scale of the habitats that will be lost. No bat roosts were identified in close proximity to the construction footprint of the proposed development and there is no potential for significant bat roosts to be disturbed by increased human presence and increased noise during construction. The potential for bats to be killed during removal of trees or structures was considered in this assessment. However, no buildings or other structures with the potential to support bat roosts will be demolished to facilitate the proposed development. In addition, the trees occurring within the development footprint were assessed as not providing suitable cavities to support any significant bat roosts. The woodland and scrub habitat occurring within the infrastructure footprint comprises largely of immature downy birch and willows. All structures within the study area were assessed for roosting potential. No roosts or potential roost features were recorded in close proximity to the proposed infrastructure.

Characterisation of unmitigated effect	The construction of the proposed development has the potential to result in Short-Term Imperceptible Negative effects on the local bat populations in the form of habitat loss, disturbance or direct mortality.
Assessment of Significance prior to mitigation	There is no potential for the construction of the proposed development to result in Significant effects on the local bat population at any geographic scale as no roosts were recorded close to the infrastructure, habitat loss and disturbance are only likely to result in imperceptible effects on the local population. The bat survey report, which is included in Appendix 6.2 provides further detail and analysis with regard to the effects on bat species.
Mitigation	Whilst no significant effects on bat species have been identified, the following potential positive effects are noted. The felling of linear sections of birch dominated woodland within the site to facilitate site access roads will result in the creation of more woodland edge habitat and as such benefit feeding and commuting bat species locally. Any loss of woodland habitat will be mitigated through replacement planting. As such, there will be no net loss of woodland and an increase in woodland edge habitat. In addition, the following construction best practice will be employed to minimise general noise and disturbance potential. Plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).
Residual Effect following Mitigation	There is no potential for the construction of the proposed development to result in Significant effects on the local bat population at any geographic scale.
Potential for Cumulative Effect	There is no significant effect on bats associated with the proposed development. It therefore cannot contribute to any cumulative effect in this regard.

6.6.4 Likely Significant Effects During Operational Phase

6.6.4.1 Effects on Habitats during Operation

The operation of the proposed development will not result in any additional land take or loss of revegetated peatland habitats and as such there is no potential for any significant effects in this regard. These habitats are not considered to be a KER in the context of the operation of the proposed development. However, the proposed development has the potential to result in enhancement of the surrounding areas through habitat rehabilitation management that will be undertaken throughout the operational phase of the proposed development. Details of the management that will be undertaken are provided in the Biodiversity Management Plan in Appendix 6.7. Measures included within the plan are additional to those that are included within the draft Rehabilitation Plan that would be implemented following cessation of peat production and are linked specifically to the wind farm development. The Draft Rehabilitation Plans for both Clongawny and Drinagh bogs are provided in Appendix 6.8 of this EIAR

Potential for effects on rivers, streams, open waterbodies and sensitive aquatic species remains a KER during operation and is assessed in detail in the following subsections.

6.6.4.1.1 Effects on Rivers and Streams, open waterbodies and sensitive aquatic faunal species.

Table 6.21 Assessment of Potential Impacts on Rivers, Streams, Open Waterbodies and Sensitive Aquatic Faunal Species

Description of Effect	The increased amount of hard standing associated with the windfarm infrastructure has the potential to result in faster run off of water from the site to the surrounding watercourses. This may have the indirect effect of causing erosion, which could lead to deterioration of surface water and supporting habitat quality. Additionally, there is the potential for the faster run off of any pollutants that may be associated with vehicular usage on the site. These impacts on water quality are fully described in Chapter 9: Hydrology and Hydrogeology of this EIAR and are described here in relation specifically to biodiversity. Note: Whilst this impact assessment is in the habitats section, it also assesses the impact on the proposed development on aquatic species including salmonids, lamprey, coarse fish, white-clawed crayfish, European eel, aquatic invertebrates and other aquatic species. The proposed development will have no direct impact on the aquatic habitat of these species and there is no potential for disturbance. The only pathway for effect to occur is as a result of water pollution and this is discussed in this section in relation to habitats and species.
Characterisation of unmitigated effect	Impact on water quality during the operational phase of the proposed development has been assessed as a permanent negative effect in the absence of mitigation. The magnitude of this impact is slight because the all major infrastructure will be located over 50 metres from any significant watercourse and the footprint of the proposed development will be minimal when compared to the overall size of the site.
Assessment of Significance prior to mitigation	Significant effects on water quality are not anticipated at any geographic scale during the operation of the proposed development.
Mitigation	Whilst no significant effects on water quality are anticipated, potential for effects on water quality associated with the operational phase drainage of the site has been fully mitigated through appropriate design and mitigation as fully described in Section 9.4.4 of Chapter 9: Hydrology and Hydrogeology and Section 6 of the CEMP.
Residual Effect following Mitigation	Following the implementation of the mitigation measures outlined above, no potential for significant effect has been identified at any geographic scale as a result of the proposed development.
Potential for Cumulative Effect	There will be no significant residual effect at any geographic scale, it can therefore be concluded that there is no potential for the proposed development to contribute in a cumulative effect in this regard

6.6.4.2 Effects on Fauna during Operation

The operation of the proposed development will not result in any additional habitat loss or deterioration and will involve a decrease in anthropogenic activity when compared to the currently ceased, peat production usage of the site.

The implementation of the Biodiversity Management Plan will ensure that any woodland and scrub that is lost to facilitate the proposed infrastructure will be replaced within the site. It will also result in the revegetation of areas of bare peat through localised rewetting, as fully described in Appendix 6.7, and will result in the establishment of habitats of higher value for local faunal species. As such the operation of the proposed development has the potential to result in significant positive effects on the non-volant terrestrial fauna at the site of the proposed development. There is no potential for significant negative effects on non-volant terrestrial fauna including badger and otter that were identified as KERs during the construction phase of the development.

Similarly, it is not anticipated that the operation of the proposed development will have any effect on marsh fritillary or habitat for the species during the operation of the proposed development. No elements of the infrastructure are located on suitable marsh fritillary habitat and no maintenance works associated with the operation of the project are proposed in any such habitat.

A Lepidoptera Management Plan (LMP) has been prepared as part of the proposed development and has been agreed in principle with Butterfly Conservation Ireland during pre-planning consultation. The management plan is provided in Appendix 6.6 and describes the measures required during the construction phase that will create a suitable substrate for the natural colonisation of devil's-bit scabious along site access tracks on site during the operational phase of the proposed development. This will ultimately allow for an increase in suitable available habitat for the species locally and thus a long-term net gain for the species. This will result in a positive impact for the species and no potential for significant negative effect has been identified at any geographic scale. This species is not identified as a KER during the operation of the proposed development.

It should be noted that no significant habitat for salmonids, lamprey, coarse fish, white-clawed crayfish, European eel, aquatic invertebrates or other aquatic species was recorded within the footprint of the proposed development and all major infrastructure such as turbine bases are located over 50 metres from the watercourses and wetlands within the site. The potential for significant effects on the above aquatic species is restricted to indirect effects on their habitat resulting from water pollution. This has been assessed in Section 6.6.4.1.1 and is not repeated below.

Potential for significant effects on bat species resulting from the operation of the proposed development were identified and therefore, these taxa were identified as KERs during the operational phase.

6.6.4.2.1 Assessment of Potential Effects on Bats during operation

Table 6.22 Assessment of Potential Impacts on Bats

Description of Effect	There is no potential for loss or fragmentation of foraging or roosting habitat for bat species during the operational phase of the proposed windfarm as there will be no additional loss of any habitats following construction. The bat survey report that is provided in Appendix 6.2 following a precautionary approach, has identified that, based on activity levels on the site, there is moderate to high median level of bat activity throughout the site with high peak levels of activity for Common and soprano pipistrelle, Leisler's bat. These are species that are at a high risk of collision with operating wind turbines due to the ecology of the species. Moderate to high levels of activity of bats of *Myotis* species was also recorded but these species are at a lower risk of collision with operating wind turbines. Low to Moderate levels of activity of brown long eared bat were recorded – this species is at low risk of collision.
Characterisation of unmitigated effect	The operation of the proposed wind farm has the potential to result in a long-term effect on Pipistrelle and Leisler's bat species as a result of mortality due to collision. The magnitude of this effect in the absence of mitigation is moderate on the basis that no significant roosts were identified in the immediate vicinity of the turbines and the median level of activity is considered moderate (on a precautionary basis). It is noted in the SNH (2019) guidelines that bat activity on windfarm sites is highly liable to change following construction of a wind farm due to the changes in habitat that occur to facilitate construction. Therefore, continued monitoring of operational wind farms for three years' post construction is recommended in the guidelines and will be undertaken at this site, to determine the actual, post construction effects on the local bat populations.

Assessment of Significance prior to mitigation	Following the precautionary principle, there is potential for the operation of the proposed development to result in Significant effects on the local bat population.
Mitigation	In order to reduce the value of the habitat for bat species in the areas surrounding the turbines, a buffer of at least 50m between the tip of the blade and any trees or other tall vegetation that could provide high quality foraging habitat for bat species will be implemented. Details of this mitigation and how it is calculated is provided in Appendix 6.2. In addition to this, ongoing monitoring of bat activity will be undertaken for at least three years' post construction of the wind farm. This will provide data and information on the actual recorded impact of the wind turbines on the local bat populations. Full details of the proposed monitoring programme are provided in Appendix 6.2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions. If, following monitoring, there are significant effects recorded, a range of measures are proposed to ensure that any such effects are fully mitigated. These measures include blade feathering, curtailment of turbines during certain conditions and increase of buffers surrounding the turbines. Any or all of the above measures may be employed following actual monitoring of the impact of the operating turbines on bats.
Residual Effect following Mitigation	Following the implementation of the monitoring and mitigation described above, there is no potential for significant residual effects on bat species.
Potential for Cumulative Effect	There is no significant residual effect on bats associated with the proposed development. It therefore cannot contribute to any cumulative effect in this regard.

6.6.5 Likely Significant Effects During Decommissioning phase

There will be no additional habitat loss associated with the decommissioning of the proposed development and therefore there will be no significant effects in this regard. In addition, the removal of the infrastructure will involve similar operations to those involved in construction but without the large-scale earth moving or excavations as the turbine bases and roads etc. will be left in place. These works would therefore be of a smaller scale but would have similar impacts on ecology to those experienced during construction. There would be no additional or ancillary impacts associated with the decommissioning phase.

The same mitigation to prevent significant impacts on water quality and associated aquatic fauna, marsh fritillary, and other terrestrial fauna during construction will be applicable to the decommissioning phase. Any measures to minimise or avoid disturbance will also be applicable. The CEMP for the project provides the details of the mitigation and best practice that will be employed to avoid any potential for significant residual effects on biodiversity during decommissioning of the proposed wind farm.

6.7 Cumulative impact

The proposed development was considered in combination with other plans and projects in the area that could result in cumulative impacts on European Sites, Nationally designated sites and protected species. This included a review of online Planning Registers and served to identify past and future plans and projects, their activities and their predicted environmental effects. The projects considered are listed in Chapter 2: Background of the Proposed Development.

6.7.1 Assessment of Plans

The following development plan been reviewed and taken into consideration as part of this assessment:

- Offaly County Development Plan 2014-2020

The review focused on policies and objectives that relate to designated sites for nature conservation, biodiversity and protected species. Policies and objectives relating to the conservation of peatlands and sustainable land use were also reviewed, particularly where the policies relate to the preservation of surface water quality. An overview of the search results with regard to plans is provided in Table 6.23.

Table 6.23 Assessment of Plans

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
Offaly County Development Plan 2014-2020	**Core Strategy Policy** <u>CSP-07</u> It is Council policy to ensure full compliance with the requirements of the EU Habitats Directive (92/43/EEC), SEA Directive (2001/42/EC) and EIA Directive 2011/92/EU and associated legislation/regulations, including the associated European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011), European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004-2011, Planning and Development (Strategic Environmental Assessment) Regulations 2004-2011 and the European Communities (Environmental Impact Assessment) Regulations 1989-2011 (or any updated/superseding legislation). Planning applications for proposed developments within the plan area that may give rise to likely significant effects on the environment may need to be accompanied by one or more of the following: an Environmental Impact Statement, an Ecological Impact Assessment Report, a Habitats Directive Appropriate Assessment Report or a Natura Impact Statement, as appropriate. <u>CSP-08</u> Natural Heritage, Landscape and Environment It is the policy of Offaly County Council, to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of European sites, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including European sites, will be implemented in accordance with relevant EU environmental directives and applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents): - EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC codified version of Directive), the Environmental Impact Assessment Directive (85/337/EEC), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the biodiversity, protected species and designated sites. There is no potential for negative cumulative impacts when considered in conjunction with the current proposal were identified. In addition, the incorporation of the public amenity trail through the proposed development will also incorporate the requirements of Policy <u>NHP-05</u> which facilitates education and increased awareness of biodiversity. This has the potential to result in a positive effect.

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	- National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development (Amendment) Act 2010 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). - Catchment and water resource management plans, including the Shannon and Eastern River Basin District Management Plan 2009-2015. - Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016 and Ireland's National Biodiversity Plan. **Energy Policies** EP–03 It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out. **Natural Heritage Policies** NHP-05 It is Council policy to continue to promote education, knowledge and pride in the natural heritage and biodiversity of the county.	

	NHP-08 It is Council policy to protect, conserve and enhance the county's biodiversity and natural heritage including wildlife (flora and fauna), habitats, landscapes and/or landscape features of importance to wildlife or which play a key role in the conservation and management of natural resources such as water. NHP-11 It is Council policy to conserve, protect and enhance where possible wildlife habitats such as rivers, streams, canals, lakes, and associated wetlands including reed-beds and swamps, ponds, springs, bogs, fens, trees, woodlands and scrub, hedgerows and other boundary types such as stone walls and ditches which occur outside of designated areas providing a network of habitats and corridors essential for wildlife to flourish. NHP-12 It is Council policy to ensure that peatland areas, which are designated for protection under international and national legislation, are conserved and managed appropriately to conserve their ecological, archaeological, cultural and educational significance. **Natural Heritage Objectives** NHO-01 It is an objective of the Council to ensure that any development proposal in the vicinity of, or affecting a designated site, complies with the provisions relating Appropriate Assessment and SEA requirements and the Council will consult with the appropriate statutory environmental authority in this regard. NHO-02 It is an objective of the Council to conserve and protect the natural heritage of the county and to conserve and protect European and National designated sites within the county including Special Protection Areas (SPAs),	

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSACs), Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Ramsar Sites, Statutory Nature Reserves, Biogenetic Reserves and Wildfowl Sanctuaries. NHO-03 It is an objective of the Council to protect, conserve and enhance the county's biodiversity and natural heritage and the principle of enhancement will be taken into account in the Development Management process. It is a particular objective to protect plants, animal species and habitats which have been identified by the Habitats Directive, Birds Directive, Wildlife Act and the Flora Protection Order.	

6.7.2 Assessment of Projects

As described in Section 2.2 of the EIAR, relevant projects have been assessed in-combination with the proposed wind farm development and include planning applications in the vicinity of the site and other wind energy applications within the wider area. These have not been repeated here to reduce the duplication of information within this EIAR. However, they have been fully considered in this assessment in terms of their potential for impact on biodiversity.

6.7.3 Assessment of Cumulative Effects

The residual construction, operational and decommissioning impacts of the proposed development are considered cumulatively with other plans and projects as described above. Particular focus has been placed on those plans and projects that are in closest proximity to the proposed development and those that could be potentially affected via downstream surface water.

The proposed development will result in a loss of approximately 32.38 ha of cutover peatland and colonising woodland/scrub, equivalent to 1.95% of these habitats recorded within the study area. This is a very small percentage of the overall quantum of habitats within the site of the proposed development, equating to 3.4%. This does not represent a significant loss of peatland or woodland. In addition, the proposed development includes mitigation in the form of habitat management and rehabilitation that will protect and enhance a far greater area that that which will be lost. This is fully described in Appended 6.7. As such, there is no potential for the proposed development to contribute to any significant cumulative habitat loss when considered in combination with any other plans and projects.

The potential for the proposed development to contribute to a cumulative effect on water quality in the Shannon catchment was considered in this chapter and also in Chapter 9 of this EIAR. Following detailed surveys, the watercourses on the site were assessed to be of low ecological significance, with the watercourses becoming increasingly more ecologically sensitive further downstream. The proposed development includes a range of measures that are in place to prevent any water pollution or hydrological effects outside the development footprint. The implementation of these measures ensures that there is no potential for significant cumulative effects on any downstream receptors, whether the proposed development is considered on its own or in combination with other plans or projects.

No significant effects as a result of the proposed development in relation to disturbance, displacement or mortality of faunal species has been identified. Therefore, there is no potential for the proposed development to contribute to any cumulative effect in this regard.

The proposed development will not result in any significant residual effects on biodiversity and will not contribute to any cumulative effect when considered in combination with other plans and projects.

In the review of the projects that was undertaken, no connection that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the proposed development.

7. ORNITHOLOGY

7.1 Introduction

This chapter assesses the likely significant effects that the proposed Derrinlough Wind Farm may have on avian receptors. Particular attention has been paid to species of ornithological importance. These include species with national and international protection under the Wildlife Acts 1979-2012 and the EU Birds Directive 2009/147/EC among other relevant legislation. Where potential effects are identified, mitigation is described and residual impacts on avian receptors are assessed.

This chapter is supported by Technical Appendices 7.1 to 7.9. Appendix 7.1 gives a detailed list of all species recorded on site as well as outlining target and non-target species. Appendix 7.2 contains details on survey effort, survey times and weather conditions while Appendix 7.3 contains summary tables outlining the abundance and monthly distribution of species recorded during various survey methods. Appendix 7.4 contains the raw survey data from the core two-year survey period (October 2017 – September 2019), as well as Figures displaying the locations of each observation for the Target species. Appendix 7.5 contains confidential records on an ecologically sensitive species (red-necked phalarope). Appendix 7.6 contains the Collision Risk Assessment document which illustrates how the Collision Risk Modelling was undertaken for this site. Appendix 7.7 contains seasonal survey reports from Biosphere Environmental Services (BES) at the development site, between the period of October 2014 and March 2018, prior to MKO surveys which commenced in April 2018. Appendix 7.8 contains the proposed Habitat Enhancement Plan. Appendix 7.9 contains the proposed Post-Construction Bird Monitoring Programme. The proposed development area, core EIAR site boundary and areas surveyed are provided in Figures 7.1 - 7.9.

The chapter is structured as follows:

- The Introduction provides a description of the Proposed Development and the relevant legislation, guidance and policy context regarding ornithology.
- This is followed by a comprehensive description of the ornithological surveys and impact assessment methodologies that were followed to inform the robust assessment of likely significant effects on avian receptors.
- A description of the Baseline Ornithological Conditions and Receptor Evaluation is then provided. This is followed by an Assessment of Effects, which as per Scottish National Heritage Guidance (2017), includes direct habitat loss, displacement and mortality from collision. Potential significant effects are described with regard to each phase of the Proposed Development: construction, operational and decommissioning. Potential cumulative effects in combination with other projects are fully assessed.
- Proposed mitigation and best practice measures to avoid, reduce or offset the identified potentially significant effects are described and discussed. This is followed by an assessment of residual effects taking into consideration the effect of the proposed mitigation and best practice measures.
- The conclusion provides a summary statement on the overall significance of predicted effects on ornithology.

The following list defines the meaning of the technical terms used in this chapter:

- "Key Ornithological Receptor" (KOR) is defined as a species occurring within the zone of influence of the development upon which likely significant effects are anticipated and assessed.
- "Zones of Influence" (ZOI) for individual ornithological receptors refers to the zone within which potential effects are anticipated ZOIs were assigned following best available guidance (SNH 2016 and McGuinness et.al 2015).

7.1.1 Description of the Proposed Development

The proposed development comprises 21 no. turbines with an overall blade tip height of up to 185 metres above the top of foundation, a substation and all ancillary infrastructure. A detailed description of the Proposed Development is included in Chapter 4 of this EIAR.

The Proposed Development will have an operational life of 30 years from the date of commissioning of the wind farm.

7.1.2 Legislation, Guidance and Policy Context

This EIAR is prepared in accordance with the requirements of the 2011 EIA Directive (Directive 2011/37/EU) as amended by EIA Directive 2014/52/EU, the Planning and Development Acts 2000-2019, the Planning and Development Regulations 2001-2019 and the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

The following are the key legislative provisions applicable to habitats and fauna in Ireland:

- Irish Wildlife Acts 1976 to 2018.
- The European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) (transposes EU Birds Directive 2009/147/EC and EU Habitats Directive 92/43/EEC).
- The European Communities (Birds and Natural Habitats) (Sea-fisheries) Regulations 2013 (S.I. No. 290 of 2013).
- The European Communities (Birds and Natural Habitats) (Amendment) Regulations 2013 (S.I. No. 499 of 2013).
- The European Communities (Birds and Natural Habitats) (Amendment) Regulations 2015 (S.I. No. 355 of 2015).
- The International Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971.

In the absence of specific National Irish Ornithological Survey Guidance, the following guidance documents published by Scottish Natural Heritage (SNH) have been followed to inform this assessment:

- SNH (2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Scottish Natural Heritage.
- SNH (2018) *Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model.* Scottish Natural Heritage, Edinburgh, UK.
- SNH (2016). *Assessing Connectivity with Special Protection Areas (SPAs).* Scottish Natural Heritage.
- SNH (2012). *Assessing the Cumulative Impact of Onshore Wind Energy Developments.* Scottish Natural Heritage.
- SNH (2006). *Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Sites.* Scottish Natural Heritage.
- SNH (2009). *Monitoring the impact of onshore wind farms on birds.* Scottish Natural Heritage.
- SNH (2000). *Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action.* SNH Guidance Note.
- (CIEEM, 2018). Guidelines for Ecological Impact Assessment (EcIA).

The following Irish Guidance documents were also consulted:

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

- McGuinness, D., 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.* Guidance Document. Birdwatch Ireland.
- Birds of Conservation Concern in Ireland 2014-2019 (Colhoun, K. and Cummins, S. 2013).

This assessment has been prepared with respect to the various planning policies and strategy guidance documents listed below:

- Planning and Development Acts 2000 – 2018.
- Offaly Country Council (2014). Offaly County Development Plan 2014-2020.
- EPA (2017). *Draft revised guidelines on the information to be contained in Environmental Impact Assessment Reports.* Environmental Protection Agency.
- EPA (2015). Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements.
- DoEHLG (2013). *Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment.* Department of the Environment, Community and Local Government (where relevant).
- European Commission (2011). *Wind energy development and Natura 2000.* Guidance document.
- European Commission (2017). Environmental Impact Assessment of Projects.
- Draft Revised guidelines on the information to be contained in Environmental Impact Statements (EPA, 2017).
- EPA (2003). *Advice notes on current practice (in the preparation of Environmental Impact Statements* (where relevant).
- EPA (2002). *Guidelines on the information to be contained in Environmental Impact Statements.* Environmental Protection Agency (where relevant).
- NRA (2009). *Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2).* National Roads Authority.
- European Commission (2002). *Assessment of plans and projects significantly affecting Natura 2000 sites.*

7.1.3 Statement of Authority and Competence

This ornithology chapter has been prepared by Ecologist, Mr David Naughton (BSc.) and Senior Ornithologist, Mr. Padraig Cregg (BSc., MSc.) of MKO. Both are suitably qualified, competent, professional ecologists with extensive experience of completing avifaunal assessments and are competent experts for the purposes of the preparation of this EIAR. The scope of works and survey methodology was devised by Biosphere Environmental Services (BES) (October 2017 to March 2018) and by Senior Ornithologist, Mr. Alex Ash (BSc.) (April 2018 to September 2019) and is fully compliant with recent SNH guidance. The chapter has been reviewed by Pat Roberts (B.Sc. Environmental Science) and John Hynes (B.Sc., M.Sc., MCIEEM).

Field surveys were undertaken by John Hehir (BSc.), Tom Ryan (BSc.), Joe Kelly (BSc.), Patrick Manley (BSc.), Paul Troake, Dr Brian Madden (PhD) (BES), Shane O'Neill (BES) and Joe Adamson (BES). All of the surveyors listed above are competent experts for the purposes of the preparation of this EIAR and suitably qualified.

The survey methodologies underlined in this EIAR chapter have been peer reviewed by Dr Tom Gittings. Dr Gittings has been trading as an independent ecological consultant since 2001. He has over 18 years' experience as a professional ecologist and is a full member of the Chartered Institute of Ecology and Environmental Management.

7.2 Assessment Approach and Methodology

7.2.1 Desk Study

A comprehensive desk study was undertaken to search for any relevant information on species of conservation concern which may potentially make use of the study area. The assessment included a thorough review of the available ornithological data including:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), National Biodiversity Data Centre (NBDC), Irish Wetland Bird Survey I-WeBS.
- Review of Bird Atlases: (Sharrock, 1976; Lack, 1986; Gibbons et al., 1993; Balmer et al., 2013).
- Review of Birds of Conservation Concern (BoCCI) in Ireland 2014-2019 (Colhoun & Cummins, 2013).
- Review of specially requested records from the NPWS Rare and Protected Species Database.
- Review of impact assessments associated with nearby developments including wind farms.

7.2.2 Consultation

7.2.2.1 Scoping and Consultation

Consultation was undertaken with the relevant statutory and non-statutory organisations as part of the EIAR scoping to inform the current assessment. Full details can be found in Section 2.6 of Chapter 2.

Table 7-1 provides a list of the organisations consulted with regard to Ornithology during the scoping process and notes where scoping responses were received.

Copies of all scoping responses are included in Appendix 2.1 of this EIAR. The recommendations of the consultees have informed the EIAR preparation process and the contents of this chapter. Table 2.3 in Chapter 2 of this EIAR describes where the comments raised in the scoping responses received have been addressed in this assessment.

Table 7-1 Consultation Responses

	Consultee	Response	Issues Raised	Action Required
01	An Taisce	No Response Received	N/A	N/A
02	BirdWatch Ireland	Response Received 8th of November 2019	Scoping letter received by BWI and forwarded on to Policy Officer.	N/A
03	Department of Agriculture, Food and the Marine	Response Received 23rd of July 2019	Felling Licence required if tree felling will be undertaken	No felling will be undertaken
04	Irish Peatland Conservation Council	Response Received 8th of November 2019	Requested a Bord na Móna Rehabilitation Plan	Rehabilitation Plan undertaken (see Appendix 6-8 Derrinlough Rehabilitation Plan)

	Consultee	Response	Issues Raised	Action Required
05	Irish Red Grouse Association	No Response Received	N/A	N/A
06	Irish Raptor Study Group	No Response Received	N/A	N/A
07	Irish Wildlife Trust	No Response Received	N/A	N/A
08	National Parks & Wildlife Services	Response Received 30th of December 2019	See Section 7.4.5 in this Chapter	See Section 7.4.5 in this Chapter

7.2.3 Identification of Target Species and Key Ornithological Receptors

This section of the report describes the criteria used for the selection of target species. The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ornithological Receptors. Following a comprehensive desk study, initial site visits and consultation, a list of "Target species" likely to occur in the zone of influence of the Proposed Development was derived. The observation/survey work carried out on the site was specifically designed to survey for these identified target species in accordance with SNH guidance (2017). The target species list (see Appendix 7.1) was drawn from:

- Annex I of the EU Birds Directive.
- Special Conservation Interests (SCI) of Special Protection Areas (SPA) within the zone of likely significant effect.
- Species protected under the fourth schedule of the Wildlife Acts 1976-2018.
- Red and Amber listed birds of Conservation Concern.

Following analysis of the collated bird survey data, it was possible to refine the list of Target species to identify "Key Ornithological Receptors" and exclude species which were not recorded during the extensive surveys and those for which pathways for significant effect could not be identified.

7.2.4 Field Surveys

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and March 2018 in the form of Vantage Point surveys and walked transects. Field surveys at Derrinlough were undertaken by MKO between April 2018 and September 2019 which included a range of various distribution and abundance surveys for targeted species as well as continuation of the Vantage Point Surveys.

Survey data gathered during the survey period October 2017 - September 2019 forms the core dataset for the assessment of effects on ornithology. It is supplemented by additional data derived from surveys undertaken on the site by BES between October 2014 and September 2017. The data provided in this report is robust and allows clear, precise and definitive conclusions to be made on the avian receptors identified within the subject site. Field survey methodologies have been devised to survey for the bird species composition and assemblages that occur within the study area and its hinterland and which are potentially susceptible to impacts from this type of development.

7.2.4.1 Initial Site Assessment

Based on the results of the desk study, consultation and reconnaissance site visits, the likely importance of the study area for bird species was ascertained. Based on the collated information available from the above preliminary assessment and adopting a precautionary approach, a site-specific scope for the ornithological survey was developed.

7.2.4.2 Survey Methodologies

The survey work undertaken between October 2017 and September 2019 forms the core dataset for the assessment of effects on ornithology. Surveys from the period October 2017 to March 2018 were undertaken by Biosphere Environmental Services (BES). Surveys from the period April 2018 to September 2019 were undertaken by McCarthy Keville O'Sullivan (MKO).

In the absence of specific national bird survey guidelines, the ornithological surveys were designed and undertaken in full accordance with '*Recommended bird survey methods to inform impact assessment of onshore wind farms*' (SNH, 2017).

The various survey types undertaken are described below.

7.2.4.2.1 *Vantage Point Surveys*

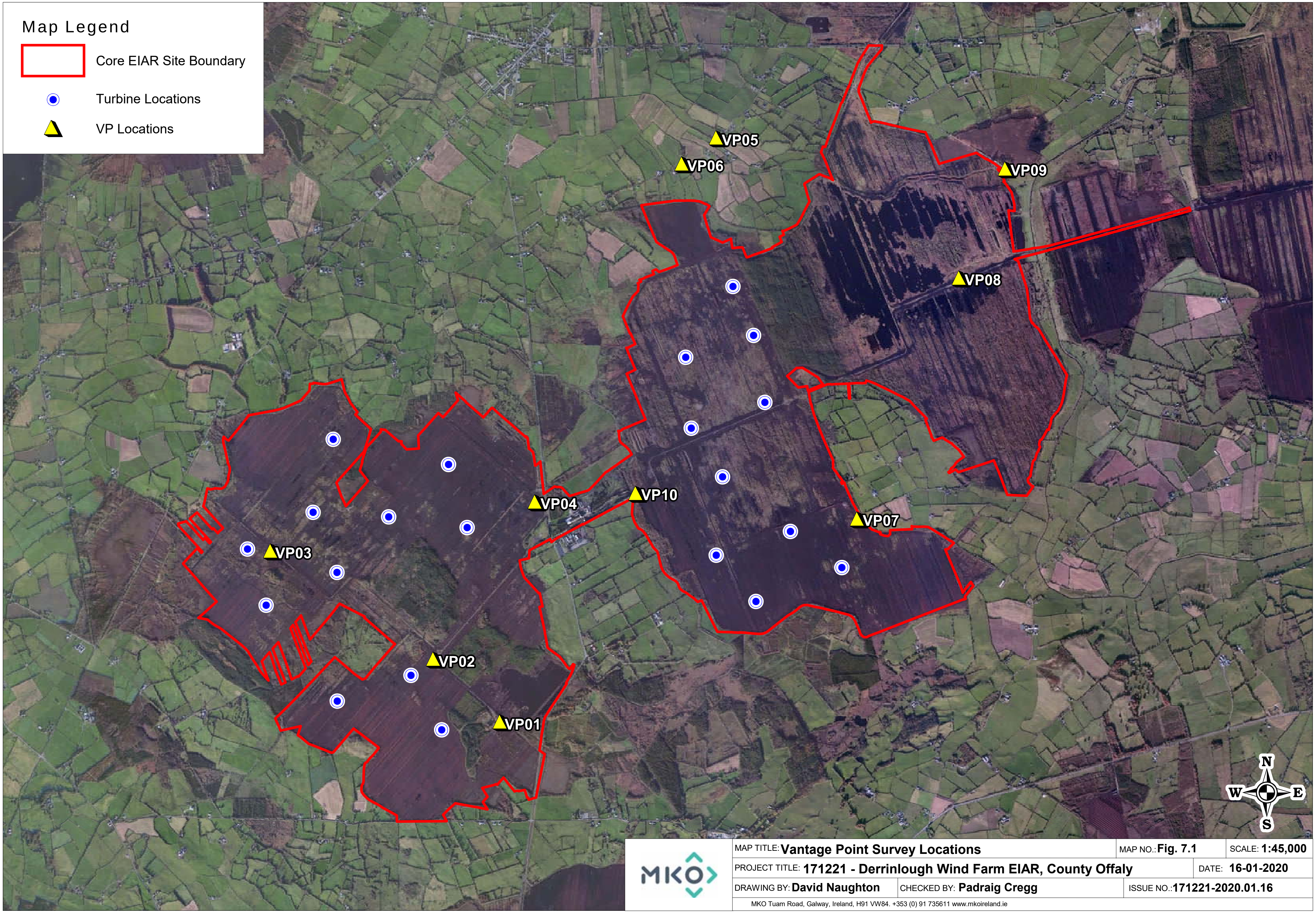
Vantage point surveys were undertaken in accordance with SNH guidance from October 2017 to September 2019. Surveys were conducted monthly throughout this survey period from ten fixed point vantage points (VP1 – VP10) to allow comprehensive coverage to a 500m radius of the outermost proposed turbines in accordance with SNH 2017. Vantage point surveys are designed to quantify the level of flight activity and its distribution over the survey area. The primary purpose of the survey is to provide data to inform the collision risk model, which makes predictions of mortality, from collisions with turbines. The validity of vantage point surveys were confirmed by MKO by conducting viewshed analysis, as described below, and further checked by a recce visit and field surveys. Figure 7.1 shows the locations of all vantage points relative to the development site.

Viewshed Analysis

Viewshed analysis was carried out to confirm coverage of the study area from fixed vantage point locations (i.e. VP1 – VP10). Viewsheds were calculated using Resoft Wind Farm ZTV (Zone of Theoretical Visibility) software in combination with Mapinfo Professional (Version 10.0) using a notional layer suspended at 25m, which is representative of the minimum height considered for the Potential Collision Risk Area based on a worst-case scenario turbine model. While the relevance of being able to view as much of the site to ground level is acknowledged, the SNH guidance emphasises the importance of visibility of the 'collision risk volume' when the data is to be used to estimate the risk of collision with turbines by birds.

The area visible from each vantage point was ground-truthed (i.e. confirmed during field surveys) to incorporate landscape features (e.g. woodland, spoil heaps etc.) into the analysis that would not otherwise be accounted for in the computer modelling programme. The vantage points were selected to effectively cover the 500 m Survey Area to ground level, when truncated at 2km and all airspace out to 2km and beyond was visible.

The viewshed analysis involved testing each VP location for its visibility coverage by creating a viewshed point 1.5 meters in height (to represent the height of observer) on a map using 10 metre contours terrain data. The relative height of forestry and its effects on visibility is also accounted for. Using the ZTV software, a viewshed of 360 degrees was produced calculating an area 25 metres from ground level up to a 2km radius. The resulting viewshed image was then cropped to 180 degrees to give the viewshed from each VP location in line with SNH (2014, 2017). At the time of selection for VPs



Map Legend
Core EIAR Site Boundary
Turbine Locations
VP Locations
VP01
VP02
VP03
VP04
VP05
VP06
VP07
VP08
VP09
VP10
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MKO
MAP TITLE: Vantage Point Survey Locations
MAP NO.: Fig. 7.1
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 16-01-2020
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the turbine locations, turbine model or swept heights were not known. The final turbine layout was received in November 2018, which was subsequently reviewed against the Viewshed Analysis to ensure that survey coverage was efficient.

In order to review the viewshed coverage from the VP locations and ensure that the viewsheds provided sufficient coverage of the proposed turbines and 500m of same, a 500m buffer was applied to the outer most turbines of the proposed wind farm development in line with SNH (2014, 2017). The viewshed analysis offers the best possible views of the study area with adequate coverage of the proposed turbine layout, using as few VPs as possible. The visible view shed at 25m is presented on Figures 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.6, 7.2.7, 7.2.8, 7.2.9, 7.2.10.

Data Recording and Digitisation

Data on bird observations and flight activity was collected from a scanning arc of 180° and a 2km radius by an observer at each fixed location for six hours per month (SNH 2017). Due to weather constraints, some surveys ended early but were continued at a later date in the month to ensure that six hours of surveys were conducted per month in accordance with SNH guidance (2017). Surveys were scheduled to provide a spread over the full daylight period including dawn and dusk watches to coincide with the peaks in bird activity. Target species were as per listed in Table 1 of Appendix 7.1.

Survey effort for vantage point watches is presented in Appendix 7.2, Table 1. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Table 7-2 below shows a summary of the VP survey work undertaken.

Table 7-2 Vantage Point Survey Effort

Survey Season	Months	Minimum Effort per VP
2017/2018 Non-Breeding Season (10VPs)	Oct-Mar	36 hours/VP*
2018 Breeding Season (10VPs)	Apr-Sep	36 hours/VP
2018/2019 Non-Breeding Season (10VPs)	Oct-Mar	36 hours/VP
2019 Breeding Season (10VPs)	Apr-Sep	36 hours/VP

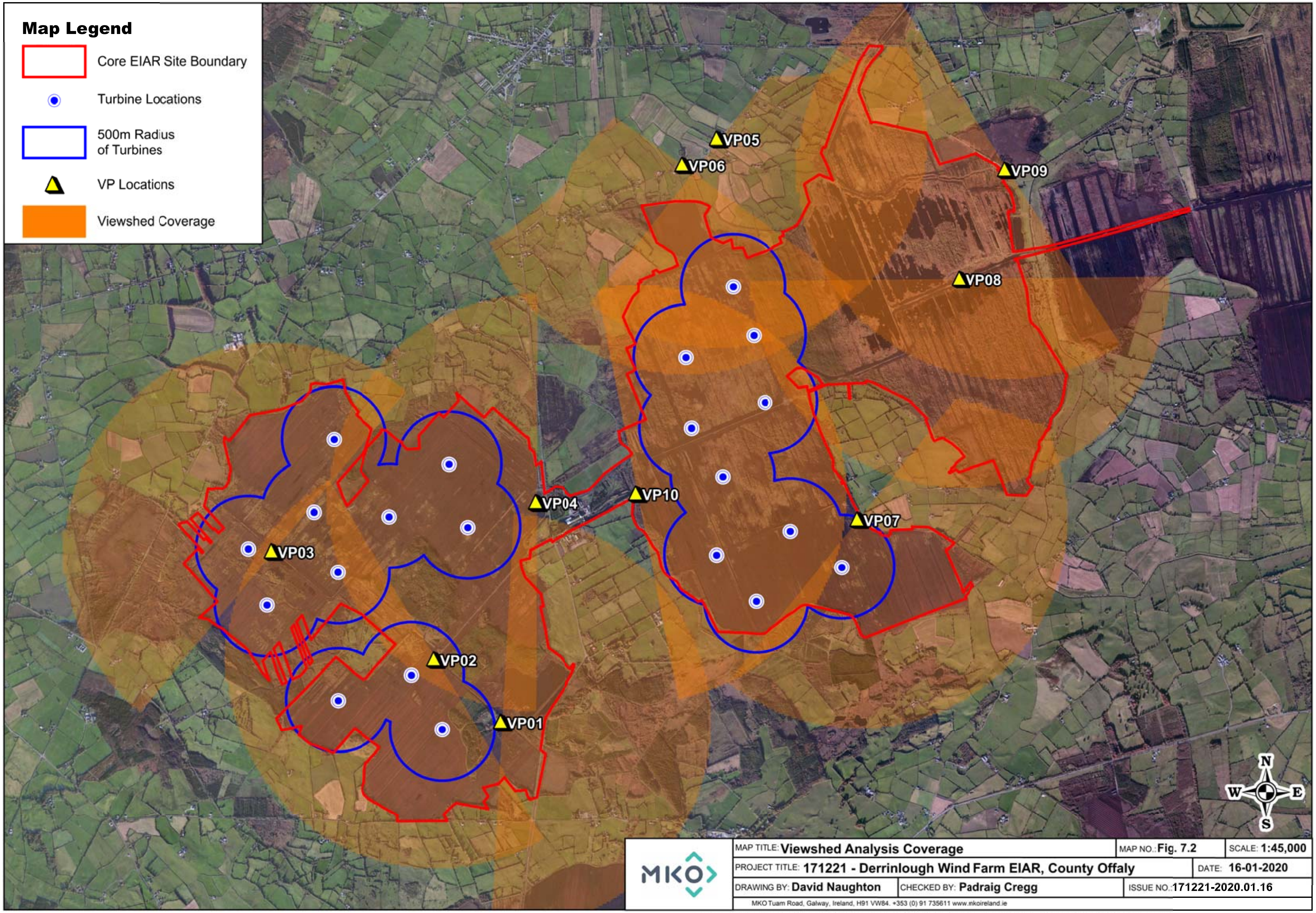
*** With the exception of VP8 during the 2017/18 Winter Season; this VP was surveyed for a total of 35 hours.**

Birds which use the airspace around turbines are susceptible to collision with operating turbines. The swept area of the rotor blade is the area in which a collision is theoretically possible. Possible collision height (PCH) is therefore defined as the area of space occupied by the turbine rotors. Observed flight activity was recorded as per defined flight bands which were chosen in relation to the dimensions of potential turbine models for the site. Bands were split into 0-10m, 10-25m, 25m-175m and 175m+. All flight activity within the height bands 25-175m and 175m+ is considered to be within the Potential Collision Height (PCH) with regard to the turbine swept area, based on a worst-case scenario for turbine modelling.

Each flight observation was assigned a unique identifier when mapped in the field and subsequently digitised using GIS software.

7.2.4.2.2 *Breeding Bird Surveys (O'Brien and Smith Methodology)*

Breeding walkover transect surveys were undertaken to determine the presence of bird species of high conservation concern and identify areas of possible, probable or confirmed breeding territories for bird species observed within the study area. Survey methodology followed the O'Brien and Smith method for lowland sites as outlined in Gilbert et al. (1998) and SNH (2017) ('The O'Brien and Smith (1992) method for censusing lowland breeding wader populations'). The survey area extended 500m beyond the site boundary as recommended by SNH (2017).



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MAP TITLE: Viewshed Analysis Coverage		MAP NO.: Fig. 7.2	SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly		DATE: 16-01-2020	
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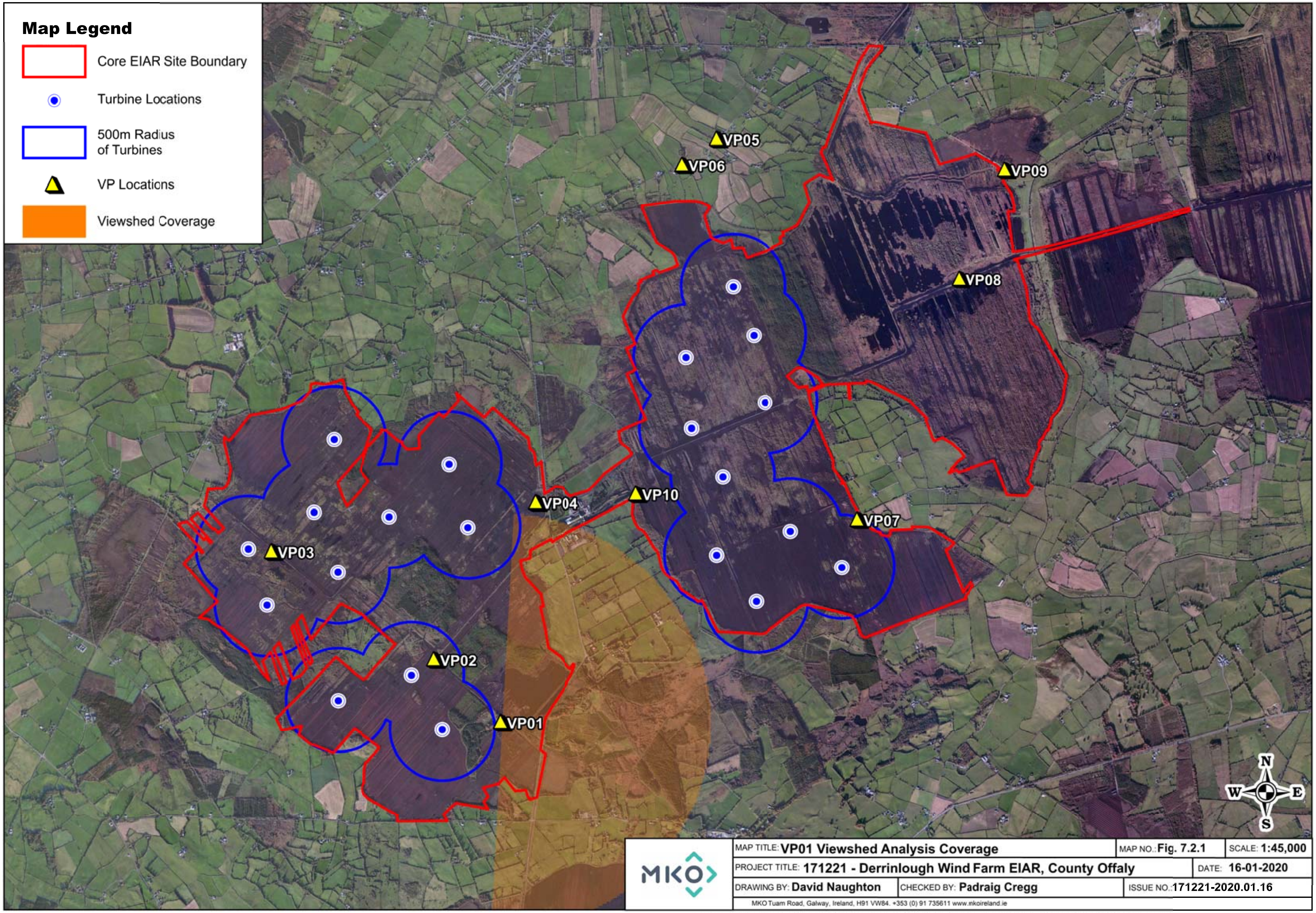

Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Radius of Turbines
VP Locations
Viewshed Coverage
VP01
VP02
VP03
VP04
VP05
VP06
VP07
VP08
VP09
VP10
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MKO
MAP TITLE: VP01 Viewshed Analysis Coverage
MAP NO.: Fig. 7.2.1
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 16-01-2020
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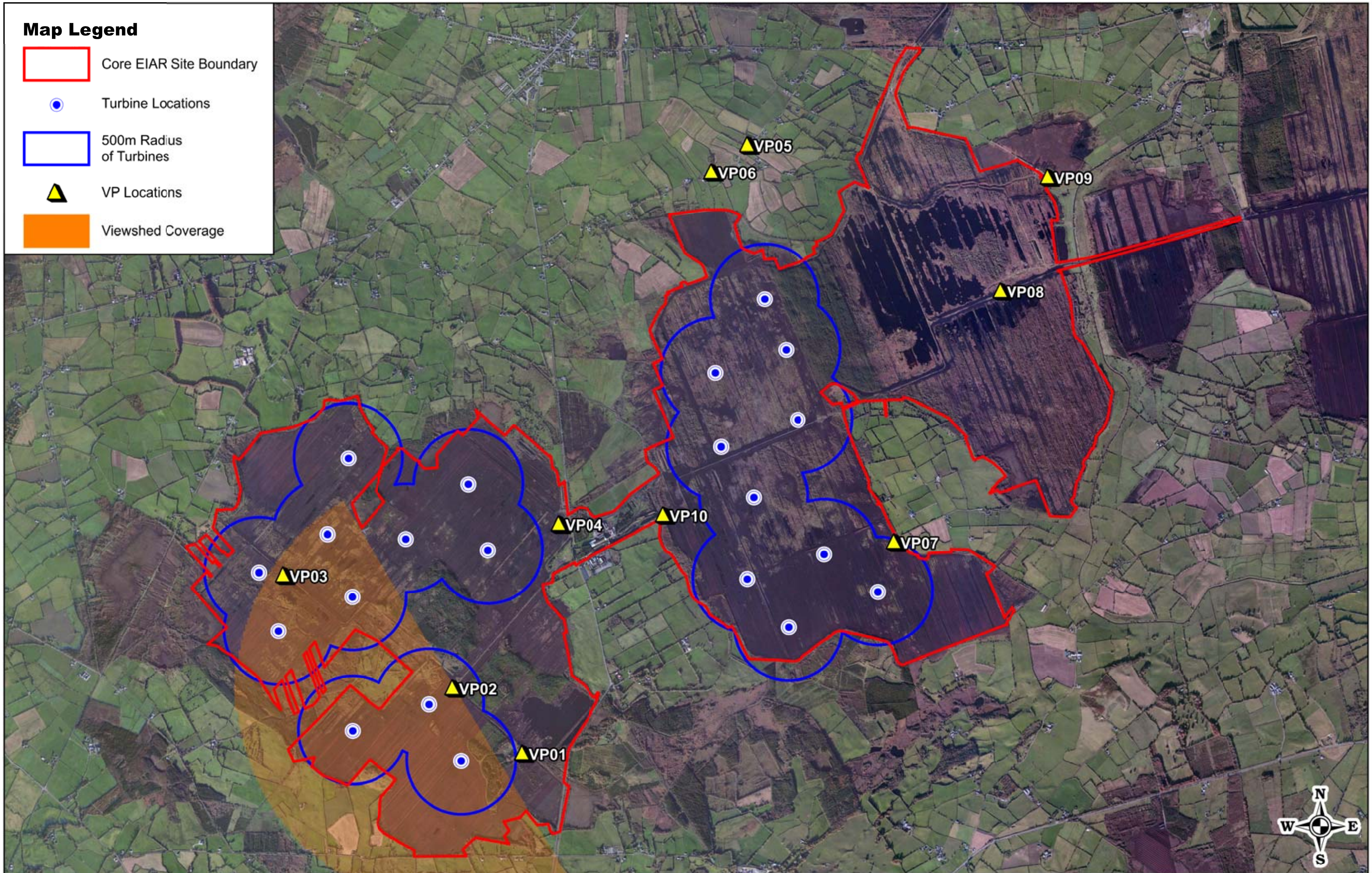

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MAP TITLE: VP02 Viewshed Analysis Coverage | MAP NO.: Fig. 7.2.2 | SCALE: 1:45,000

PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly | DATE: 16-01-2020

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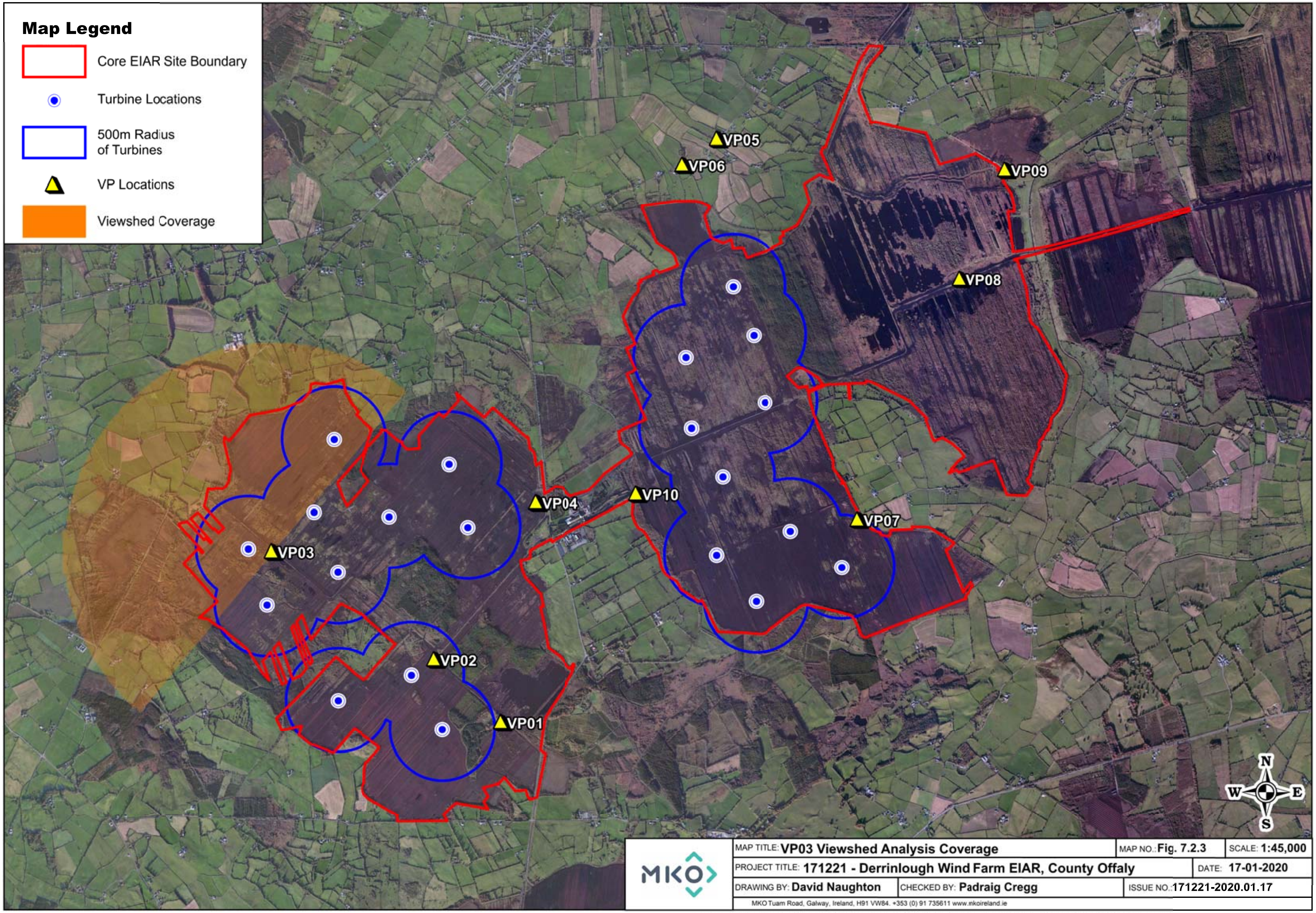

Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Radius of Turbines
VP Locations
Viewshed Coverage
VP01
VP02
VP03
VP04
VP05
VP06
VP07
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MAP TITLE: VP03 Viewshed Analysis Coverage
MAP NO.: Fig. 7.2.3
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
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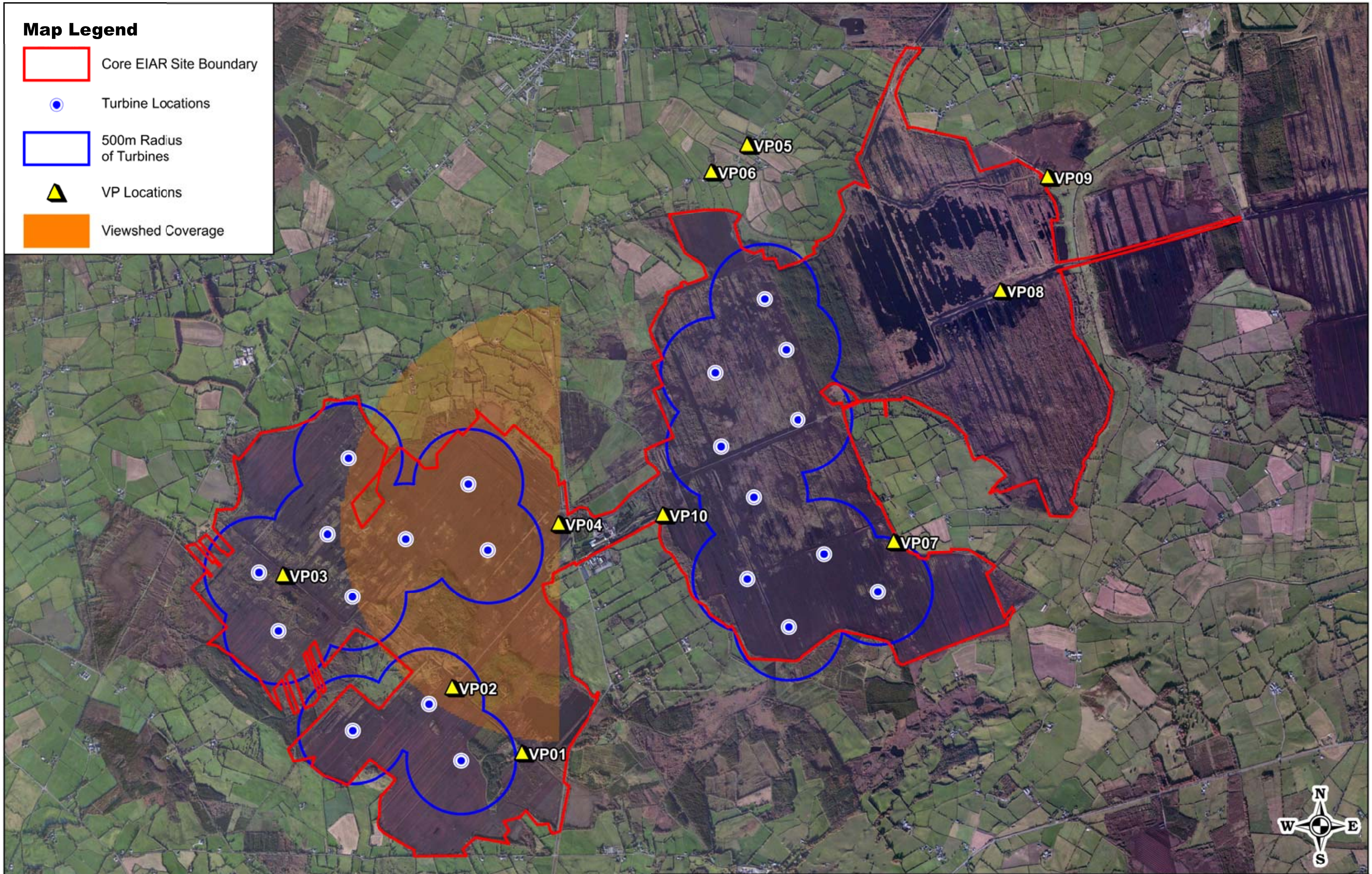

MAP TITLE: VP04 Viewshed Analysis Coverage | MAP NO.: Fig. 7.2.4 | SCALE: 1:45,000

PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly | DATE: 17-01-2020

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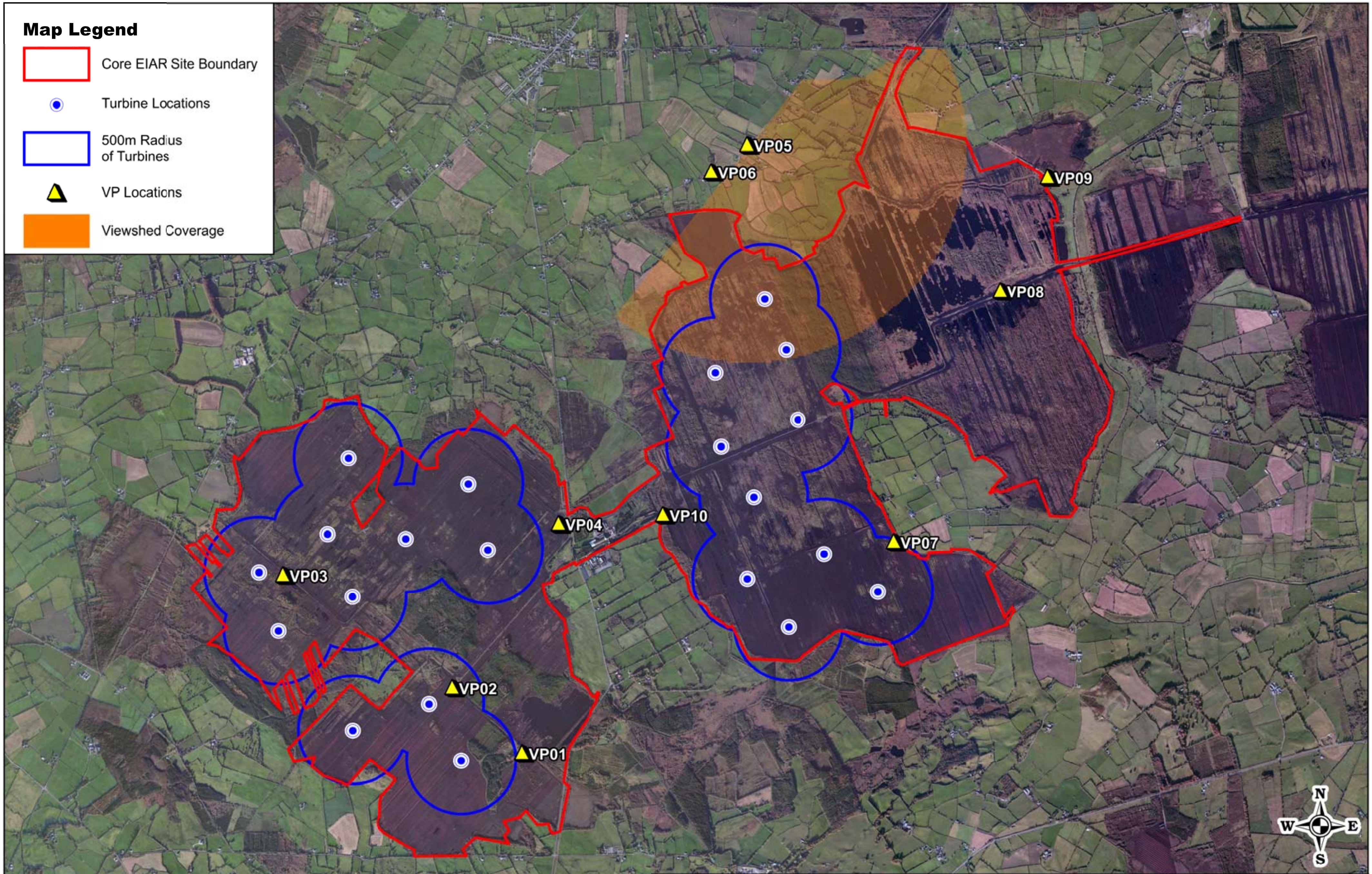

MAP TITLE: VP05 Viewshed Analysis Coverage		MAP NO.: Fig. 7.2.5	SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly			DATE: 17-01-2020
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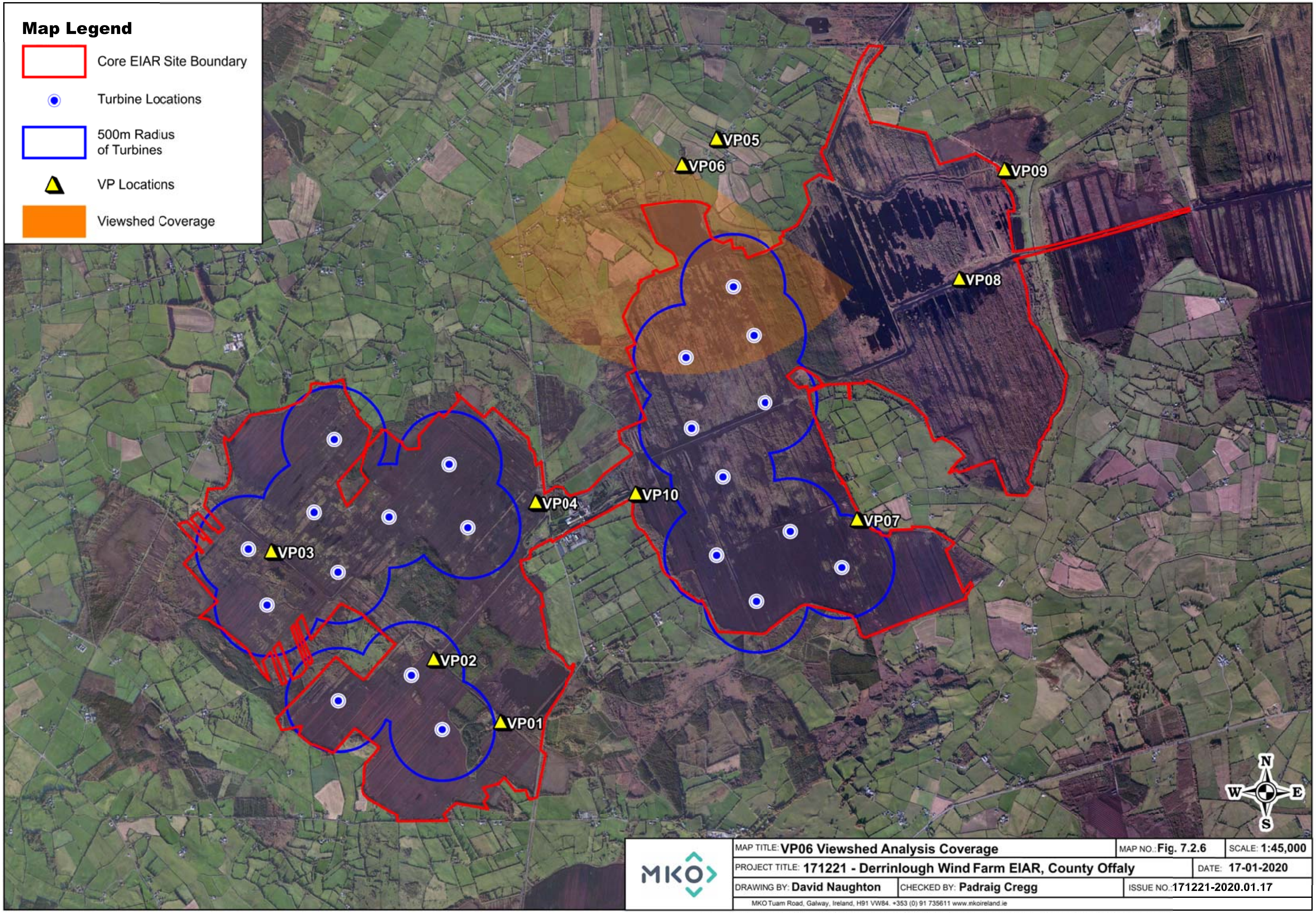
Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Radius of Turbines
VP Locations
Viewshed Coverage
VP05
VP06
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VP07
VP03
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VP01
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MAP TITLE: VP06 Viewshed Analysis Coverage
MAP NO.: Fig. 7.2.6
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 17-01-2020
DRAWING BY: David Naughton
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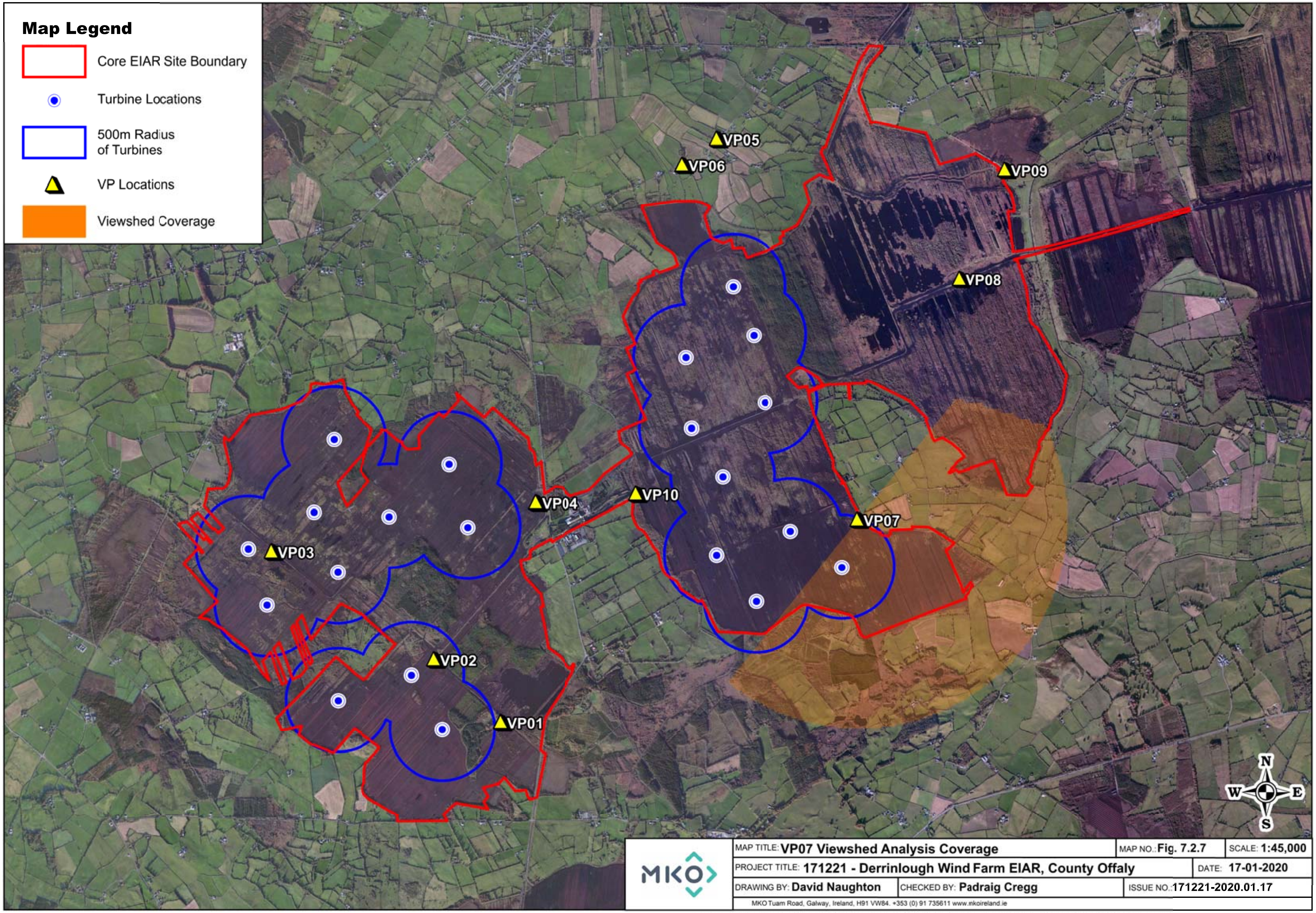

Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Radius of Turbines
VP Locations
Viewshed Coverage
VP01
VP02
VP03
VP04
VP05
VP06
VP07
VP08
VP09
VP10
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MAP TITLE: VP07 Viewshed Analysis Coverage
MAP NO.: Fig. 7.2.7
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 17-01-2020
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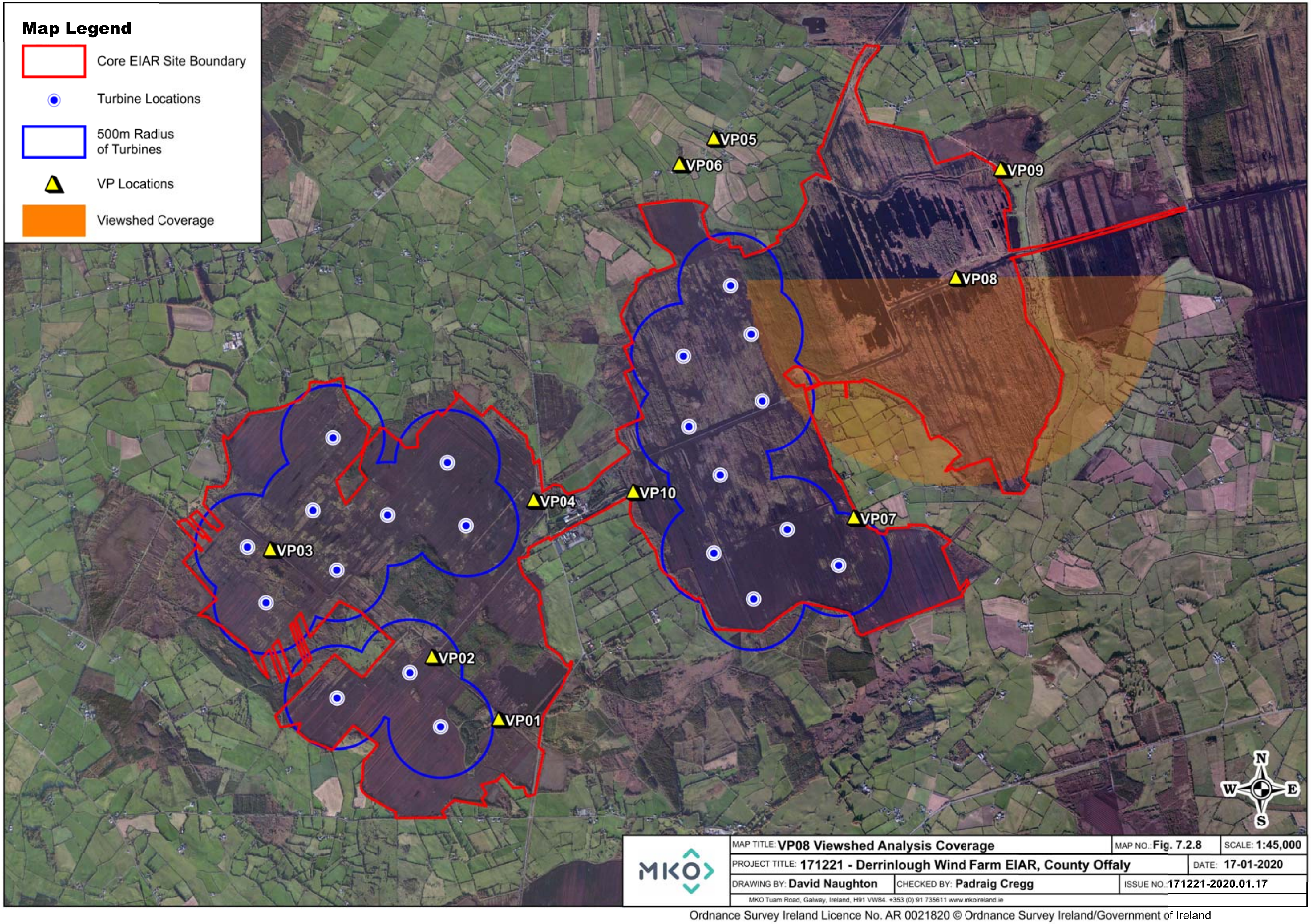

Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Radius of Turbines
VP Locations
Viewshed Coverage
VP01
VP02
VP03
VP04
VP05
VP06
VP07
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VP09
VP10
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MAP TITLE: VP08 Viewshed Analysis Coverage
MAP NO.: Fig. 7.2.8
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 17-01-2020
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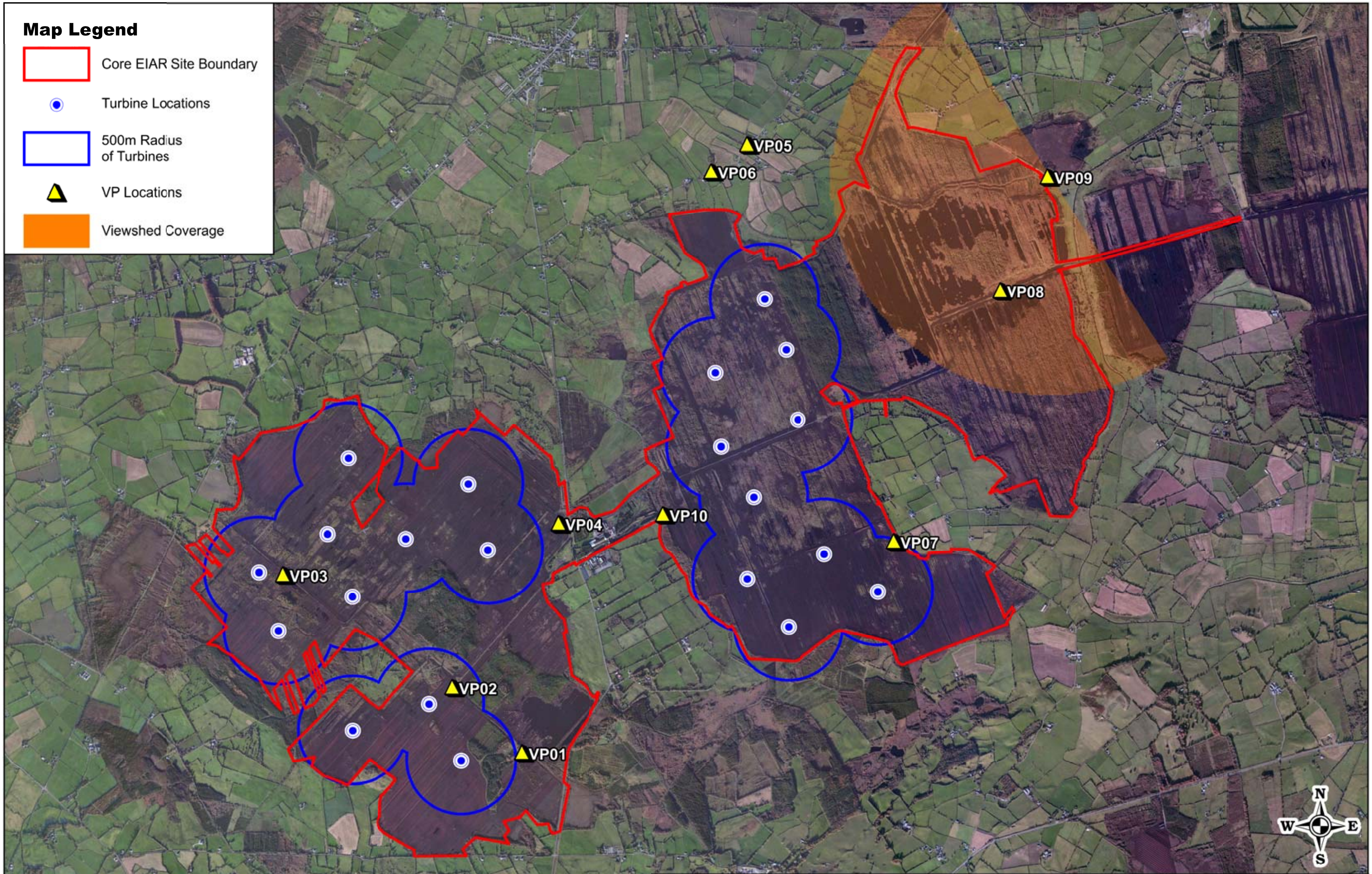

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MAP TITLE: VP09 Viewshed Analysis Coverage | MAP NO.: Fig. 7.2.9 | SCALE: 1:45,000

PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly | DATE: 17-01-2020

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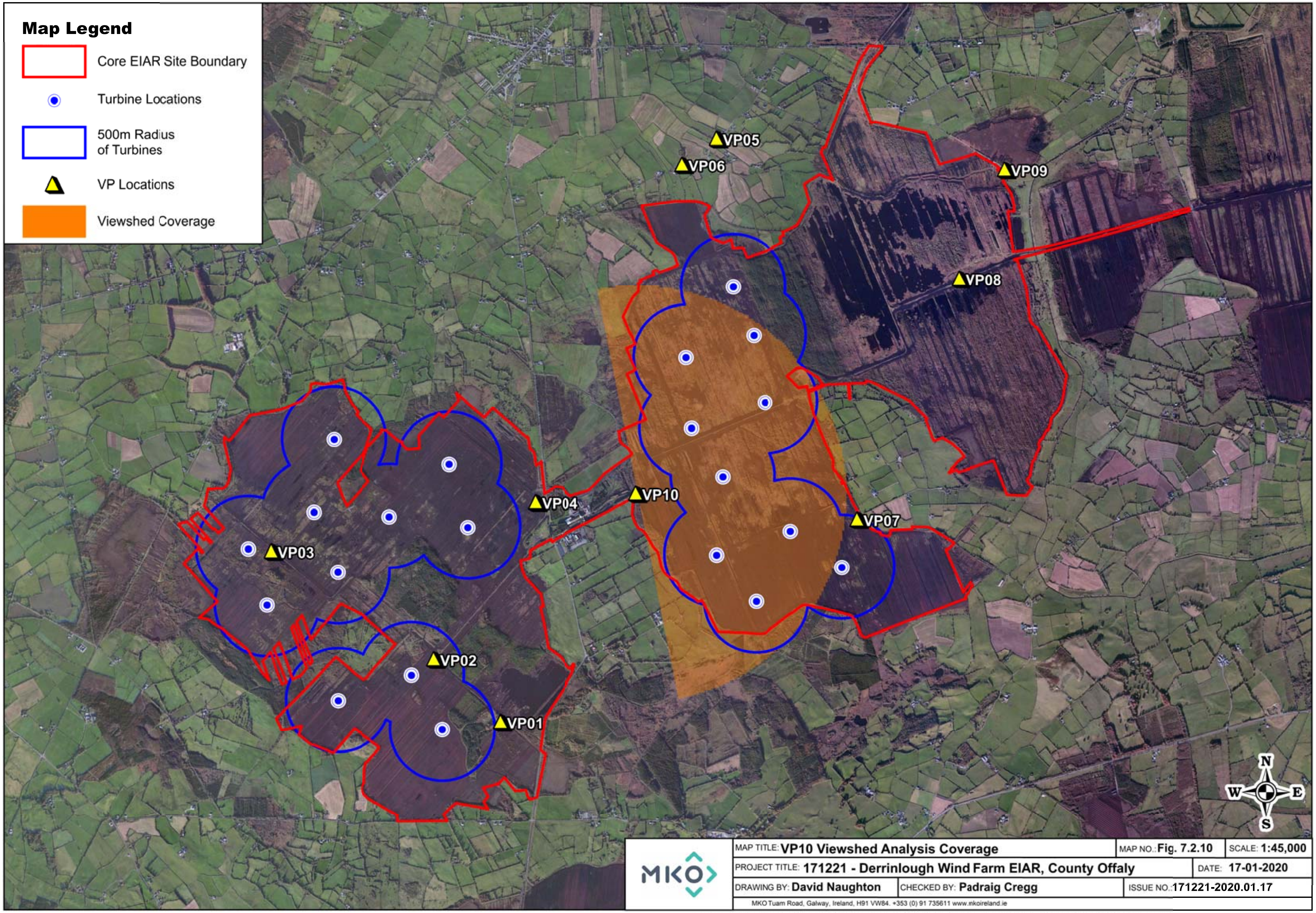

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Transect routes were devised to ensure coverage of different habitat complexes between vantage point locations within the study area. Transects were selected in order to survey every area of suitable breeding/foraging habitat to within 100m, in areas where access allowed. Where access was not possible for example on 3rd party lands, the areas were surveyed from Bord na Móna property or public roads where possible. Target species included waders, raptors, waterbirds and gulls. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Walkover surveys were carried out from dawn onward during the core breeding season months of April, May and June (2018) and April, May, June and July (2019), with the site being visited on eight days per month. The core breeding season for lowland waders is April-June, which was surveyed during both the 2018 and 2019 breeding season. In addition, breeding season surveys in 2019 included the month of July to determine success of breeding birds or any potential late breeding pairs. Following all survey visits, the field maps were analysed to determine the number and location of breeding territories. All non-breeding individuals and species encountered were also recorded.

Survey effort is presented in Appendix 7.2, Table 2. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 7.3 shows the area surveyed.

7.2.4.2.3 Breeding Raptor Surveys

Breeding raptor surveys (i.e. birds of prey and owls) were conducted within the study area and its immediate surrounds. Survey methodology was as outlined in Hardey et al. (2013). Breeding Raptor Surveys aimed to cover all areas of suitable raptor breeding habitat within 2km of the site boundary, including hen harrier, merlin, peregrine, and other raptor species.

This included surveying suitable buildings (where access allowed) within a 1km radius (as per SNH 2017 recommendations for surveying owls) of the site for barn owl. Two building were identified with potential to support barn owl (>500m) to the west of the proposed development area. No evidence of occupancy was recorded.

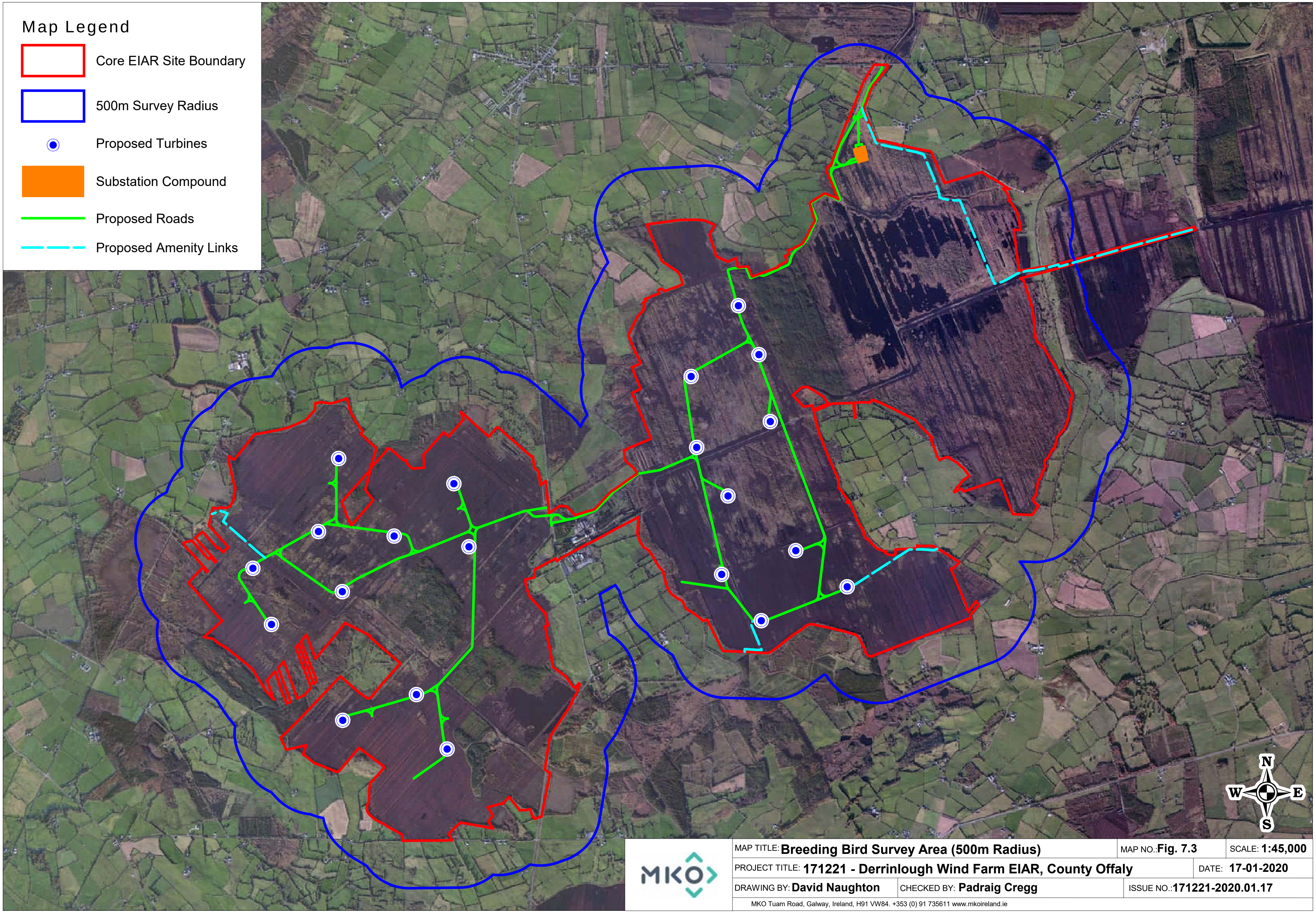
Raptor surveys, in the form of walked transects and short VP watches, were conducted within a 2km radius of the site boundary on a monthly basis during the core breeding season (April – July 2018 and 2019). The aim of these surveys was to identify occupied territories and establish whether breeding was successful within the study area.

Survey effort details are provided in Appendix 7.2, Table 3. Figure 7.4 shows the areas surveyed.

7.2.4.2.4 Breeding Woodcock Surveys

Breeding woodcock surveys were undertaken in accordance with Gilbert et.al (1998). Two survey visits were undertaken in June 2018, surveyors were in position from an hour before sunset until last visible light. In 2019, three survey visits were undertaken between May and June to areas of suitable habitat. The survey area extended 500m beyond the site boundary and was focused in areas of suitable habitat. Surveys commenced one hour before sunset and continued for one hour after sunset or until it was too dark to see. Transects were slowly walked through areas of suitable woodland habitat onsite and to a 500m radius of the development area. All observations of woodcock (as well as the areas covered) are recorded on to a map. The aim of the survey was to record the presence of roding (displaying) male woodcock and thereby establish the distribution and abundance of the species in the study area. This survey method also allowed the observer to survey for owls, i.e. barn owls and long-eared owls.

Survey effort is presented in Appendix 7.2, Table 4. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 7.5 shows the transect routes surveyed.



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MAP TITLE: Breeding Bird Survey Area (500m Radius)	MAP NO.: Fig. 7.3	SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly		DATE: 17-01-2020
DRAWING BY: David Naughton	CHECKED BY: Padraig Cregg	ISSUE NO.: 171221-2020.01.17

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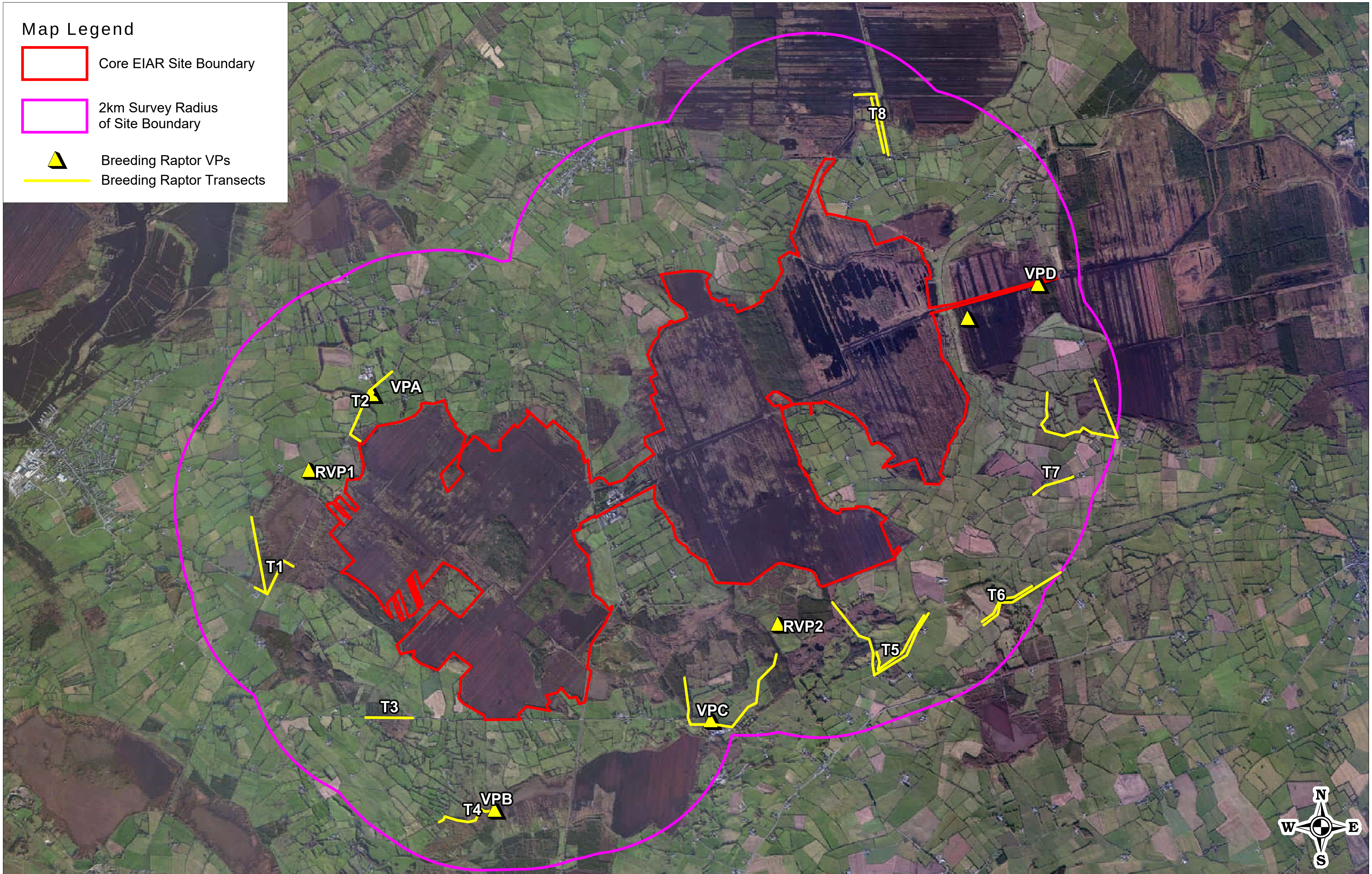

MAP TITLE: Breeding Raptor Survey Area	MAP NO.: Fig. 7.4	SCALE: 1:65,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly		DATE: 17-01-2020
DRAWING BY: David Naughton	CHECKED BY: Padraig Cregg	ISSUE NO.: 171221-2020.01.17

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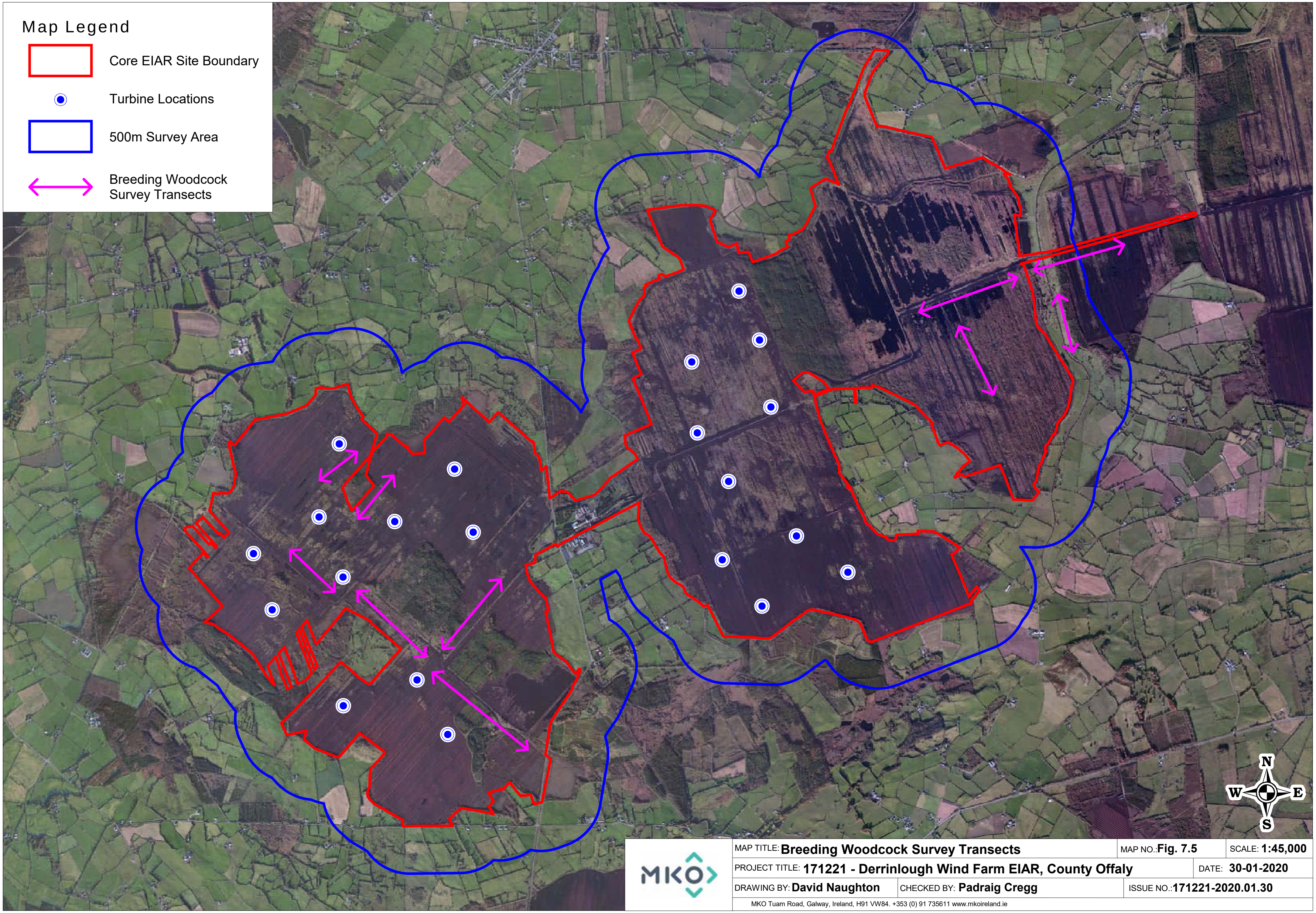
Map Legend
Core EIAR Site Boundary
Turbine Locations
500m Survey Area
Breeding Woodcock Survey Transects
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MAP TITLE: Breeding Woodcock Survey Transects
MAP NO.: Fig. 7.5
SCALE: 1:45,000
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DATE: 30-01-2020
DRAWING BY: David Naughton
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7.2.4.2.5 *Hen Harrier Roost Surveys*

These surveys were undertaken in areas of suitable roosting habitat to a 2km radius of the proposed development area (as per SNH 2017).

Hen Harriers may roost communally in winter, generally in rank ground vegetation (Clarke and Watson 1997). In Ireland, suitable roosting habitat is typically restricted to dense vegetation, such as heather, dense rushes (*Juncus spp.*) or young commercially planted conifers. Although this species breeds in upland areas, wintering birds disperse widely and can frequently be found in lowland areas of the midlands of Ireland.

Hen harrier roost surveys were undertaken at six fixed locations, between October 2018 and March 2019. Hen harrier roost survey methods followed those set out by Gilbert et al. (1998) and were in accordance with the NPWS National Winter Hen Harrier Roost Survey recommendations (Ruddock et al. 2016). Surveyors were in place an hour and a half before sunset and recorded all observations of hen harrier until last visible light. Information recorded by surveyors from the vantage points included; the number of hen harrier entering a roost, the time, age, and sex, where possible.

Full details of survey effort are provided in Appendix 7.2 Table 5. Figure 7.6 shows the locations of Hen Harrier Roost Survey VP locations.

7.2.4.2.6 *Winter Transect/Waterfowl Surveys*

Biosphere Environmental Services (BES) Surveys

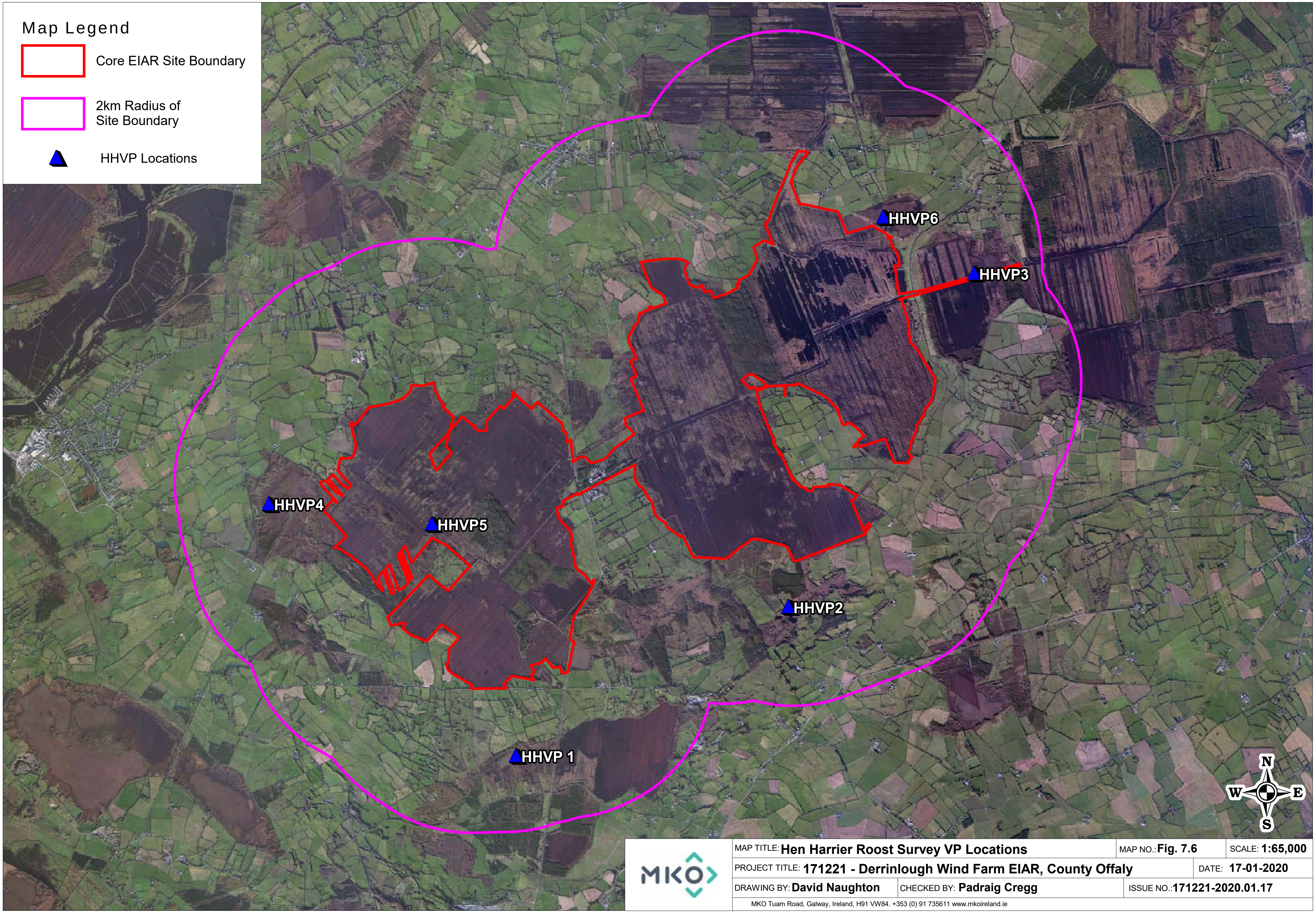
During the winter of 2017/2018 BES undertook dedicated wetland and waterfowl surveys, with a particular emphasis on whooper swan and Greenland white-fronted goose. These species were targeted based on historical use of the wider area. The survey area extended to 5km from the development boundary. The areas surveyed included Noggusboy, Derries, Derrybrat, Boora complex and Turraun bog sites as well as grasslands with foraging potential for swans and geese. These surveys were undertaken on one day per month.

Walked transects were also conducted during the months of November, January and March during the winter season (October 2017 – March 2018). Transects were selected following identifiable tracks including railways through the bog. Methodology for these surveys was broadly based on Bibby et al. (2000). The number of transects used was determined by the size of the site and diversity of habitats present. Figure 7.7a shows the transects used by BES in the 2017/2018 winter season, as well as the areas surveyed during waterfowl surveys within 5km.

McCarthy Keville O'Sullivan (MKO) Surveys

Significant wetland sites within 1km of the study area were surveyed for waterbird populations (i.e. waders, waterfowl, gulls, grebes and rails) by MKO in the winter 2018/2019 season (as per SNH 2017). The survey methodology employed followed the 'I-WeBS Counter Manual – Guidelines for Irish Wetland Bird Survey Counters' co-ordinated by BirdWatch Ireland. In accordance with SNH (2017), counts were undertaken bimonthly, August 2018 to May 2019, at each target wetland site during the wintering/migratory period. Counts were undertaken during daylight hours (including dawn and dusk) from suitable vantage points at the wetland sites. Surveys comprised of three survey days per visit, with two visits undertaken each month between August 2018 and May 2019.

In addition, transect routes were also undertaken to ensure coverage of different habitat complexes within the development site and 500m of same during winter months. While the primary concern during these surveys was wintering waterfowl, other target species (e.g. raptors, gulls, etc.) as well as passerines were also recorded. Survey effort, including details of survey duration and weather condition, is presented in Appendix 7.2, Table 6. Figure 7.7b shows the surveyed area.



Map Legend
Core EIAR Site Boundary
2km Radius of Site Boundary
HHVP Locations
HHVP6
HHVP3
HHVP4
HHVP5
HHVP2
HHVP 1
N
W
E
S
MKO
MAP TITLE: Hen Harrier Roost Survey VP Locations
MAP NO.: Fig. 7.6
SCALE: 1:65,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 17-01-2020
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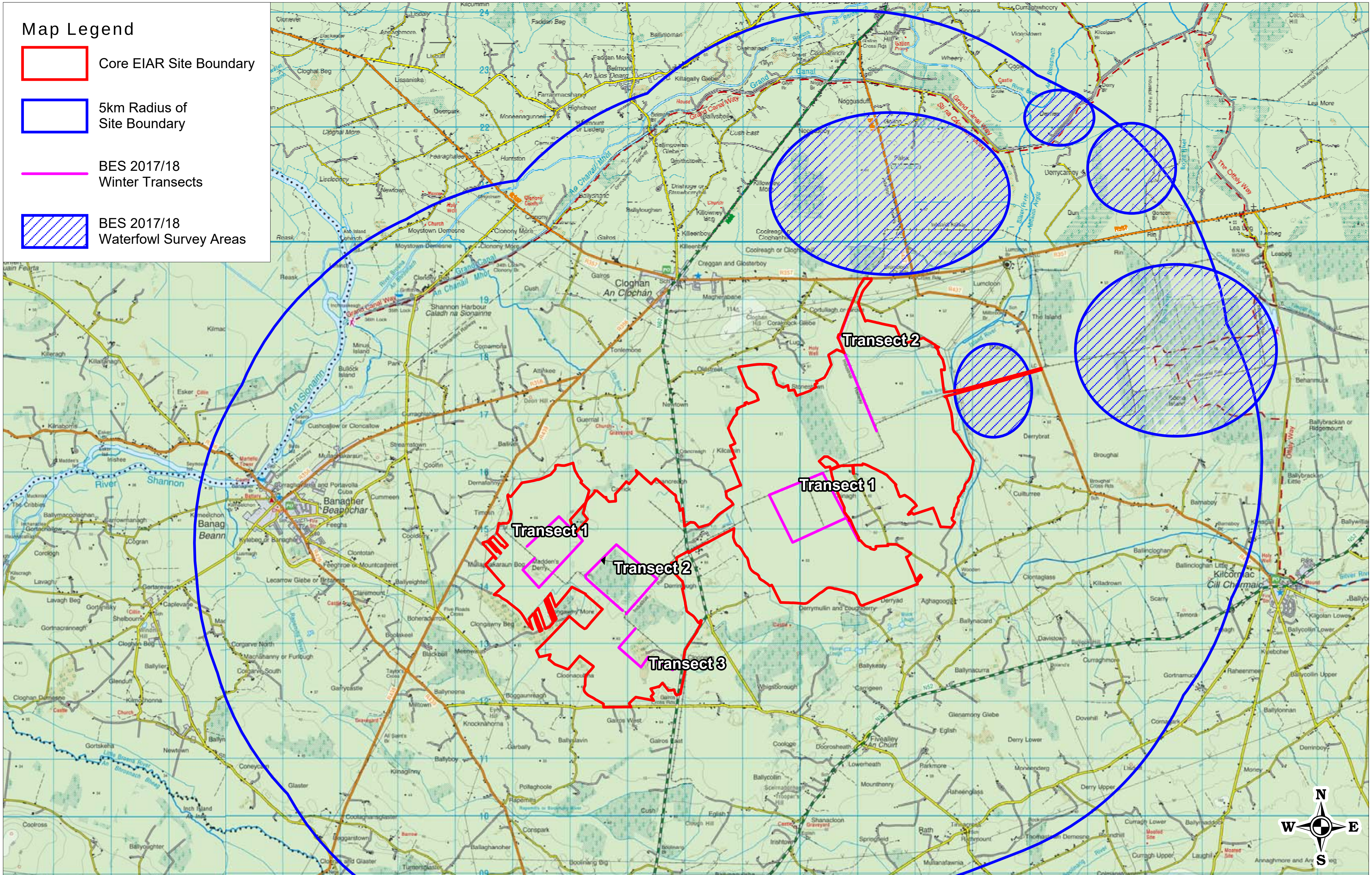

MAP TITLE: BES Winter Transect/Waterfowl Surveys 2017/18

MAP NO.: Fig. 7.7a

SCALE: 1:85,000

PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly

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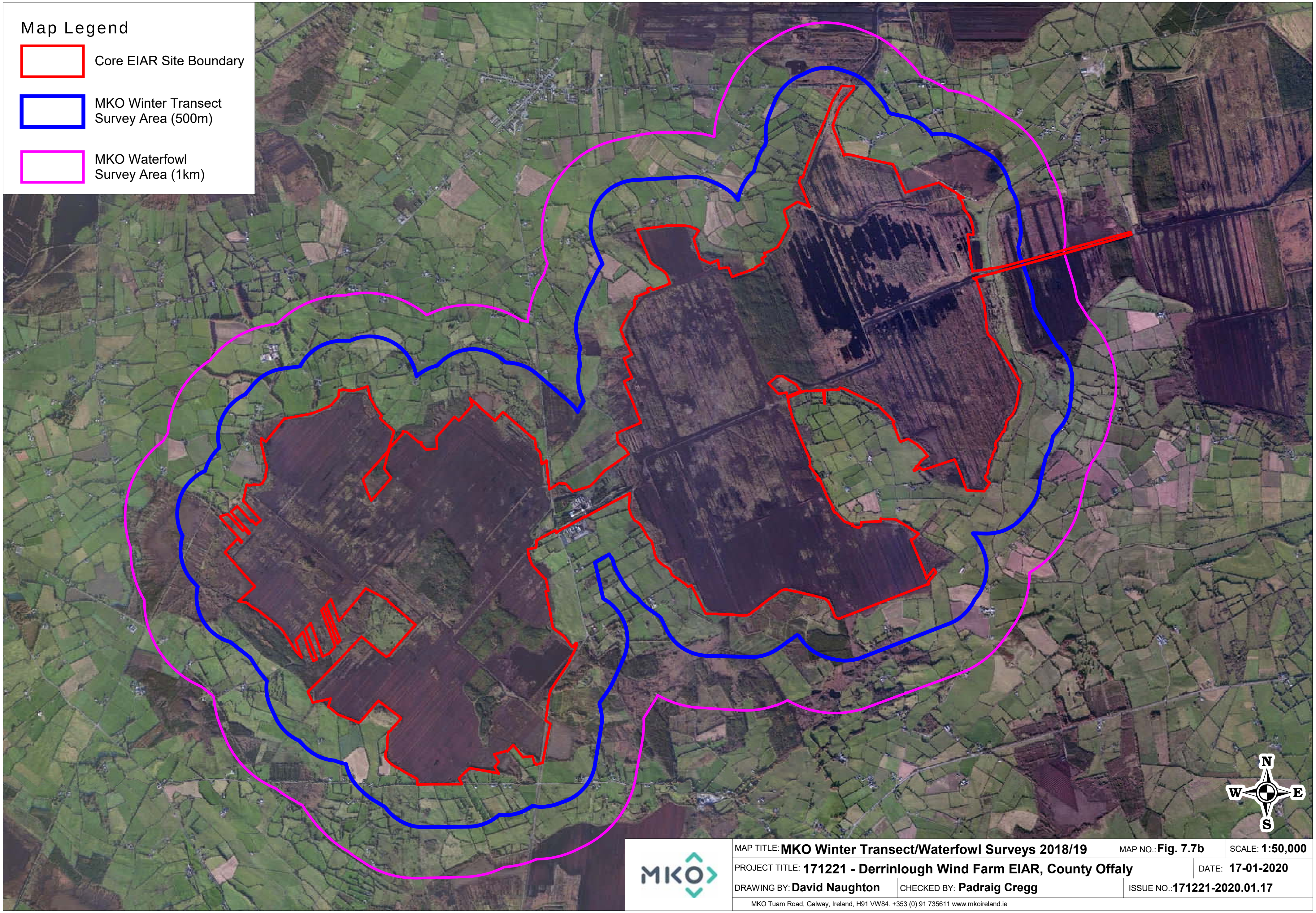
Map Legend
Core EIAR Site Boundary
MKO Winter Transect Survey Area (500m)
MKO Waterfowl Survey Area (1km)
N
W
E
S
MKO
MAP TITLE: MKO Winter Transect/Waterfowl Surveys 2018/19
MAP NO.: Fig. 7.7b
SCALE: 1:50,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
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7.2.4.2.7 Migratory Bird Surveys

Based on the results of the desk study, consultation and reconnaissance site visits, the River Shannon and Little Brosna River were identified as potential commuting/migratory corridors for bird species, particularly swans and geese. Migratory VP watches began in September 2018 to monitor the movements of sensitive wildfowl, with an emphasis on whooper swan and Greenland white-fronted geese, in the wider surroundings of the proposed development. VPs were positioned along adjacent sections of the River Shannon and Little Brosna River within an 8km radius of the development site. Surveyors recorded the movements of swans, geese and other wildfowl within the SPAs to the west of the site and the surrounding areas. The aim was to determine if there was any connectivity between these SPAs and the proposed development site to the east, i.e. if regular commuting/migratory flights were recorded these would be considered to constitute evidence of connectivity between the SPA and the proposed development area.

Watches at the six vantage points (VPs) were undertaken from September 2018 to May 2019. Three-hour watches were undertaken at these six fixed VP locations. These surveys followed vantage point survey methods as outlined in SNH (2017). Each VP was surveyed twice per month with a minimum of a two-week gap between repeat visits. Surveys regularly alternated between dusk and dawn surveys to capture the peak activity times for migrating swans and geese or flock movements between roosting/feeding sites along the River Shannon corridor. Survey effort, including details of survey duration and weather condition, is presented in Appendix 7.2, Table 7. Figure 7.8 shows the VP locations.

7.2.4.2.8 Crane Dusk Surveys

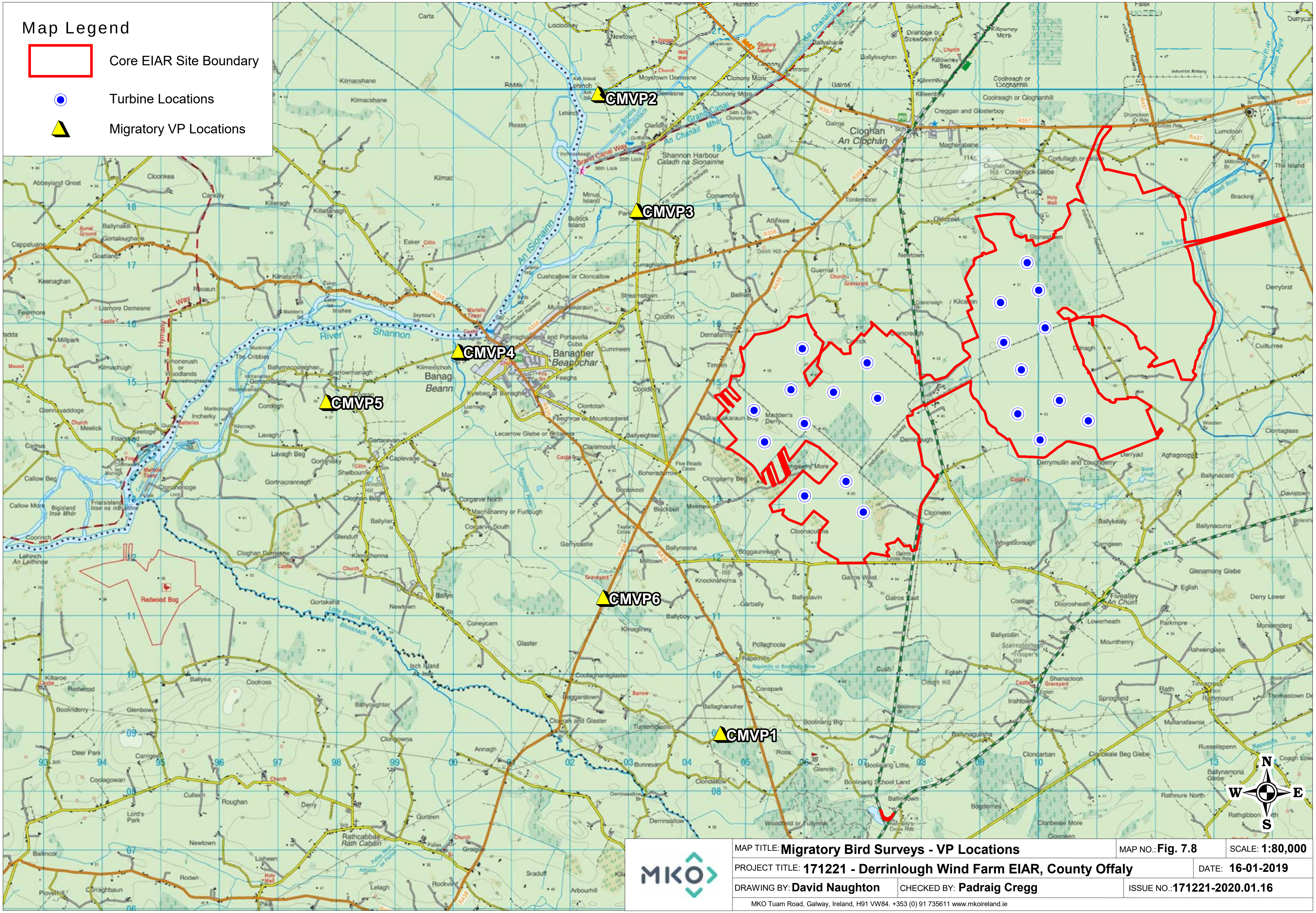
Although common crane was once a widespread and common resident bird species in Ireland, they are now extinct in this country as a breeding species with observations in recent years a rare occurrence. Common crane is now a vagrant species in Ireland, recorded predominantly during winter months. Dedicated common crane surveys were commissioned in March 2019 as this species was observed to be roosting within the development site on occasion during VP surveys between December 2018 and February 2019. Two three-hour dusk VP watches as well as one dawn watch were conducted during March 2019. Watches took place from a fixed location within the development site overlooking the area where crane had been previously recorded, to determine if the birds were still using these areas. Survey methods broadly followed SNH (2017) recommendations for flight activity surveys. Survey details are provided in Appendix 7.2, Table 8. Figure 7.9 shows the areas surveyed.

7.2.4.2.9 BES Additional Survey Effort

Survey data gathered during the period October 2017 - September 2019 forms the core dataset for the assessment of effects on ornithology. The various survey methodologies used during this survey period have been described above. The core dataset has been supplemented with additional data from BES surveys between October 2014 and September 2017.

During the period 2014 – 2017 BES undertook Vantage Point surveys at Derrinlough from fixed survey locations as well as undertaking walked transects during both breeding and non-breeding seasons. Vantage point surveys initially took place from seven fixed VPs, which included the same four VPs which were used between October 2017 and September 2019 on the Clowngawny side of the site (VP1 – VP4). An additional eight VP was added in April 2016, to provide additional coverage of the Drinagh wetlands in the east of the site. Each VP had a minimum of 36-hours per survey season in compliance with SNH guidance (SNH 2017).

While it was acknowledged that the Drinagh wetlands was to be avoided/constrained out of the development/planning processes, the importance of these areas for birds led to the introduction of an additional two VPs on the Drinagh development site in October 2017. These ten VPs were continuously surveyed for the core two-year period (October 2017 – September 2019).



Map Legend

Core EIAR Site Boundary

Turbine Locations

Migratory VP Locations

MAP TITLE: Migratory Bird Surveys - VP Locations		MAP NO.: Fig. 7.8	SCALE: 1:80,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly			DATE: 16-01-2019
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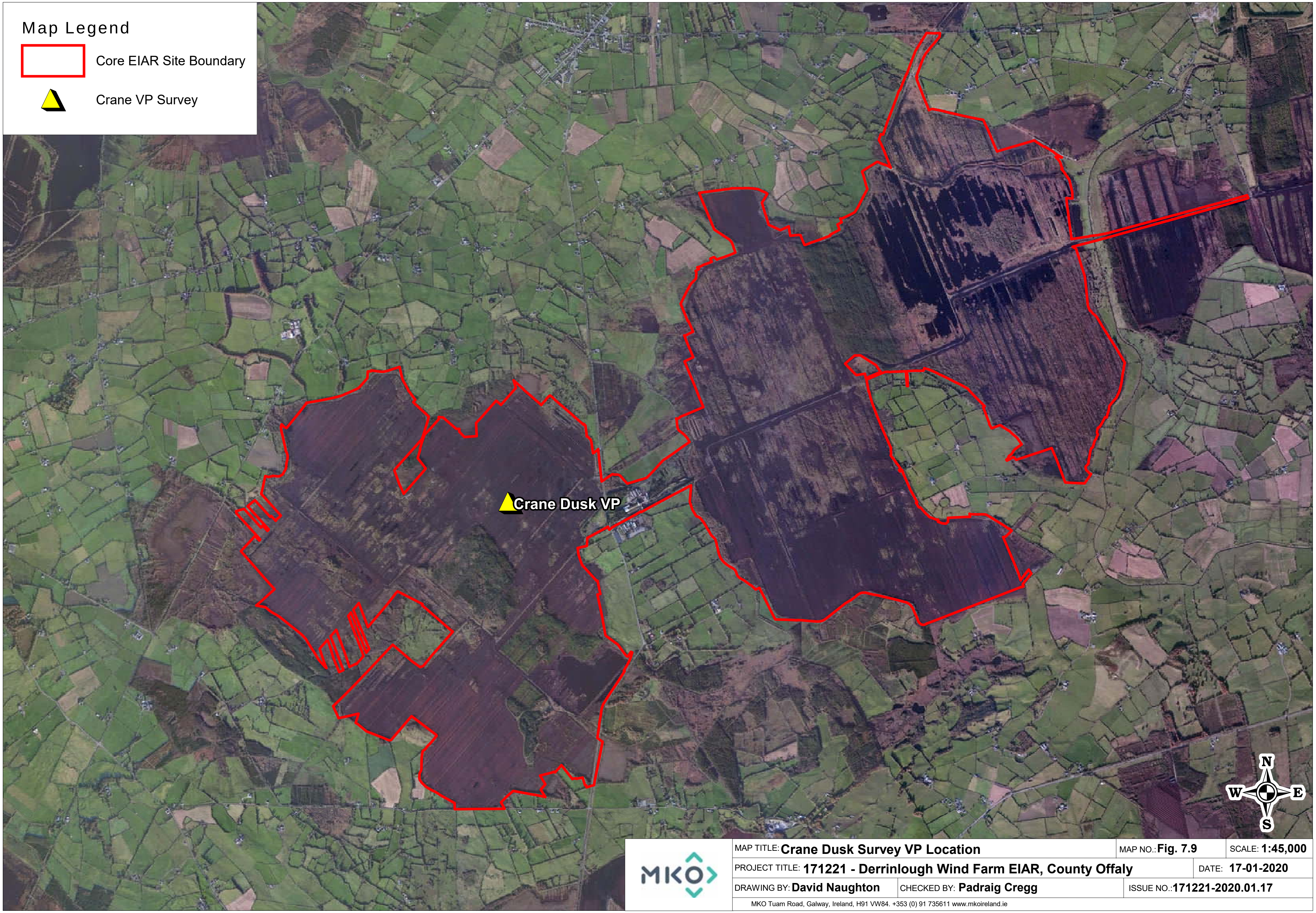
Map Legend
Core EIAR Site Boundary
Crane VP Survey
Crane Dusk VP
N
W
E
S
MKO
MAP TITLE: Crane Dusk Survey VP Location
MAP NO.: Fig. 7.9
SCALE: 1:45,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
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7.2.5 Ornithological Evaluation Criteria and Impact Assessment Methodology

7.2.5.1 Potential Effects Associated with Proposed Development

As per SNH Guidance, wind farms present three potential risks to birds (Drewitt & Langston 2006, 2008; Band et al. 2007):

- **Direct habitat loss** through construction of wind farm infrastructure;
- **Displacement** (sometimes called indirect habitat loss) if birds avoid the wind farm and its surrounding area due to turbine construction and operation. Displacement may also include barrier effects in which birds are deterred from using normal routes to feeding or roosting grounds;
- Death through **Collision** or interaction with turbine blades and other infrastructure.

For each of these three risks, the detailed knowledge of bird distribution and flight activity within and surrounding the site (which has been obtained through the studies outlined in section 7.1) has been utilised to predict the potential significant effects of the Proposed Development on birds. Potential significant effects will be assessed with regard to the construction phase, the operational phase and the decommissioning phase. They are also assessed cumulatively with other projects.

7.2.5.2 Geographical Framework

The Guidelines for Ecological Impact Assessment (EcIA) (CIEEM 2018) recommends categories of ornithological or nature conservation value that relate to a geographical framework (e.g. international, through to local). This assessment utilises the geographical framework described in Guidelines for Assessment of Ecological Impact of National Road Schemes (NRA 2009). The guidelines provide a basis for determination of whether a site is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of importance only in the local area. Internationally Important sites are designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna.

7.2.5.3 Receptor Evaluation and Impact Assessment (Percival 2003)

Percival's (2003) methodology for assessing the effects of wind farms on birds has been applied to assess the sensitivity of a species to the development type, the magnitude of the effect and the significance of the potential impact. The following tables (Table 7-3 - Sensitivity, Table 7-4 – Magnitude of effect, Table *7-5* – Determination of significance) outline the assessment criteria for each stage.

Table 7-3 Evaluation of Sensitivity for Birds (Percival 2003)

Sensitivity	Determining Factor
Very High	Species that form the cited interest of SPA's and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.

Sensitivity	Determining Factor
High	Species that contribute to the integrity of an SPA but which are not cited as a species for which the site is designated. Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, red necked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% Irish population)
Medium	Species on Annex 1 of the EU Birds Directive. Species present in regionally important numbers (>1% regional (county) population). Other species on BirdWatch Ireland's red list of Birds of Conservation Concern
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

Table 7-4 Determination of Magnitude of Effects (Percival 2003)

Sensitivity	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: < 20% of population / habitat remains
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. Guide: 20-80% of population/ habitat lost
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. Guide: 5-20% of population/ habitat lost
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/ habitat lost
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. Guide: < 1% population/ habitat lost

Table 7-5 Significance matrix: combining magnitude and sensitivity to assess significance (Percival 2003)

Significance		Sensitivity			
		Very High	High	Medium	Low
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Very Low
	Low	Medium	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low

7.2.5.4 Impact Assessment – EPA Criteria (2017 Draft)

EPA impact assessment criteria are described below and outlined in Table 7-6 and Table 7-7.

The following terms were utilised when quantifying duration and frequency of effects:

- Momentary – effects lasting from seconds to minutes
- Brief – effects lasting less than a day
- Temporary – effects lasting less than a year
- Short-term – effects lasting 1 to 7 years
- Medium term – effects lasting 7 to 15 years
- Long term – effects lasting 15 to 60 years
- Permanent – effects lasting over 60 years
- Reversible – effects that can be undone, for example through remediation or restoration
- Frequency – How often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

Table 7-6 Criteria for assessing impact significance based on (EPA, 2017)

Impact Magnitude	Definition
No change	No discernible change in the ecology of the affected feature
Imperceptible Effect	An effect capable of measurement but without significant consequences
Slight Effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effect	An effect that alters the character of the environment that is consistent with existing and emerging baseline trends
Significant Effect	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effect	An effect which obliterates sensitive characteristics

Table 7-7 Criteria for assessing impact quality based on (EPA, 2017)

Impact Type	Criteria
Positive	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities
Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
Negative	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance)

7.2.5.5 Collision Risk Assessment

Collision risk is calculated using a mathematical model to predict the numbers of individual birds, of a particular species, that may be killed by collision with moving wind turbine rotor blades. The modelling method used in this collision risk calculation follows Scottish Natural Heritage (SNH) guidance which is sometimes referred to as the Band Model (Band et al. (2007).

Two stages are involved in the model:

- Stage 1: Determination of the number of birds or flights passing through the air space swept by the rotor blades of the wind turbines.
- Stage 2: Calculation of the probability of a bird strike occurring.

Please see Appendix 7.6 for full details on the collision risk modelling method.

7.2.6 Survey Justification

A comprehensive suite of bird surveys has been undertaken at the Proposed Development site between October 2017 and September 2019. This data is supplemented by additional data from surveys undertaken on the site by BES between October 2014 and September 2017. These surveys recorded a similar species assemblage and similar activity levels.

Results are derived from a continuous two years of surveying undertaken in line with SNH Guidance. These are the results that are analysed to inform this assessment.

The proposed development footprint, including the cable route and substation, is located entirely within the proposed development site. The proposed development was subject to a various suite of comprehensive survey methods during both the breeding and winter seasons.

The surveys undertaken provide the information necessary to allow a complete, comprehensive and robust assessment of the potential impacts of the Proposed Development on avian receptors.

7.2.6.1 Mitigation

The development has been designed to specifically avoid, reduce or offset effects on all Ornithological Receptors. Where potential effects on KORs are predicted, mitigation has been prescribed to avoid, reduce or offset such effects.

Proposed best practice design and mitigation measures are specifically set out and are realistic in terms of cost and practicality. They have been subject to detailed design and will effectively address the effects on the identified KORs.

The potential significant effects of the Proposed Development were considered and assessed to ensure that all effects on KORs are adequately addressed and no significant residual effects are likely to remain following the implementation of mitigation measures / best practice.

7.2.6.2 Limitations

The information provided in this EIAR chapter accurately and comprehensively describes the baseline environment; provides an accurate prediction of the likely effects of the Proposed Development; prescribes mitigation as necessary; and describes the predicted residual impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines. No significant limitations in the scope, scale or context of the assessment have been identified.

7.3 Baseline Conditions and Receptor Evaluation

7.3.1 Identification of Designated Sites within the Likely Zone of Influence of the Development

An Article 6(3) Screening Report and Natura Impact Statement were prepared to provide the competent authority with the information necessary to complete an Appropriate Assessment for the Proposed Development in compliance with Article 6(3) of the Habitats Directive.

Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs) are designated under the EU Habitats Directive and EU Birds Directive, respectively and are collectively known as 'European Sites'. The potential for significant effects and/or adverse impacts on the integrity of European Sites is fully assessed in the AA Screening Report and Natura Impact Statement that accompanies this application. As per EPA draft Guidance 2017, "a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement" but should "incorporate their key findings as available and appropriate".

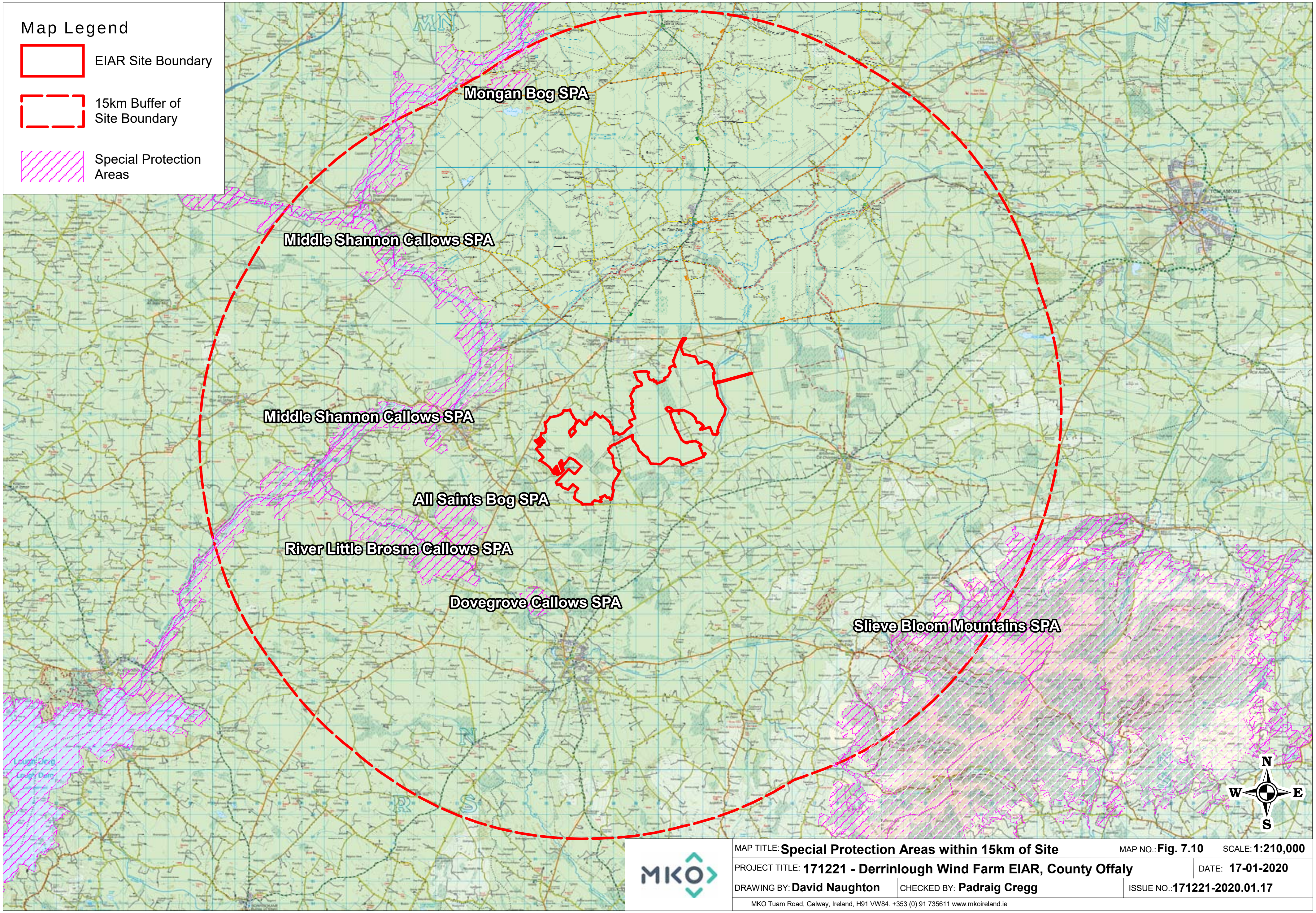
A list of the SPAs within the potential zone of influence of the development site and the associated Species of Conservation Interest (SCI) and Conservation Objectives are provided in Table 7.8 below. Potential significant effects and / or adverse impacts on Special Protection Areas are assessed in detail in the Appropriate Assessment and Natura Impact Statement provided in support of this application.

The following methodology was used to establish sites that are designated for nature conservation and have the potential to be impacted by the proposed development:

- Initially the most up to date GIS spatial datasets for European and Nationally designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 06/12/2019. The datasets were utilised to identify Designated Sites which could feasibly be affected by the proposed development.
- All designated sites within a distance of 15km surrounding the development site were identified. In addition, the potential for connectivity with European or Nationally designated sites at distances of greater than 15km from the proposed development was also considered in this initial assessment.
- Table 7.8 provides details of all relevant SPAs identified in the preceding steps and assesses which are within the likely Zone of Impact. All European Designated Sites are fully described and assessed in the Screening for Appropriate Assessment and Natura Impact Statement reports submitted as part of this planning application.

In addition, and in the absence of any specific European or Irish guidance, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between Proposed Development and Special Protection Areas. The guidance takes into consideration the distances some species may travel beyond the boundary of their SPAs and outlines information on dispersal and foraging ranges of bird species which are frequently encountered when considering projects.

SPAs located within the Likely Zone of Influence of the development are listed below in Table 7-8 and illustrated on Figure 7.10.



MAP TITLE: **Special Protection Areas within 15km of Site**	MAP NO.: **Fig. 7.10**	SCALE: **1:210,000**
PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR, County Offaly**		DATE: **17-01-2020**
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Table 7-8 Designated Sites in the Zone of Influence

Special Protection Areas and distance from proposed development	Qualifying Interests/Special Conservation Interests for which the European Site has been designated (https://www.npws.ie, 21/02/2018)	Conservation Objectives
Middle Shannon Callows SPA (004096) 2.33 km to the west of the development site.	- Whooper Swan *(Cygnus Cygnus)* [A038] - Wigeon *(Anas penelope)* [A050] - Corncrake *(Crex crex)* [A122] - Golden Plover *(Pluvialis apricaria)* [A140] - Lapwing *(Vanellus vanellus)* [A142] - Black-tailed Godwit *(Limosa Limosa)* [A156] - Black-headed Gull *(Larus ridibundus)* [A179] - Wetland and Waterbirds [A999]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at Middle Shannon Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it." (NPWS (2018) Conservations objectives for Middle Shannon Callow SPA [004096]. Generic version 6.0)
All Saints Bog SPA (004103) 2.69 km southwest of the development site.	- Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." (NPWS (2018) Conservations objectives for All Saints Bog SPA [004103]. Generic version 6.0)
Dovegrove Callows SPA (004137) 4.21 km to the south of the development site.	- Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." (NPWS (2018) Conservations objectives for Dovegrove Callows SPA [004137]. Generic version 6.0)

Special Protection Areas and distance from proposed development	Qualifying Interests/Special Conservation Interests for which the European Site has been designated (https://www.npws.ie, 21/02/2018)	Conservation Objectives
River Little Brosna Callows SPA (004086) 4.48 km to the southwest of the development site.	- Whooper Swan *(Cygnus Cygnus)* [A038] - Wigeon *(Anas penelope)* [A050] - Teal *(Anas creca)* [A052] - Pintail *(Anas acuta)* [A054] - Shoveler *(Anas clypeata)* [A056] - Golden Plover *(Pluvialis apricaria)* [A140] - Lapwing *(Vanellus vanellus)* [A142] - Black-tailed Godwit *(Limosa Limosa)* [A156] - Black-headed Gull *(Larus ridibundus)* [A179] - Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395] - Wetland and Waterbirds [A999]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at River Little Brosna Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it." (NPWS (2018) Conservations objectives for Middle Shannon Callow SPA [004086]. Generic version 6.0)
Slieve Bloom Mountains SPA (004160) 11.64 km to the southeast of the development site.	- Hen Harrier *(Circus cyaneus)* [A082]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." (NPWS (2018) Conservations objectives for Slieve Bloom Mountains SPA [004160]. Generic version 6.0)
River Suck Callows SPA (004097) 12.30 km northwest of the development site.	- Whooper Swan *(Cygnus Cygnus)* [A038] - Wigeon *(Anas penelope)* [A050] - Golden Plover *(Pluvialis apricaria)* [A140] - Lapwing *(Vanellus vanellus)* [A142] - Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395] - Wetland and Waterbirds [A999]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at River Suck Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise

Special Protection Areas and distance from proposed development	Qualifying Interests/Special Conservation Interests for which the European Site has been designated (https://www.npws.ie, 21/02/2018)	Conservation Objectives
		it.” (NPWS (2018) Conservations objectives for River Suck Callow SPA [004097]. Generic version 6.0)
Mongan Bog SPA 13.3km	- Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: ‘*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA*,’ (NPWS, version 6, 2018).
Lough Derg (Shannon) SPA 19km	- Cormorant (Phalacrocorax carbo) [A017] - Tufted Duck (Aythya fuligula) [A061] - Goldeneye (Bucephala clangula) [A067] - Common Tern (Sterna hirundo) [A193] - Wetland and Waterbirds [A999]	This site has the generic conservation objective: *To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA*.’ (NPWS Generic version 6.0, 2018) There is a second conservation objective for this site: *To maintain or restore the favourable conservation condition of the wetland habitat at Lough Derg (Shannon) SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.*

7.3.2 Breeding and Wintering Bird Atlas Records

Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland' (Balmer et al., 2013) is the most recent comprehensive work on wintering and breeding birds in Ireland.

Previous Bird Atlases have been the primary source of information on the distribution and abundance of British and Irish birds prior to Bird Atlas 2007–11. The three previously published atlases were:

- Sharrock, J.T.R. (1976) The atlas of breeding birds in Britain and Ireland.
- Lack, P.C. (1986) The atlas of wintering birds in Britain and Ireland.
- Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The new atlas of breeding birds in Britain and Ireland: 1988-1991.

The entire development site lies within hectads N01 and N11.

Table 7-9 presents a list of species of conservation interest species recorded from the relevant hectads:

Table 7-9 Breeding Bird Atlas Data (Hectads N01 and N11)

Species Name	Breeding Atlas 68-72		Breeding Atlas 88-91		Breeding Atlas 07-11		Conservation Status
	N01	N11	N01	N11	N01	N11	
Nightjar *(Caprimulgus europaeus)*	Poss	Prob	-	-	-	-	BD, RL
Dunlin *(Calidris alpina)*	-	-	-	-	-	Non-B	RL
Hen Harrier *(Circus cyaneus)*	Conf	Conf	-	-	-	Non-B	BD
Corncrake *(Crex crex)*	Conf	Prob	Breed	-	Conf	-	BD, RL
Kingfisher *(Alcedo atthis)*	Conf	Conf	Seen	Seen	Poss	Poss	BD
Marsh Harrier *(Circus aeruginosus)*	-	-	-	-	Non-B	Non-B	BD
Barn Owl *(Tyto alba)*	Conf	Conf	Seen	-	Poss	-	RL
Quail *(Coturnix coturnix)*	-	-	Seen	-	Prob	Poss	RL
Grey Partridge *(Perdix perdix)*	Conf	Conf	-	Breed	Poss	Conf	RL
Redshank *(Tringa totanus)*	-	-	Breed	-	Prob	Conf	RL
Woodcock *(Scolopax rusticola)*	Conf	Conf	Seen	-	Prob	Prob	RL
Tufted Duck *(Aythya fuligula)*	-	-	-	-	Poss	Conf	RL
Wigeon *(Anas penelope)*	-	-	Seen	-	-	Prob	RL
Pochard *(Aythya ferina)*	-	Conf	-	-	-	-	RL
Red Grouse *(Lagopus lagopus)*	Conf	Conf	-	-	-	-	RL

Species Name	Breeding Atlas 68-72		Breeding Atlas 88-91		Breeding Atlas 07-11		Conservation Status
	N01	N11	N01	N11	N01	N11	
Lapwing *(Vanellus vanellus)*	Conf	Conf	Breed	Breed	Conf	Conf	RL
Curlew *(Numenius arquata)*	Conf	Conf	Breed	Seen	Conf	Non-B	RL
Black-headed Gull *(Larus ridibundus)*	Conf	-	-	Seen	Prob	Conf	RL
Meadow Pipit *(Anthus pratensis)*	Conf	Conf	Breed	Breed	Conf	Conf	RL
Grey Wagtail *(Motacilla cinerea)*	Conf	Conf	Breed	Breed	Conf	Prob	RL
Whinchat *(Saxicola rubetra)*	-	-	Seen	Seen	Conf	-	RL
Yellowhammer *(Emberiza cintrinella)*	Conf	Conf	Seen	Seen	Poss	Prob	RL

BD=Birds Directive; RL = BoCCI Red List; Seen = recorded; Breed = breeding; Non-B = non-breeding; Poss = possible breeding; Prob = probable breeding; Conf = confirmed breeding; - = Not Recorded

Six species listed in Annex I of the EU Birds Directive have been recorded within the relevant ten-kilometre squares during surveys for past breeding bird atlases. Sixteen bird species have been recorded in hectads N01 and or N11 during past breeding bird atlas surveys which are listed on the BoCCI Red List.

Table 7-10 shows those species recorded in the relevant hectads (N01 and N11) in the wintering birds' atlases that are also protected under the EU Birds Directive or mentioned on the Birds of Conservation Concern in Ireland (BoCCI) red list.

Table 7-10 Wintering Bird Atlas Data (Hectads N01 & N11)

Species Name	Wintering Atlas 81-84		Wintering Atlas 07-11		Conservation Status
	N01	N11	N01	N11	
Golden Plover *(Pluvialis apricaria)*	Pres	-	Pres	Pres	BD, RL
Whooper Swan *(Cygnus cygnus)*	Pres	-	Pres	Pres	BD
Hen Harrier *(Circus cyaneus)*	-	-	Pres	Pres	BD
Greenland White-fronted Goose *(Anser albifrons flavirostris)*	-	-	Pres	Pres	BD
Kingfisher *(Alcedo atthis)*	Pres	-	Pres	Pres	BD
Little Egret *(Egretta garzetta)*	-	-	Pres	Pres	BD
Peregrine *(Falco peregrinus)*	Pres	-	Pres	-	BD
Merlin *(Falco columbarius)*	Pres	-	Pres	Pres	BD
Bar-tailed Godwit *(Tyto alba)*	-	-	Pres	-	BD
Ruff *(Philomachus pugnax)*	-	-	Pres	-	BD

Species Name	Wintering Atlas 81-84		Wintering Atlas 07-11		Conservation Status
	N01	N11	N01	N11	
Short-eared Owl *(Tyto alba)*	-	-	Pres	-	BD
Barn Owl *(Tyto alba)*	Pres	-	Pres	Pres	RL
Wigeon *(Anas penelope)*	Pres	-	Pres	Pres	RL
Shoveler *(Anas clypeata)*	-	-	Pres	-	RL
Pintail *(Anas acuta)*	-	-	Pres	-	RL
Pochard *(Aythya ferina)*	-	-	Pres	Pres	RL
Tufted Duck *(Aythya fuligula)*	-	-	Pres	Pres	RL
Lapwing *(Vanellus vanellus)*	Pres	Pres	Pres	Pres	RL
Redshank *(Tringa totanus)*	-	-	Pres	Pres	RL
Goldeneye *(Bucephala clangula)*	-	-	-	Pres	RL
Woodcock *(Scolopax rusticola)*	Pres	Pres	Pres	Pres	RL
Black-headed Gull *(Larus ridibundus)*	Pres	Pres	Pres	Pres	RL
Grey Partridge *(Perdix perdix)*	-	-	Pres	Pres	RL
Curlew *(Numenius arquata)*	-	-	Pres	Pres	RL
Dunlin *(Calidris alpina)*	-	-	Pres	-	RL
Meadow Pipit *(Anthus pratensis)*	Pres	Pres	Pres	Pres	RL
Grey Wagtail *(Motacilla cinerea)*	Pres	-	Pres	Pres	RL
Yellowhammer *(Emberiza cintrinella)*	Pres	-	-	-	RL

BD = EU Birds Directive Annex I; RL = BoCCI Red List; Pres = present in hectad; - = not recorded

Eleven species listed in Annex I of the EU Birds Directive have been recorded within the relevant ten-kilometre squares during surveys for past wintering bird atlases: A further seventeen bird species have been recorded in hectads N01 and or N11during past wintering bird atlas surveys which are listed on the BoCCI Red List.

7.3.3 Bird Sensitivity Mapping Tool

A Bird Sensitivity Mapping Tool for wind energy development was developed by BirdWatch Ireland and provides a measured spatial indication of where protected birds are likely to be sensitive to wind energy developments. The tool can be accessed via the National Biodiversity Data Centre Website (www.biodiversityireland.ie) and is accompanied by a guidance document (McGuiness et al. (2015).

The criteria for estimating a zone of sensitivity (i.e. 'low', 'medium', 'high' and 'highest') is based on a review of the behavioural, ecological and distributional data available for each species.

The majority of the development site is located within a *Low* bird sensitivity zone. A small area to the west of the Derrinlough briquette factory is located within an area with no data on bird sensitivity to wind energy. This area with no data available includes turbine T7. A small area to the east of the briquette factory is located within a *Medium* bird sensitivity zone. This area classified as a *Medium* bird sensitivity zone includes turbines T13 and T20. These areas were surveyed as part of the extensive survey scope.

7.3.4 Irish Wetland Bird Survey (IWeBS) Records

The study area is not covered by an IWeBS site and the nearest site (Cloghanhill) is located approximately 1.2km to the north of the development site boundary. Data from IWeBS sites in County Offaly has been used to estimate wintering populations of waterbirds identified as KORs. Datasets for the following sites were downloaded from www.birdwatchireland.ie and reviewed:

Offaly IWeBS Sites

- Blackwater Railway Lake
- Boora Lakes – Back Lakes Finnamores
- Cloghanhill
- Little Brosna Callows
- Little Brosna Callows (aerial)
- Raheen Lough
- Shannon Callows
- Shannon Callows (aerial)
- Turraun Nature Reserve

Furthermore, detailed IWeBS data was received from Birdwatch Ireland on the 12th of September 2018, including data from all IWeBS survey sites within several kilometres of the development site. Species specific information is provided below in Section 7.6, where relevant.

7.3.5 NPWS Rare and Protected Species Dataset

An information request was sent to the NPWS requesting records from the Rare and Protected Species Database on the 14th of February 2019. A subsequent follow up email was sent in August 2019 requesting any newly recorded bird data which may have subsequently been made available. The sections below provide the records obtained from the NPWS from the most recent data request response (30th December 2019) regarding rare and protected bird species.

Corncrake

The NPWS identified that there were two historical records of corncrake within the hectad N01 from a survey in 2010. These birds were recorded between 3-5km from the development boundary. It is believed that the records of corncrake from these surveys occurred exclusively along the Shannon Callows, several kilometres to the west of the development site, during the 2010 breeding season. Furthermore, this species has experienced a severe decline in recent years with breeding pairs very rare. It is highly unlikely that the development site or surrounding areas have the potential to support breeding corncrake populations.

Curlew

The NPWS identified one confirmed breeding curlew pair in 2017 within the 10km hectad N01. This confirmed breeding curlew pair was recorded between 3-5km from the development boundary.

7.3.6 Literature Review

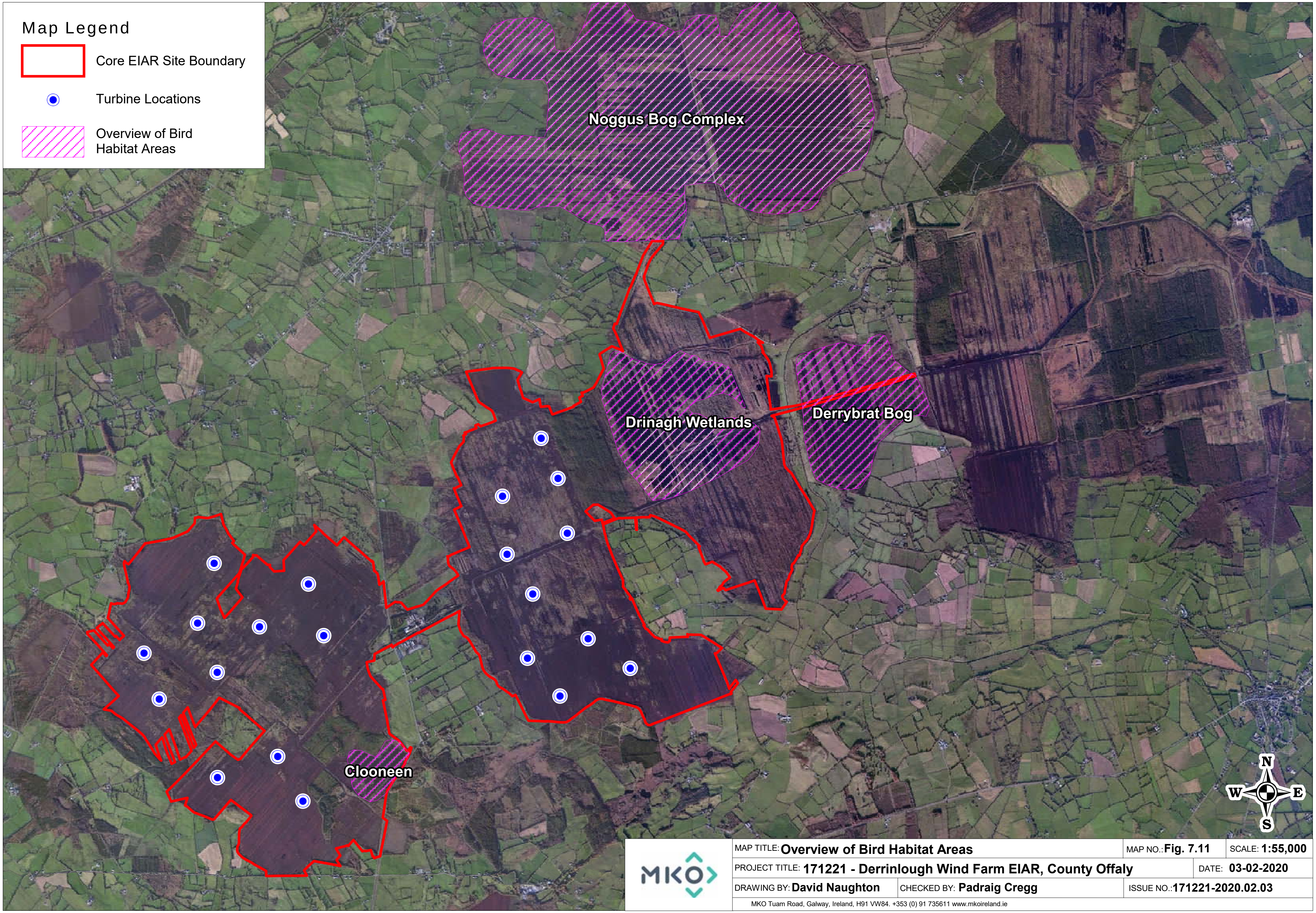
A review of relevant literature that detailed sensitive breeding records for the development site was undertaken as part of the desk study for the development site. Due to the confidential nature regarding this information, detail from the literature review has been placed in Confidential Appendix 7.5.

7.4 Field Survey Results

A comprehensive list of all bird species recorded during surveys is provided in Table 2 of Appendix 7.1. The target species listed below were recorded within the zone of influence of the Proposed Development during the ornithological surveys. The list is ordered in accordance with conservation significance: Annex I species, SCIs of designated sites, Red listed species and raptors.

- Whooper Swan (Annex I species)
- Golden Plover (Annex I species)
- Red-necked Phalarope (Annex I species)
- Hen Harrier (Annex I species)
- Common Crane (Annex I species)
- Kingfisher (Annex I species)
- Little Egret (Annex I species)
- Marsh Harrier (Annex I species)
- Merlin (Annex I species)
- Peregrine (Annex I species)
- Lapwing (Red listed with regard to Breeding and Wintering populations)
- Black-headed Gull (Red listed with regard to Breeding populations)
- Herring Gull (Red listed with regard to Breeding populations)
- Woodcock (Red listed with regard to Breeding populations)
- Curlew (Red listed with regard to Breeding and Wintering populations)
- Dunlin (Red listed with regard to Breeding and Wintering populations)
- Redshank (Red listed with regard to Breeding and Wintering populations)
- Shoveler (Red listed with regard to Wintering populations)
- Tufted Duck (Red listed with regard to Wintering populations)
- Wigeon (Red listed with regard to Wintering populations)
- Long-eared Owl (Raptor, Schedule IV of the Wildlife Act; 1976)
- Buzzard (Raptor, Schedule IV of the Wildlife Act; 1976)
- Sparrowhawk (Raptor, Schedule IV of the Wildlife Act; 1976)
- Kestrel (Raptor, Schedule IV of the Wildlife Act; 1976)
- Snipe (Amber listed with regard to Breeding andWintering populations)
- Ringed Plover (Green listed with regard to Breeding & Wintering populations)
- Teal (Amber listed with regard to Breeding and Wintering populations; SCI of River Little Brosna Callows SPA)
- Black-tailed Godwit (Amber listed with regard to Wintering populations; SCI of River Little Brosna Callows SPA)

The following sections describe the observations of each target species under the individual survey headings. There are several defined areas utilised by birds which are mentioned throughout this chapter. The locations of these areas in relation to the development site can be found on Figure 7.11. Survey data and mapping for each target species is provided in the technical appendices (Appendices 7-2 to 7-5). Appendix 7.3 presents results summary tables including:



Map Legend
Core EIAR Site Boundary
Turbine Locations
Overview of Bird Habitat Areas
Noggus Bog Complex
Drinagh Wetlands
Derrybrat Bog
Clooneen
N
W
E
S
MKO
MAP TITLE: Overview of Bird Habitat Areas
MAP NO.: Fig. 7.11
SCALE: 1:55,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR, County Offaly
DATE: 03-02-2020
DRAWING BY: David Naughton
CHECKED BY: Padraig Cregg
ISSUE NO.: 171221-2020.02.03
MKO Tuam Road, Galway, Ireland, H91 VW84. +353 (0) 91 735611 www.mkoireland.ie

- Summary of seasonal Vantage Point Survey Effort.
- Summary of the monthly distribution of flight activity recorded for the target species during the vantage point watches (VPs).
- Summary of observations at Potential Collision Height for target species during VPs.
- Summary of the monthly distribution of flight activity recorded for the non-target species during VPs.
- Summary of monthly distribution of target species during Breeding Bird Surveys.
- Summary of monthly distribution of non-target species during Breeding Bird Surveys.
- Summary of monthly distribution of Breeding Raptor Survey results.
- Summary of monthly target species distribution during Winter Transect/Waterfowl Surveys.

7.4.1 Whooper Swan

Raw Survey data for whooper swan is provided in Appendix 7.4. Results summary tables are presented in Appendix 7.3.

Vantage Point Surveys

Whooper swan were recorded in flight on 62 occasions during Vantage Point Surveys (see Appendix 7.4, Figure 7.1.1). Twenty- nine observations occurred during the 2018/2019 winter season, between October 2018 and December 2018. The maximum flock size recorded during the 2018/2019 winter season was eight birds. The remaining 33 observations occurred during the 2017/2018 winter season, between October 2017 and February 2018. The maximum flock size recorded during the 2017/2018 winter season was 227 birds. All records of large whooper swan flocks from the 2017/2018 winter season were associated with birds roosting at the Drinagh wetlands, more than 500m east of the nearest turbine. Only seven of the 62 observations occurred within the potential collision risk zone of swept turbines.

Twenty-seven of the 62 flights occurred within 500m of the proposed turbine layout. Thirty-one observations were noted by the surveyor as birds travelling over the proposed development site. Thirty-one observations were of birds landing or flying from areas of flooded cutover bog (see Appendix 7.4, Figure 7.1.1).

In addition to the 62 observations of birds in flight, there were also thirteen observations of whooper swan either heard calling but not seen or observed roosting, feeding and or preening on flooded areas of cutover bog. Observations ranged from a pair to a flock of 163 birds. On the 13th of December 2017 a flock of 163 whooper swan were recorded preening on ponds to the east of the Drinagh wetlands, while a flock of 61 birds were also recorded roosting at the Drinagh wetlands on the same day.

Winter Transect/Waterfowl Surveys

Whooper swan were recorded on 53 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.1). Fifty-two of the 53 observations occurred between October 2018 and March 2019, while there was one observation from September 2019. Numbers recorded ranged from individuals to a maximum flock of 24 birds.

Five distinct roosting/foraging areas for whooper swan were recorded within one kilometre of the development site, three of which were within proximity of the development footprint, while birds were also recorded at the Drinagh wetlands and Noggus which is located to the north of the proposed development boundary. The majority of all roosting and foraging activity occurred around the Drinagh wetlands to the east of turbines with 21 observations in this area including all observations of large flocks (see Figure 7.7.1.1 in Appendix 7.4).

In addition, there were five observations of whooper swan recorded during winter transect surveys from the 2017/18 winter season. All five observations occurred around the Drinagh Wetlands east of the turbines. Three observations occurred during a survey on the 11th of November 2017 while there were two further observations from the 25th of January 2018.

Migratory Bird Surveys

Whooper Swan were only recorded on eleven occasions during Migratory Bird Surveys along the River Shannon and Little Brosna River between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.1). No evidence of birds commuting between the proposed development and the River Shannon or Little Brosna River was recorded. Only four of the eleven observations consisted of birds seen flying in the general direction to or from the proposed development site, while the remaining seven observations consisted of birds seen in flight over the Shannon to the north of Banagher. Numbers recorded ranged from a pair to a flock of 29.

Incidental Observations

There were two incidental observations of whooper swan during Hen Harrier Roost Surveys. On the 26th of October 2018 during a survey at HHVP6 a flock of eight swans were seen travelling towards the development site. On the 21st of March 2019 during a survey at HHVP3 a flock of eight swans were seen roosting on a flooded area of cutover bog at Derrybrat to the east of turbines. There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5. Relevant records pertaining to Whooper Swan are outlined below.

- **2014/15 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog (west of briquette factory) on six dates during the 2014/15 winter season in small flocks (maximum eight birds). This species was more regularly recorded at Drinagh Bog (east of briquette factory), observed on 13 dates through the winter though again mostly in small numbers (>10 birds). A flock of 50+ swans was present on the 12th of November 2014.
- **2015/16 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog on three dates during the winter season in small flocks (maximum eight birds). Birds were more regularly recorded at Drinagh Bog, observed on six dates through the winter though again mostly in small numbers (maximum 11 birds).
- **2016 Breeding Season:** A single whooper swan was present from the 12th of April to at least the 9th of May 2016. While not appearing injured, the bird may have suffered an injury to prevent it from migrating to the breeding grounds.
- **2016/17 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog on four dates during the winter season in small flocks (maximum eight birds). Birds were much more frequently recorded at Drinagh Bog, observed on several dates throughout the winter in larger flocks (up to 33 birds in November, but in separate flocks of no greater than ten birds per group).

7.4.2 Golden Plover

Raw Survey data for golden plover is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Golden plover were recorded in flight on 33 occasions during Vantage Point Surveys (see Appendix 7.4, Figure 7.1.2). Twenty-three of the 33 flights occurred within the potential collision risk zone for turbine swept area. All observations of golden plover occurred during the winter months (October – April), only a few observations occurred during April which was likely to be from a lingering wintering population.

Fourteen of the 33 flights were recorded during the 2017/2018 winter season, while the remaining 19 observations occurred during the 2018/2019 winter season (October – April). Observations ranged from flocks of three to 220 birds. Six of the 33 flights were of flocks of golden plover observed more than 500m to the east of the proposed turbines over the Drinagh wetlands. Much of the golden plover flight activity is associated with a discrete few areas of suitable habitat or involved birds traveling between these areas (See Appendix 7.4, Figure 7.1.2).

In addition to the 33 observations of birds in flight, there were also three observations of birds which were not seen in flight. On the 9th of January 2018, a flock of golden plover were heard calling while in flight during a survey at VP6 to the north of the site, these birds were not seen. On the 25th of October 2017, a flock of 16 golden plover were observed roosting on bare peat within the development site and also within 500m of the proposed turbines. On the 15th of January 2018, a flock of 30 golden plover were observed resting on bare peat within the proposed development site and also within 500m of the proposed turbines.

Breeding Bird Surveys

Golden plover were recorded on eight occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.1). Seven of the eight observations occurred during April 2018. The remaining observation occurred on the 9th of April 2019 as a flock of 60 birds were recorded travelling over the site. No evidence of breeding activity was recorded. All observations are likely to be associated with a lingering wintering population. Observations ranged from a pair of birds to a flock of 110 birds.

Four observations consisted of flocks roosting on areas of cutover bog, while the remaining four observations consisted of flocks in flight travelling over the development site.

Winter Transect/Waterfowl Surveys

Golden plover were only recorded on eight occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.2). Five of the eight observations occurred during October 2018, while a single bird was seen foraging at an area of flooded cutover bog, to the north of the development site at Noggus bog on the 23rd of May 2019. Five observations occurred onsite and within 500m of the proposed turbine locations, within the Clongawny side of the development site. On the 3rd of October 2018 a flock of 46 birds were recorded in flight over the Drinagh wetlands to the east of proposed turbines. On the 5th of October 2018 a flock of ten golden plover were recorded roosting on an area of cutover bog in the northeast corner of the development site around the Stonestown area, more than 500m from the nearest proposed turbine. The largest flock recorded within the Clongawny section of the development site during these surveys was a flock of four birds.

Migratory Bird Surveys

Golden plover were observed on 22 occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.2). Nineteen of the 22 observations consisted of birds recorded in flight over the Shannon and adjacent grasslands, with evidence recorded of birds travelling to or from the direction of the development site. In addition, there were three observations of flocks of 70 – 550 birds recorded in flight around the Little Brosna River and Dovegrove Callows SPA to the south of the development site. None of these three observations indicate that these birds were coming from or going to the proposed development area. Numbers recorded during Migratory Bird Surveys ranged from a flock of three birds to a flock of 2,000 birds.

Incidental Observations

There was one incidental observation of golden plover between October 2017 and September 2019. On the 10th of December 2018 golden plover was recorded as an incidental during a Hen Harrier Roost Survey at HHVP6.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog (west of briquette factory) on six dates during the 2014/15 winter season in small to large flocks (maximum 400 birds). This species was also recorded on six dates at Drinagh Bog (east of briquette factory), again in small to large flocks (maximum 62 birds). Most observations of this species were of birds travelling over the site and not utilising areas within Derrinlough for roosting or feeding on a regular basis.
- **2015/16 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog on four dates during the 2015/16 winter season in small to large flocks (maximum 120 birds). This species was also recorded on seven dates at Drinagh Bog but with much larger flocks observed (maximum 345 birds).
- **2016/17 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog on four dates during the 2016/17 winter season in small to large flocks (maximum 600 birds). Birds were much more frequently recorded at Drinagh Bog, observed on ten dates throughout the winter in small to large flocks (maximum flock of c.1,000 birds).
- **2017 Breeding Season:** Golden plover were recorded once during the 2017 breeding season as a flock of c.40 birds flew over Clongawny bog on the 21st of April.

7.4.3 Red-necked Phalarope

Raw Survey data for red-necked phalarope is provided in Confidential Appendix 7.5.

Breeding Bird Surveys

Red-necked phalarope were only recorded twice during Breeding Bird Surveys (see Appendix 7.5, Figure 7.3.2). One observation occurred on the 19th of June while the other occurred on the 21st of June 2018. These were presumed to be the same individual. Further details are provided in Confidential Appendix 7.5.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results from the 2014/15, 2015/16, 2016/17 and 2017/18 are all located in Appendix 7.7. Due to the sensitive nature of some of the observations during both the 2016 and 2017 breeding seasons, these reports have been redacted and placed in Confidential Appendix 7.5.

7.4.4 Hen Harrier

Raw Survey data for hen harrier is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Hen harrier were recorded on 21 occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.3). Only seven of the 21 observations of birds in flight occurred within, or partially within, 500m of the proposed turbine layout. The majority of hen harrier flight activity occurred around the Drinagh wetlands to the east of the proposed turbines. All 21 observations were of individual birds in hunting flights over areas of cutover bog. Fourteen of the 21 observations occurred during the non-breeding season months (September – March), while there were seven observations during the core breeding season for hen harrier (April – August). All observations from the core breeding season consisted of ringtails (female or juvenile birds). No males were observed during this survey period and no evidence of breeding was recorded.

Five observations were recorded during the 2017/18 winter season, between the months of October and February. Four observations were recorded during the 2018 breeding season, between the months of May and August. Nine observations occurred during the 2018/19 winter season, between the months of October and March. Finally, there were three observations of a female hen harrier hunting around the Drinagh wetlands to the east of the proposed turbines in early August 2019.

Only two of the 21 flights occurred within the Potential Collision Height (PCH), while the remaining 19 observations occurred below the potential lowest rotor swept height.

Breeding Bird Surveys

Hen harrier were only recorded once during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.3). An adult male was seen in a hunting flight on the 14th of June 2019 in the northwest corner of the development site, more than 500m from the nearest turbine, before flying away to the west.

Hen Harrier Roost Surveys

Hen harrier were recorded on six occasions during dedicated Hen Harrier Roost Surveys from the 2018/19 winter season (see Appendix 7.4, Figure 7.6.1). On the 5th of December 2018 a hen harrier was recorded flying into a potential wintering night roost at dusk, approximately 1.3km from the development site boundary and approximately 4km from the nearest proposed turbine. Approximately seven minutes later the bird took flight and was recorded leaving the area. There were a further three observations on the 20th of February 2019 of a female hen harrier hunting and in flight around this previously identified roost site from the 5th of December. In addition, a hen harrier was recorded in a travelling/non-hunting flight on the 18th of December 2018 in an area several kilometres from the identified roost site, approximately 500m from the development site.

A second potential wintering night roost was identified during a Winter Transect/Waterfowl Survey on the 28th of January 2019. The location of both potential hen harrier winter roosts are shown on Figure 7.6.1.1 in Appendix 7.4. No roosts were found to be in use on more than one occasion during the extensive surveys undertaken.

Winter Transect/Waterfowl Surveys

Hen harrier were recorded on five occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.3). Four of the five observations consisted of a female hunting and in flight over areas of cutover bog. On the 28th of January 2019 a male hen harrier was seen flying over an area of cutover bog before landing on an area of raised bog and rank heather to roost (see Figure 7.6.1.1 in Appendix 7.4). This roost location was within the development site and approximately 500m from the proposed turbines. This site was not found to be in use on subsequent visits.

Four observations occurred onsite and within 500m of the proposed turbine locations, predominantly around areas of cutover bog surrounding the briquette factory. The remaining observation occurred on the 4th of March 2019 as a female was seen hunting at Noggus bog, to the northeast of the development site.

Incidental Observations

There were three incidental observations of hen harrier during Migratory Bird Surveys along the Shannon between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.3). A male hen harrier was noted hunting along a reedbed within the Shannon Callows on the 12th of September and again on the 21st of September 2018 within the same area during surveys at CMVP3. In addition, there was also an observation of a female hen harrier hunting along the Shannon during a survey at CMVP4 on the 9th of September 2019. On the 24th of September 2019 during a Winter Transect/Waterfowl Survey a female hen harrier was recorded hunting on two occasions over an area of cutover bog close to VP7.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Hen harrier were recorded at Drinagh bog on eleven dates during the 2014/15 winter season, involving at least three individuals. There was no evidence of night roosting recorded on site. This species was not recorded on the Clongawny bog (west of the briquette factory).
- **2015/16 Winter Season:** Hen harrier were recorded at Drinagh bog on five dates during the 2015/16 winter season, involving at least three individuals. There was only one record of hen harrier at Clongawny bog as an individual was seen hunting over an area of intact bog on the 16th of January 2016. There was no evidence of night roosting recorded on site.
- **2016 Breeding Season:** Hen harrier were recorded at Drinagh bog twice on during the 2016 breeding season. On the 26th of July a male was seen hunting over the western margin of the Drinagh wetlands before flying over conifer plantation. On the 5th of August a male (possibly the same bird) was seen hunting over the reedbeds. This species was not recorded on the Clongawny bog.
- **2016/17 Winter Season:** Hen harrier were recorded at Drinagh bog on seven dates during the 2016/17 winter season, involving at least three individuals. There was no evidence of night roosting recorded on site. This species was not recorded on the Clongawny bog.
- **2017 Breeding Season:** Hen harrier were recorded at Drinagh bog once during the 2017 breeding season. A male bird was seen hunting over reedbeds in the northeast corner of the Drinagh wetlands on the 25th of August 2017. This species was not recorded on the Clongawny bog.

7.4.5 Common Crane

Raw Survey data for common crane is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Common crane were recorded in flight on five occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.4). All five observations occurred during the 2018/19 winter season, between December 2018 and March 2019. Two of the five observations occurred at the Potential Collision Height (PCH). A group of four birds were observed travelling over the site and landing on areas of flooded cutover bog within the development site and close proximity of the development infrastructure on three occasions between December 2018 and February 2019. The remaining two observations were of a single bird observed twice on the 7th of March 2019, leaving the development site after dawn where the individual was roosting overnight, before travelling east. Observations of this species indicate that the birds were using the area as an overnight roost, but no evidence of feeding or loafing occurred within the development site was recorded during daylight hours.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Common crane were not recorded during surveys between October 2014 and September 2017.

7.4.6 Kingfisher

Raw Survey data for kingfisher is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Kingfisher were only recorded twice during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.5). Both observations occurred in the same area to the east of the Drinagh Wetlands, just south of VP9, more than 2.5km east of the nearest proposed turbine. On the 20th of September 2018 an individual was recorded travelling over an area of cutover bog, while on the 19th of September 2019 an individual kingfisher was recorded landing on a bulrush stem and fishing in an area of flooded cutover bog.

Breeding Bird Surveys

Kingfisher were only recorded on three occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.4). All three observations occurred around the periphery of the site boundary, two of which were on the western edge of the development site while the other occurred in the Stonestown townland to the north of the site. On the 21st of June 2018 an individual bird was recorded travelling along a drainage ditch. The remaining two observations were of individual birds recorded in flight during the 2019 breeding season. No evidence of breeding activity was recorded during either the 2018 or 2019 season surveys.

Winter Transect/Waterfowl Surveys

Kingfisher were only recorded twice during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.4). Both observations occurred in the same area to the east of the Drinagh Wetlands, more than 2km east of the nearest proposed turbine. On the 3rd of October 2018 an individual was recorded travelling over a drainage ditch, while on the 4th of March 2019 an individual kingfisher was observed beside a drainage ditch to the east of the Drinagh wetlands.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** A kingfisher was recorded in an area of flooded bog at Clongawny on the 24th of November 2014, seen hunting and feeding. This species was not recorded at Drinagh Bog.
- **2015/16 Winter Season:** A kingfisher was recorded perched at an area of flooded bog at Clongawny on the 22nd of September 2015. This species was not recorded at Drinagh Bog.
- **2016 Breeding Season:** A kingfisher was recorded perched on a willow tree/scrub at a flooded are of cutover bog at Clongawny on the 22nd of June. This species was not recorded at Drinagh Bog.

7.4.7 Little Egret

Raw Survey data for little egret is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Little egret were recorded in flight on 23 occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.6). Only two of the 23 observations of birds in flight occurred within, or partially within, 500m of the proposed turbine layout. The majority of little egret flight activity occurred around the Drinagh wetlands to the east of the proposed turbines. Only three of the 23 flights occurred within the potential collision risk zone for turbine swept area.

Sixteen of the 21 observations were of individual birds travelling over or landing on areas of cutover bog. A pair of birds were recorded in flight together on four occasions, while a flock of five birds were also observed once during a VP survey on the 20th of November 2018. Eleven of the 23 observations occurred during the core breeding season (April – August). Two observations occurred during the 2017/18 winter season, between December and January. Five observations were recorded during the 2018 late breeding season/post-breeding dispersal period, between late July and August. Ten observations occurred during the 2018/19 winter season, between the months of October and January. Finally, there were six observations of little egret recorded between July and August 2019.

Breeding Bird Surveys

Little egret was only recorded once during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.5). Two birds were seen foraging on a flooded area of cutover bog within the Drinagh wetlands on the 7th of June 2018. The observation occurred approximately one-kilometre east of the nearest turbine. No evidence of breeding activity was recorded in either breeding season surveyed.

Winter Transect/Waterfowl Surveys

Little egret were recorded on 24 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.5). Two observations occurred in August 2018, three in September 2018, while there 17 observations of little egret between October 2018 and March 2019. In addition, there was one observation of this species during a survey on the 3rd of May 2019 and one observation on the 3rd of September 2019. There were six observations of pairs of little egret, while the remaining 18 observations consisted of individual birds. Only two of the 24 observations were within 500m of the proposed turbine locations. Two observations occurred around the flooded area of cutover bog at Clooneen. Eleven observations occurred around the Drinagh wetlands to the east of the proposed turbines, while nine observations occurred at Noggus bog to the northeast.

Migratory Bird Surveys

Little egret were only observed once during Migratory Bird Surveys between September 2018 to May 2019 (see Appendix 7.4, Figure 7.8.4). A single bird was recorded in flight on the 19th of February 2019, travelling over the Little Brosna River, several kilometres to the south of the development site.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2015/16 Winter Season:** A little egret was recorded in flight over Drinagh Bog on the 10th of December 2015. This species was not recorded at Clongawny Bog.
- **2016/17 Winter Season:** A little egret was recorded on an area of flooded bog at Clongawny on the 12th of November 2016. There were two observations of individuals seen at Drinagh. One of these occurred on the 7th of November 2016 and the other occurred on the 9th of February 2017.
- **2017 Breeding Season:** A little egret was recorded on a flooded area of cutover bog at Clongawny on the 12th of September 2017.

7.4.8 Marsh Harrier

Raw Survey data for marsh harrier is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Marsh harrier were only recorded twice during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.7). Both observations were of a juvenile bird observed hunting over the Drinagh wetlands on two occasions during a VP survey on the 25th of April 2019, more than 1.5km from the nearest proposed turbine.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2017 Breeding Season:** A female hen harrier was recorded in flight over the Drinagh wetland on the 6th of June 2017. This species was not recorded at Clongawny Bog.

7.4.9 Merlin

Raw Survey data for Merlin is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Merlin were only recorded on four occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.8). All four observations were of individual birds recorded in flight during the 2017/18 winter season between December 2017 and March 2018. Observations consisted of both male and female birds recorded hunting, perched and in flight on four separate survey dates between this period. Three of the four observations occurred within, or partially within 500m of the proposed turbine layout. All four flights occurred below the potential lowest rotor swept height.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Merlin was recorded on three occasions during the 2014/15 winter season surveys at Clongawny Bog, with the same individual possibly recorded on each occasion. This species was not recorded during surveys at Drinagh Bog during 2014/15.
- **2015/16 Winter Season:** Merlin was recorded on four occasions during the 2015/16 winter season surveys. Two observations occurred at Clowngawny Bog and two at Drinagh Bog. Observations consisted of at least two individuals (i.e. one male and one female).
- **2016 Breeding Season:** A male merlin was observed perched on a peat pile in Clongawny on the 10th of August.
- **2016/17 Winter Season:** Merlin were recorded twice Drinagh Bog during the 2015/16 winter season. This species was not recorded during surveys at Clongawny Bog during 2016/17.
- **2017 Breeding Season:** An individual merlin was observed successfully hunting and killing a ringed plover at Clongawny Bog on the 16th of September 2017.

7.4.10 Peregrine

Raw Survey data for Peregrine is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Peregrine were recorded in flight on twenty occasions during Vantage Point Surveys (see Figure 7.1.9, Appendix 7.4). Nineteen of the twenty observations consisted of individual birds in flight, while a pair of birds were recorded in flight together and interacting with one another on the 26th of January 2018 during the non-breeding season. Seven of the twenty observations occurred during the core breeding season months (April – August). Four of which occurred during the 2018 breeding season and three observations occurred during the 2019 breeding season. There were six observations of peregrine in flight during the 2017/18 winter season and seven observations from the 2018/19 winter season.

Ten flights occurred within, or partially within, 500m of the proposed turbine layout. Fifteen flights occurred within the Potential Collision Height (PCH), while the remaining five observations occurred below the potential lowest rotor swept height.

In addition, there two observations of peregrine perched on open bog and not in flight during VP surveys. On the 23rd of October 2017 a peregrine was seen perched on bog during a survey at VP7, while on the 14th of December 2017 a peregrine was seen perched on bog, again during a survey at VP7.

Breeding Bird Surveys

Peregrine were only recorded once during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.6). An individual was recorded travelling over an area of cutover bog and agricultural grassland flying west over the southeast corner of the development site on the 2nd of May 2018.

Breeding Raptor Surveys

Peregrine were only recorded twice during Breeding Raptor Surveys (see Appendix 7.4, Figure 7.4.1). On the 9th of July 2018 an individual was recorded circling and gliding over an area of forestry directly south of the development site before turning north and flying directly over the development site before travelling away to the northwest. On the 10th of July 2018 an individual was recorded in a low flight over an area of improved agricultural grassland more than 1.5km to the south of the development site.

Winter Transect/Waterfowl Surveys

Peregrine were only recorded once during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.6). On the 6th of February 2019 a single peregrine was recorded carrying prey while in flight over the southeast corner of the development site within 500m of the proposed turbines.

Migratory Bird Surveys

Peregrine were only observed once during Migratory Bird Surveys between September 2018 to September 2019 (see Appendix 7.4, Figure 7.8.5). A single bird was recorded in flight on the 12th of April 2019, travelling over an area of bog woodland and cutover bog, approximately 4km to the southwest of the proposed development site.

Incidental Observations

There were two incidental observations of peregrine during Hen Harrier Roost Surveys. On the 22nd of October 2018 an individual peregrine was recorded flying above HHVP3, while on the 17th of December 2018 during a survey at HHVP2 an individual peregrine was recorded in flight.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Peregrine was recorded on three occasions during the 2014/15 winter season surveys at Clongawny Bog, with the same individual (male) possibly recorded on each occasion. This species was more regularly recorded at Drinagh Bog, observed on four dates through the winter season. Three observations were of individual birds in hunting or travelling flights over Drinagh. On the 5th of February 2015 a pair of peregrine were seen in flight together arriving from south before landing on bog and preening/interacting with one another. Both flew to edge of Drinagh wetland and continued preening.
- **2015/16 Winter Season:** Peregrine was recorded on two dates during the 2014/15 winter season surveys at Clongawny Bog. Observations consisted of a female and male seen on separate dates during winter months. This species was more regularly recorded at Drinagh Bog, observed on three dates through the winter season.
- **2016 Breeding Season:** Peregrine was only recorded once during the 2016 breeding season surveys. On the 9th of September a peregrine was seen in flight over Clongawny Bog.
- **2016/17 Winter Season:** Peregrine was recorded once during the 2014/15 winter season surveys at Clongawny Bog, as a female was seen perched on peat with prey on the 21st of January 2017. This species was more regularly recorded at Drinagh Bog, observed on four dates throughout the winter season.
- **2017 Breeding Season:** Peregrine was only recorded twice during the 2017 breeding season surveys. On the 28th of July a peregrine was seen circling high over Clongawny, while on the 12th of September a bird was seen flying over an area of cutover bog at Clongawny.

7.4.11 Lapwing

Raw Survey data for lapwing is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Lapwing were recorded in flight on 195 occasions during Vantage Point Surveys. One-hundred and twenty-one of these observations occurred during the core breeding season months between April and August (see Figure 7.1.10a, Appendix 7.4). Forty-one observations occurred during the 2018 breeding season, while the remaining 80 observations occurred during the 2019 breeding season (April - August). Eighty-one of the 121 observations from breeding season months occurred within 500m of the proposed turbines. Most observations were of breeding birds (pairs or individuals) observed in flight below the potential collision height (i.e. below 25m). The majority of the observations during breeding season surveys occurred within 500m of the proposed turbines to the west of the briquette factory.

There were 74 observations of lapwing during non-breeding season months (September – March) (see Figure 7.1.10b, Appendix 7.4). Twenty-seven observations occurred during the 2017/18 non-breeding season (October – March) while 47 observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019. The maximum flock size recorded during VP surveys from the non-breeding season (September – March) was 206 birds. The majority of flight activity from the winter seasons was of large flocks flying over the development site. Only 22 of the 74 observations from the winter months occurred within 500m of the proposed turbines. The majority of flight activity occurred more than 500m from the proposed turbines around VP1 to the south and VP5 and VP6 to the northeast.

In addition to the 195 observations of birds in flight, there were six observations (seen or heard) of non-flying birds. Five of the six observations consisted of birds roosting and or feeding during non-breeding season months, while a lapwing was heard calling on numerous occasions throughout a survey at VP3 on the 16th of April 2019 but was not seen.

Breeding Bird Surveys

Lapwing were recorded on 98 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.7). There were 52 observations from the 2018 breeding season while there were 46 observations of lapwing during 2019 Breeding Bird Surveys.

Fifty-five of the 98 observations related to birds breeding, displaying, calling or pairs recorded in areas of suitable breeding habitat. Forty-three observations related to birds recorded flying over the site or roosting on wet areas of bog, with no evidence of breeding activity recorded. Twenty-one of these were of individual birds while the remainder consisted predominantly of pairs with some observations also of small flocks (3 – 35 birds).

There were 16 breeding territories within the development site or within 500m of the development boundary during 2018 Breeding Bird Surveys. In addition, there was one breeding pair at Derrybrat more than 2km to the east of the development infrastructure.

In 2019 there were 16 breeding territories recorded onsite or within 500m of the development boundary. In addition, there were three pairs at Derrybrat, more than 2km east of the development infrastructure, and ten lapwing pairs at Noggus, to the north of the site. The location of all 2018 breeding lapwing territories is provided in Figure 7.3.6.1, while the 2019 breeding territories are provided in Figure 7.3.6.2 in Appendix 7.4.

Winter Transect/Waterfowl Surveys

Lapwing were recorded on 50 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.7). Twenty-four observations occurred during the 2018/19 non-breeding season between August 2018 and February 2019, while there were 25 observations during the core 2019 breeding season months (March – May). In addition, there was a single observation of a flock of 17 lapwing roosting within the Drinagh wetlands during a survey in September 2019. The majority of observations from the winter months occurred around the Drinagh wetlands, while there were nine observations within the development site, including the Clooneen wetland and flooded areas of cutover bog to the west and east of the Briquette factory.

On the 27th of November 2018 two large flocks of 350 birds and 250 birds were both recorded roosting on areas around the Drinagh wetlands to the east of the proposed turbines. Furthermore, a flock of 400 birds were recorded flying over the Drinagh wetland on the 5th of November 2018. Large numbers of wintering lapwing are therefore dependant on the Drinagh wetland for foraging and roosting.

Only six of the 25 observations from the core breeding season (March – May) occurred onsite or within 500m of the development site. The vast majority of observations from the breeding season months occurred offsite around Noggus bog and Derrybrat to the northeast and east of the development infrastructure respectively.

On the 23rd of May 2019 a lapwing pair with three recently hatched chicks were recorded foraging around a flooded area at Noggus to the northeast of the development site. On the 27th of May 2019 a breeding pair were recorded incubating at a scrape/nest with four eggs at Derrybrat bog, to the east of the development infrastructure, before being disturbed by the surveyor and alarm calling.

Nineteen observations involved birds roosting on flooded areas of cutover bog. Eight observations related to breeding activity between March and May 2019.

In addition, there were 60 observations of lapwing during winter transect surveys from the 2017/18 winter season. Twelve observations occurred around the Clongawny area in the western section of the development site during a survey in January 2018. The remaining 48 observations occurred around the Drinagh Wetlands in the east of the development site. Forty-five observations occurred during a survey on the 11th of November 2017 while there were three observations from the 21st of March 2018.

Migratory Bird Surveys

Lapwing were recorded on 24 occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.6). Twenty observations occurred during the 2018/19 winter season between October 2018 and February 2019, while there was one observation of lapwing from August 2019 and three observations from September 2019. Twenty of the 24 observations consisted of birds recorded in flight over the Shannon, predominantly to the north of Banagher where the Grand Canal and River Brosna meet the Shannon. There was no indication during any of these observations that birds were travelling to or from the direction of the development site.

In addition, there were four observations of flocks of 4 – 500 birds recorded in flight around the Little Brosna River and Dovegrove Callows SPA to the south of the development site. None of the observations in this area indicated that these birds were coming from or going to the proposed development site.

Incidental Observations

There were eight incidental observations of lapwing recorded across various surveys between October 2017 and September 2019. Four of which occurred during Crane dusk surveys in March 2019 close to VP4. There were two observations on the 7th of March and two observations on the 14th of March. There were two observations of a pair of lapwing recorded flying and calling while in flight over a flooded area at Noggus bog to the northeast of the development site, during a breeding raptor survey on the 16th of May 2018. On the 26th of June 2018, the surveyor made a casual observation prior to commencing a survey, of a flock of approximately 15 lapwing feeding and or roosting around the Drinagh Wetland within the north-eastern section of the development site, with no evidence of breeding activity observed. On the 21st of March 2019 an individual lapwing was recorded calling while in flight at Derrybrat to the east of the development infrastructure during a Hen Harrier Roost Survey at HHVP3.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Lapwing was recorded frequently at Clongawny Bog during the 2014/15 winter season surveys, although a number of these observations were off-site including observations of flocks of c.135 and c.200 birds. Records of lapwing on-site included six observations of flocks of 40 – 100 birds. In addition, a lone lapwing was seen on an area of flooded cutover bog in February and March apparently holding a breeding territory. Lapwing were also frequently recorded at Drinagh Bog during the 2014/15 winter season, although many of these observations consisted of small parties flying across the site. A maximum flock size of 228 birds were seen at the Drinagh wetlands on the 13th of February 2015.
- **2015/16 Winter Season:** Lapwing was recorded on four dates during the 2015/16 winter season surveys at Clongawny Bog. Flock sizes recorded ranged from three to 120 birds. On the 20th of March 2016 three birds were on an area of flooded cutover bog with territorial/breeding behaviour observed. Lapwing was recorded more frequently at Drinagh Bog during the 2015/16 winter surveys, although many of the records were of relatively small parties flying across the site. On the 26th of September a flock of c.800 – 1,000 birds were seen circling high over the Drinagh wetlands before landing. In addition, an estimated 3-4 pairs of breeding/territorial lapwing were present at the Drinagh wetlands in March 2016.
- **2016 Breeding Season:** Lapwing was observed on four dates at Clongawny Bog during the 2016 breeding season, with evidence of breeding recorded on three of

these dates. There were four active breeding lapwing pairs at Drinagh Bog in late March 2016. It is considered that at least three of these pairs probably bred but the success rate is unknown. In addition, there was a non-breeding flock of c.90 birds recorded on the 23rd of June.

- **2016/17 Winter Season:** Lapwing was recorded on six dates during the 2016/17 winter season surveys at Clongawny Bog, with flocks sizes ranging between two and c.800 birds. On the 28th of March a pair were seen at an area of flooded bog indicating territorial/breeding behaviour. Lapwing was recorded more frequently at Drinagh Bog during the 2016/17 winter surveys, although many of the records were of relatively small parties flying across the site. Flock sizes recorded ranged from c.50 to c.700 birds, which were mostly recorded around the Drinagh wetlands.
- **2017 Breeding Season:** Two pairs of territorial/breeding lapwing were recorded at Clongawny Bog in April and early May. While the birds were still present into June, no further evidence of breeding activity was observed during this period. Likewise, at Drinagh Bog, two active breeding lapwing pairs were observed in April and May 2017, although breeding appeared to have failed for both pairs by late May. In addition, a flock of c.370 non-breeding birds were seen at the Drinagh wetlands on the 28th of September.

7.4.12 Black-headed Gull

Raw Survey data for black-headed gull is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Black-headed gull were recorded in flight on 217 occasions during Vantage Point Surveys (see Appendix 7.4, Figure 7.1.11). Two-hundred and four of these observations occurred during the core breeding season months between April and July. One-hundred and thirty-three of these observations occurred during the 2018 breeding season, while the remaining 71 observations occurred during the 2019 breeding season (April – July).

Only thirteen observations occurred outside of the core breeding season months for this species. Nine of these observations occurred during a VP survey on the 1st of March 2019. One observation occurred in August 2018, one in November 2018, one in February 2019 and one observation in August 2019. These observations are all likely to be associated with a lingering or an early establishing breeding population. Breeding activity was recorded within the development site in both 2018 and 2019.

Observations ranged from individuals to a flock of 40 birds. In total 86 of the recorded flights occurred within the Potential Collision Height (PCH).

Breeding Bird Surveys

Black-headed gull were recorded on 49 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.8). There were 27 observations from the 2018 breeding season while there were 22 observations during 2019 Breeding Bird Surveys. Eight observations indicated breeding activity as birds were seen and heard calling defending breeding territories or establishing breeding colonies. Twelve observations related to birds recorded roosting or foraging on flooded areas of cutover bog. Thirty-one observations related to birds recorded flying over the development site.

On the 2nd of May 2018, 300 black-headed gull were recorded in the early stages of establishing a breeding colony on an island in an area of flooded cutover bog to the east of the briquette factory within the development site. Nest scraps and territorial behaviour were recorded. However, the site was abandoned approximately a week later. There were also an additional five probable black-headed gull breeding territories onsite or within 500m of the development site. There was one probable breeding pair in the Clooneen area, three probable breeding pairs west of the briquette factory and one probable breeding to the east of the briquette factory.

In 2019, six breeding pairs of black-headed gull were recorded onsite or within 500m the development area. Two breeding pairs were recorded within the Clooneen area, three breeding pairs were recorded within an area of flooded bog just west of the briquette factory and VP4, while there was also one possible breeding pair within the Drinagh wetlands. Furthermore, a slightly smaller breeding colony than that seen in 2018, established itself on Noggus bog, further details are provided in subsequent paragraphs.

Six distinctive breeding areas were identified across the combined 2018 and 2019 Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.8.1).

Winter Transect/Waterfowl Surveys

Black-headed gull were recorded on 14 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.8). Thirteen observations occurred between the 28th of April and 23rd of May 2019. On the 25th of February 2019 a pair of gulls were recorded around the Clooneen flooded area. There were three further observations of black-headed gull around this location between March and May 2019 as flock sizes of between five and eight birds were recorded roosting around the flooded area. A pair of black-headed gull were recorded at the Drinagh wetlands to the east of the proposed turbines on the 28th of March 2019. The remaining nine observations were related to a colony of approximately 150 birds attempting to establish a breeding colony and roosting at an area of flooded cutover bog, at Noggus northeast of the development site. Birds within the colony were recorded incubating eggs during surveys in late May.

Migratory Bird Surveys

Black-headed gull were recorded on seven occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.7). Six of the seven observations occurred during the 2018/19 winter season between October 2018 and February 2019, while there was one observation of a flock of ten birds recorded in flight over the Shannon on the 6th of August 2019. Three observations consisted of birds recorded in flight around the Dovegrove Callows SPA to the south of the development site, between October 2018 and January 2019. The remaining four observations all occurred along the River Shannon, to the north of Banagher, between February 2019 and August 2019. Flock sizes recorded ranged from 5 birds – 70 birds. No evidence of birds travelling to or from the direction of the development site was recorded during these surveys.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Black-headed gull was recorded on three occasions at Clongawny Bog during the 2014/15 winter season surveys. All three observations occurred between February and March 2015 with individuals seen in breeding plumage and indicating early breeding displays and territorial behaviour at an area of flooded bog. This species was observed twice at Drinagh Bog, as small flocks were seen in flight over the site in March 2015. There was no evidence of breeding activity recorded at Drinagh Bog
- **2015/16 Winter Season:** Black-headed gull was recorded twice at Clongawny Bog during the 2015/16 winter season surveys. Observations occurred between February

and March 2016 with individuals seen in breeding plumage and indicating early breeding displays and territorial behaviour at an area of flooded bog. This species was observed once at Drinagh Bog, as three birds were seen on a spit in the Drinagh wetlands on the 21st of March 2016.

- **2016 Breeding Season:** Breeding black-headed gull were recorded on three occasions at Clongawny Bog during the 2016 breeding season surveys. Peak numbers were recorded on the 9th of May 2016 as c.160 birds were observed with c.60 of which apparently on nests at Clooneen wetland. On the 22nd of June only c.20 gulls were present, including four fledged young. A number of nests/chicks may have been lost due to flooding caused by heavy seasonal rains. Breeding black-headed gull were also recorded at Drinagh Bog. Territorial birds were present in April and May with c.10 birds sitting on apparent nests on an island within the Drinagh wetlands. Birds had departed and abandoned breeding attempts in this area by June.
- **2016/17 Winter Season:** Black-headed gull was recorded once at Clongawny Bog during the 2016/17 winter season surveys. A flock of 36 gulls were observed in breeding plumage at Clooneen wetland on the 28th of March 2017, in breeding plumage and indicating early breeding displays and territorial behaviour. This species was not recorded at Drinagh Bog during the 2016/17 winter season.
- **2017 Breeding Season:** A breeding black-headed gull was recorded at Clooneen during the 2017 breeding season with a peak count of c.30 occupied nests on the 11th of May. By early June numbers had dropped to no more than c.15 nests, before the breeding colony abandoned the areas entirely by 22nd June, with only adult birds remaining. Fluctuating water levels and predation are both believed to have contributed to the failure of the colony. Breeding black-headed gull were also recorded at Drinagh Bog. Thirteen territorial birds were present at the Drinagh wetlands in April with a single occupied nest seen in early May. These birds had departed this area by the start of June 2017.

7.4.13 Herring Gull

Raw Survey data for herring gull is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Herring gull were recorded in flight on ten occasions during Vantage Point Surveys, seven of which occurred within PCH (see Appendix 7.4, Figure 7.1.12). Nine of the ten observations occurred between July and August 2018. Individuals to a maximum flock of five birds were recorded travelling over the development site. The remaining observations consisted of an individual in flight over an area of improved agricultural grassland and cutover bog to the north of the development site on the 23rd of November 2018.

Only one flight occurred within, or partially within 500m of the proposed turbine layout. Observations ranged from individuals to a flock of five birds.

Breeding Bird Surveys

Herring gull were only recorded once during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.9). A flock of three birds were recorded travelling over the development site on the 4th of May 2018. No evidence of breeding activity was recorded.

Winter Transect/Waterfowl Surveys

Black-headed gull were only recorded once during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.9). A pair of birds were observed around the Drinagh wetlands to the east of the proposed turbines.

There were no additional observations of this species during any of the other comprehensive surveys.

7.4.14 Woodcock

Raw Survey data for woodcock is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Woodcock were recorded in flight on 30 occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.13). Twenty-seven of the 30 observations occurred during the months of April and May with regular roding activity. Both individuals and pairs were recorded in flight. Fifteen observations occurred during VP surveys in May 2018 approximately at dusk, while the remaining twelve observations occurred during the 2019 breeding season between April and May.

Only three observations occurred during winter months. On the 22nd of December 2017 a woodcock was flushed. On the 19th of December 2018 a woodcock was recorded in flight while on the 7th of February 2019 a single woodcock was again recorded in flight. Twelve of the 30 observations occurred within, or partially within, 500m of the proposed turbine layout. All flight activity occurred below the potential lowest rotor swept height.

There were five distinct breeding areas where roding activity occurred with at least one breeding pair estimated per area. Three of these were within 500m of the proposed turbines while the other two were more than one kilometre to the east of the proposed turbine layout over the Drinagh wetlands and Derrybrat (see Appendix 7.4, Figure 7.1.13.1).

Breeding Bird Surveys

Woodcock were only recorded twice during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.10). There was only one observation of woodcock from the 2018 breeding season while there was one observation from the 2019 Breeding Bird Surveys. On the 1st of May 2018 a single woodcock was flushed from an area of scrub to the east of the Drinagh wetlands, on the eastern edge of the site boundary. On the 11th of June 2019 an individual woodcock was recorded flying over the development site and within 500m of the proposed turbines.

Breeding Woodcock Surveys

Woodcock were recorded on 71 occasions during dedicated Breeding Woodcock Surveys (see Appendix 7.4, Figure 7.5.1). As mentioned above, there were five distinct breeding areas where roding activity occurred with at least one breeding pair estimated per area. Twenty-nine observations occurred during the 2018 breeding season (June) while the remaining 42 observations occurred during the 2019 breeding season (May and June).

There were 18 flights of roding woodcock activity recorded on the 5th of June 2018 and eleven roding woodcock flights on the 28th of June 2018. There were twelve observations of roding woodcock on the 23rd of May 2019 and five observations on the 30th of May 2019. There were ten observations of roding woodcock on the 6th of June 2019 and seven observations on the 18th of June 2019. Lastly, there were three observations of roding woodcock on the 25th of June 2019 and five observation on the 27th of June 2019.

Winter Transect/Waterfowl Surveys

Woodcock were recorded on seven occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.10). All seven observations occurred between January and March 2019, consisting of individual birds which were flushed by the surveyor during walked transects. Four of the seven observations occurred within 500m of the proposed development footprint, while three observations occurred around the Drinagh wetlands to the east of the proposed turbines.

In addition, there was a single observation of woodcock during winter transect surveys from the 2017/18 winter season. The observation occurred during a winter transect survey in January 2018 around the Clongawny area in the western section of the development site.

Incidental Observations

There were fifteen incidental observations of woodcock between October 2017 and September 2019. Ten of the eleven observations were recorded during Hen Harrier Roost Surveys from winter months when the populations of native breeding woodcock are greatly supplemented by wintering birds from eastern Europe.

The remaining five observations occurred during Migratory bird surveys. Four observations occurred during January 2019 as individual birds were recorded in flight several kilometres to the west and south of the development site. On the 23rd of May 2019 a roding male woodcock was observed in flight at dusk during a survey at CMVP1, several kilometres to the south of the development site.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2015/16 Winter Season:** Woodcock was recorded twice during winter season surveys at Clongawny Bog. Three woodcock were flushed from the edge of conifer woodlands and scrub on the 15th of Decemeber, and two more were flushed from the same approximate area on the 16th of January 2016. This species was not recorded at Drinagh Bog.
- **2016/17 Winter Season:** Woodcock was recorded once during winter season surveys at Clongawny Bog. On the 18th November a pair of woodcock were flushed from the edge of the track at the conifer plantation in the centre of the site. Woodcock were also recorded once during winter season surveys at Drinagh bog as a pair were flushed from a track on the 8th of November.

7.4.15 Curlew

Raw Survey data for curlew is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Curlew were recorded in flight on three occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.14). All three observations occurred between July and August 2019, outside the core breeding season for this species. Each flight occurred in excess of 500m from the nearest proposed turbine. A single bird was recorded in flight over the Drinagh wetlands area more than one-kilometre east of the nearest proposed turbine, during a survey at VP8 on the 16th of July 2019. On the 1st of August 2019 a single bird was recorded in flight and alarm calling over an area of cutover bog northeast of VP1. On the 7th of August 2019 a flock of twelve curlew were recorded in flight leaving the Drinagh wetland area before circling and landing in area of agricultural grassland approximately one kilometre to the east of the nearest proposed turbine.

In addition to the three observations of birds in flight, there were also four observations of birds which were heard calling but not seen. On the 3rd of September 2018 an individual bird was heard calling from an area of flooded cutover bog near VP1. On the 16th of July 2019 during a survey at VP8 a bird was heard calling from the Drinagh wetlands. On the 11th of September during a survey at VP7 a bird was heard calling prior to the start of the survey before dawn. On the 13th of September 2019 during a survey at VP8 a bird was heard calling again from the Drinagh wetland area.

Breeding Bird Surveys

Curlew were recorded on four occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.11). There were two observations of curlew from the 2018 breeding season while there were also two observations from the 2019 Breeding Bird Surveys. On the 7th of June 2018 a single curlew was flushed by the observer from a flooded area of cutover bog within the development site and within 500m of the proposed turbines. The individual remained calling while in flight over the area for six minutes following the disturbance. On the 12th of June 2018 a single curlew was heard calling from the Stonestown/Drinagh Wetland area but was not seen.

On the 11th of June 2019 an individual bird was recorded flying and calling over an area of cutover bog in the southeast corner of the development site. On the 20th of June 2019, two curlew were recorded roosting on an island at the Drinagh wetland to the east of the development infrastructure. While these observations occurred during the core breeding season, no evidence of breeding activity was recorded during either the 2018 or 2019 breeding seasons. The lack of observations of curlew earlier in the season (i.e. March to May inclusive), is a strong indication that these individuals were not associated with a breeding attempt on or near the site.

Winter Transect/Waterfowl Surveys

Curlew were only recorded once during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.11). During a survey on the 5th of November a curlew was heard calling from an area of improved agricultural grassland to the southeast of the development site but was not seen.

Migratory Bird Surveys

Curlew were recorded on seven occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.8). All seven observations consisted of birds recorded in flight at two distinct areas along the River Shannon. Six of these observations occurred between October 2018 and January 2019, while there was a single observation of a flock of seven birds recorded in August 2019. Flock sizes recorded ranged from 15 – 40 birds. No evidence of birds travelling to or from the direction of the development site was recorded during these surveys.

Incidental Observations

There was only one incidental observation of curlew between October 2017 and September 2019. On the 26th of June 2018, a flock of nine curlew were recorded roosting around the Drinagh wetland just north of the development site but within 500m of same, during a casual observation prior to a survey.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2016 Breeding Season:** Curlew was recorded once during 2016 breeding season surveys at Drinagh Bog. A pair of curlew were seen on the 23rd of June 2016. Due to the time of this observation these birds are believed to be post-breeding birds (i.e. bred away from the site before moving on to wintering/non-breeding grounds). This species was not recorded at Clongawny Bog.
- **2017 Breeding Season:** Curlew was recorded once during 2017 breeding season surveys at Drinagh Bog. A flock of 26 non-breeding birds were observed on the Drinagh wetlands on the 28th of September 2017. This species was not recorded at Clongawny Bog.

7.4.16 Dunlin

Raw Survey data for Dunlin is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Dunlin were only recorded once during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.15). On the 25th of May 2018 an individual bird was recorded circling a flooded southern corner of the site just north of VP1. The bird was lost from view to the west of the proposed development area. The entire flight occurred more than 500m from the proposed turbine locations.

Winter Transect/Waterfowl Surveys

Dunlin were only recorded on one occasion during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.12). On the 23rd of May 2019 a flock of four birds were recorded foraging over flooded bog at Noggus bog to the northeast of the proposed development site.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2017 Breeding Season:** Dunlin was recorded once during 2017 breeding season surveys at Drinagh Bog. A flock of 32 dunlin were seen in summer plumage on the 8th of May. Due to the nature and time of this observation these birds are believed to be birds on Migration between wintering and breeding grounds. This species was not recorded at Clongawny Bog.

7.4.17 Redshank

Raw Survey data for redshank is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Breeding Bird Surveys

Redshank were recorded on 13 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.12). There were nine observations of redshank from the 2018 breeding season while there were four observations from the 2019 Breeding Bird Surveys. All nine observations from the 2018 Breeding Bird Surveys occurred around the Drinagh Wetlands to the east of the proposed turbines. A breeding pair were seen and heard on several occasions throughout the breeding season.

Two of the four 2019 observations occurred at Derrybrat bog, more than 2km to the east of the proposed substation. The remaining two observations occurred around the Drinagh wetlands. A pair were suspected to have bred at both locations, although redshank breeding sites can be particularly difficult to locate.

Winter Transect/Waterfowl Surveys

Redshank were recorded on twelve occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.13). All twelve observations occurred between March and May 2019, which overlaps with the core breeding season period for this species. All twelve observations occurred within three breeding territories, none of which were located within the development footprint. The nearest of these occurred at the Drinagh wetlands in the east of the development site. The remaining two breeding territories were both more than 500m from the development infrastructure. One of these was at Noggus bog to the northeast, while the other was at Derrybrat to the east.

In addition, there were two observations of redshank during winter transect surveys from the 2017/18 winter season. Both observations occurred during a survey on the 21st of March 2018 around the Drinagh wetlands area.

Incidental Observations

There were four incidental observations of redshank between October 2017 and September 2019. Two of these observations were recorded during Vantage Point Surveys of birds not seen in flight. On the 3rd of September 2018 during a survey at VP1 an individual redshank was seen foraging at the edge of the Drinagh wetland area at 07:30am. On the 16th of April 2019 during a survey at VP3 a redshank was heard calling on numerous occasions throughout the survey but wasn't seen.

On the 21st of March 2019 during a Hen Harrier Roost Survey at HHVP3 a single redshank was seen flying and landing on a flooded area of cutover bog at Derrybrat more than 2km to the east of the development infrastructure. On the 26th of June 2018 a casual observation of a group of four birds was recorded in the Drinagh wetland, within the development site. The birds were noted by the surveyor as two probable breeding pairs, while one bird exhibited clear agitated/territorial behaviour.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2015/16 Winter Season:** Redshank was recorded once during winter season surveys at Drinagh Bog. Up to six birds were at the Drinagh wetlands on the 21st of March 2016, with some birds showing signs of breeding behaviour. This species was not recorded at Clongawny Bog.
- **2016 Breeding Season:** Two pairs of breeding redshank were recorded during 2016 breeding season surveys at the Drinagh wetlands. Both pairs were highly territorial in May and early June, with a further 1-2 birds present which may have represented a third breeding pair. This species was not recorded at Clongawny Bog.
- **2016/17 Winter Season:** Redshank was recorded once during winter season surveys at Drinagh Bog. On the 27th of March 2017 three birds were recorded, believed to be a returning breeding population.
- **2017 Breeding Season:** At least one territorial redshank pair was recorded during 2017 breeding season surveys at the Drinagh wetlands. The pair was present in April and May, but quiet in the area by the 6th of June, indicating a failed breeding attempt.

7.4.18 Shoveler

Raw survey data for shoveler is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Shoveler were only recorded twice during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.16). Both observations occurred during the same survey at VP8 near Drinagh wetlands on the 25th of April 2019. A male was recorded in flight and landing on the flooded area near VP8, before two males and a female were recorded leaving the area and flying west towards the development site approximately one hour later.

Both flights occurred in excess of 1.5km from the nearest proposed turbine and were recorded flying below the potential lowest rotor swept height.

Breeding Bird Surveys

Shoveler were only recorded once during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.13). On the 10th of April 2019 a flock of four birds were flying over an area of cutover bog, on the eastern edge of the Drinagh wetlands, more than one kilometre from the nearest proposed turbine.

Winter Transect/Waterfowl Surveys

Shoveler were recorded on five occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.14). All five observations occurred between the 2nd of January and 3rd of May 2019.

Three observations occurred at Noggus bog, to the northeast of the development site where birds were recorded roosting on flooded areas of bog. On the 29th of April 2019 a single duck was recorded roosting on an area of flooded bog at Derrybrat, more than 2km to the east of the development infrastructure. The remaining observation occurred near the area of flooded bog at Clooneen. A flock of five shoveler were recorded.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2016 Breeding Season:** Shoveler was recorded twice during breeding season surveys at Drinagh Bog. On the 12th of April 2016 a pair were seen in an area of suitable breeding habitat at the Drinagh wetland, while only one bird was present in early May. This species was not recorded at Clongawny Bog.
- **2017 Breeding Season:** Shoveler was recorded once during breeding season surveys at Drinagh Bog. On the 8th of May 2017 a pair were seen in an area of suitable breeding habitat at the Drinagh wetland. This species was not recorded at Clongawny Bog.

7.4.19 Tufted Duck

Raw Survey data for tufted duck is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Tufted duck were only recorded in flight on two occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.17). On the 18th of April 2018 a pair of ducks were recorded flying and landing on a flooded area of cutover bog within the Drinagh wetlands, approximately 1.5km from the nearest proposed turbine. On the 30th of April 2019 an individual bird was recorded flying and landing on a flooded area of cutover bog within the Drinagh wetlands, approximately one kilometre from the nearest proposed turbine.

Both flights occurred in excess of one kilometer from the nearest proposed turbine location and were recorded flying below the potential lowest rotor swept height.

In addition to the two observations of birds in flight, there were also four observations of non-flying birds. All four observations occurred during the 2017/18 winter season during surveys at VP5 overlooking the Drinagh wetlands. Birds were recorded feeding on flooded areas of Drinagh with flock sizes ranging between three and five birds between the 10th of October 2017 and the 24th of March 2018.

Breeding Bird Surveys

Tufted duck were recorded on 20 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.14). There were ten observations of tufted duck from the 2018 breeding season and ten observations from the 2019 Breeding Bird Surveys. All 20 observations consisted of individual birds or small flocks, maximum of eight birds, recorded roosting and or foraging on flooded areas of cutover bog.

Only two of the 20 observations occurred within 500m of the proposed turbine locations. Two observations occurred in the Clooneen wetland, while the remaining sixteen observations all occurred around the Drinagh wetlands to the east of the proposed turbines.

Winter Transect/Waterfowl Surveys

Tufted duck were recorded on eleven occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.15). Numbers recorded ranged from an individual duck to a flock of seven birds. Observations occurred between the 2nd of January and 23rd of May 2019. Only one observation occurred within the development site or 500m of the proposed turbines. On this occasion a pair of birds were recorded on the 25th of February 2019. Three observations occurred at Noggus bog, to the northeast of the development site where birds were recorded roosting on flooded areas of bog. The remaining seven observations all occurred around the Drinagh wetlands to the east of the proposed turbines, as small flocks of birds were recorded roosting in the area.

In addition, there were fifteen observations of tufted duck during winter transect surveys from the 2017/18 winter season. All fifteen observations occurred with the Drinagh wetland area to the east of the development infrastructure. There were four observations of tufted duck on the 11th of November 2017, five observations from the 25th of January 2018 and six observations from the 6th of March 2018.

Incidental Observations

There was one incidental observation of tufted duck between October 2017 and September 2019. On the 26th of June 2018, a casual observation of two broods of tufted duck were recorded at the Drinagh wetland area, just north of the development site but within 500m of same, prior to a survey.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Tufted duck was recorded twice during winter season surveys at Drinagh Bog. On the 25th of March 2015 a flock of four ducks were observed, believed to be a returning breeding population. On the 6th of January 2015 a single bird was seen on water at the Drinagh wetlands. This species was not recorded at Clongawny Bog.
- **2015/16 Winter Season:** Tufted duck was recorded in both February and March 2016 during winter season surveys at Drinagh Bog as small flocks, believed to be a returning breeding population, arrived at the Drinagh wetlands. This species was not recorded at Clongawny Bog.
- **2016 Breeding Season:** Tufted duck was recorded during breeding season surveys at Clongawny Bog as a pair were seen on Clooneen wetland between April and July in an area of suitable breeding. Breeding may have occurred although there was no evidence of a nest or fledged young in later months. This species was also recorded at Drinagh Bog during the breeding season. Sixteen adults were seen on the Drinagh wetlands in April, with seven pairs seen in May. In June at least four breeding pairs were recorded with hatched chicks (one brood of eight).
- **2016/17 Winter Season:** Tufted duck was recorded in small numbers (>10 birds) between October and February with numbers increasing in March to sixteen birds, due to a returning breeding population, with territorial behaviour observed. This species was not recorded at Clongawny Bog.
- **2017 Breeding Season:** Tufted duck was recorded during breeding season surveys at Drinagh Bog between April and June. Up to 20 adults were observed in April on the Drinagh wetlands, some of which were in pairs, while there was an estimated six pairs

in May and at least two pairs with fledged young in June 2017. This species was not recorded at Clongawny Bog.

7.4.20 Wigeon

Raw Survey data for wigeon is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Wigeon were not recorded during Vantage Point Surveys between October 2017 and September 2019.

Winter Transect/Waterfowl Surveys

Wigeon were recorded on ten occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.16). Numbers recorded ranged from an individual duck to a flock of 35 birds. Nine of the ten observations occurred between October 2018 and March 2019, while an individual duck was recorded during a survey on the 27th of September 2019. Only one observation occurred within the development site or 500m of the proposed turbines. On this occasion a flock of 19 birds were recorded on the 9th of January 2019. Three observations occurred around the Drinagh wetlands to the east of the proposed turbines, while the remaining six observations occurred around Noggus bog, more to the northeast of the development site. At Noggus, birds were recorded roosting and foraging.

Migratory Bird Surveys

Wigeon were only recorded twice during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7.4, Figure 7.8.9). On the 26th of November 2018 a flock of 16 birds were recorded travelling over the Shannon, to the west of the development site. On the 29th of January 2019 a flock of 90 birds were seen in flight over the Dovegrove Callows SPA to the south of the development site. No evidence of birds travelling to or from the direction of the development site was recorded during these surveys.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Wigeon was recorded on one occasion during winter season surveys at Clongawny Bog, as a flock of five birds were recorded on the 19th of November. A flock of sixty wigeon were also observed on Drinagh Bog, at the Drinagh wetlands, on the 27th of December 2015.
- **2015/16 Winter Season:** Wigeon was recorded on one occasion at Clongawny Bog during winter season surveys, as a pair of birds were seen in flight over the site on the 20th of October. Wigeon were more frequently recorded at Drinagh Bog, with observations occurring on four dates with a maximum flock of 33 birds recorded.
- **2016/17 Winter Season:** Wigeon was recorded on three surveys dates at Drinagh Bog during winter season surveys, with a maximum flock of 22 birds recorded on the Drinagh wetlands on the 8th of December 2016.

7.4.21 Long-eared Owl

Raw Survey data for long-eared owl is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Long-eared owl were only recorded once during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.18). On the 9th of May 2019 an individual owl was recorded flying low overhead during a survey at VP1. The bird was noted to be travelling towards an area of forestry to the south of the development site at dawn. The flight occurred partially within 500m of the proposed turbines and was recorded flying below the potential lowest rotor swept height.

Incidental Observations

There was one incidental observation of long-eared owl between October 2017 and September 2019. On the 19th of March 2019 a long-eared owl was heard calling at dusk after a Hen Harrier Roost Survey at HHVP2 near Black Lough, approximately 500m south of the development site.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2016/17 Winter Season:** Long-eared owl was recorded on one occasion during winter season surveys at Clongawny Bog, as an individual was heard calling from conifer wood on site on the 27th of January 2017. This species was not recorded at Drinagh Bog.

7.4.22 Buzzard

Raw Survey data for buzzard is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Buzzard were recorded in flight on 433 occasions during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7.4, Figure 7.1.19). Two-hundred and eighty-five of these observations occurred during the core breeding season months between April and August, while there were 148 observations of buzzard during non-breeding season months (September – March). One-hundred and seventy observations occurred during the 2018 breeding season, while the remaining 115 observations occurred during the 2019 breeding season (April - August).

Thirty-two observations occurred during the 2017/18 non-breeding season (October – March) while 106 observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019. In addition, there were ten observations of buzzard in flight during VP surveys in September 2019.

The majority of the flight activity occurred within, or partially within 500m of the proposed turbines. Two-hundred and fifty-six of the 433 flights occurred within, or partially within, the Potential Collision

Height (PCH), while the remaining 177 observations occurred below the potential lowest rotor swept height.

In addition to the 433 observations of birds in flight, there were 16 observations (seen or heard) of non-flying birds during non-breeding season months. Twelve of the 16 observations consisted of birds perched on trees, telephone poles, etc. The remaining four observations consisted of birds heard calling but were not seen.

Breeding Bird Surveys

Buzzard were recorded on 44 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.15). There were 22 observations from the 2018 breeding season and 22 observations of buzzard during 2019 Breeding Bird Surveys. The majority of observations of buzzard during Breeding Bird Surveys occurred in areas of improved agricultural grassland or forested areas offsite but within 500m of the development boundary.

Six observations related to birds calling or pairs recorded in areas of suitable breeding habitat. Four of these observations occurred during the 2018 breeding season, while the remaining two occurred during the 2019 breeding season. On the 24th of May 2018 a buzzard was recorded carrying prey into an area of conifer plantation before settling in this area. This observation confirmed breeding in the area with a nest site likely to be located in the area of conifer planation adjacent to the western boundary of the development site.

On the 20th of May 2019 a buzzard was recorded near an old nest within an area of conifer plantation to the south of the development site. This observation was noted as a possible breeding territory.

The location of both breeding territories from 2018 and 2019 can be seen on Figure 7.3.15.1 in Appendix 7.4.

Breeding Raptor Surveys

Buzzard were recorded on 68 occasions during Breeding Raptor Surveys (see Appendix 7.4, Figure 7.4.2). Forty-six observations occurred during the 2018 breeding season, while the remaining 22 observations occurred during the 2019 breeding season (April – July). Observations occurred predominantly off-site and in two distinct areas. The majority of flight activity occurred either near an area of forestry directly south of the development site, or to the northeast near an area of grassland between Banagher and the development site. Three distinct breeding territories were identified, through observations of calling birds, prey deliveries and breeding displays (see Figure 7.4.2.1 in Appendix 7.4). One territory was located within an area of forestry to the south of the development site while there were two breeding territories located to the north of the development site in small copses of native broadleaf woodland.

Winter Transect/Waterfowl Surveys

Buzzard were recorded on 27 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.17). Numbers recorded ranged from an individual to a group of three birds recorded flying together. Observations occurred between September 2018 and March 2019. Observations of this species occurred predominantly within the development site and within 500m of the proposed turbine locations.

In addition, there were six observations of buzzard during winter transect surveys from the 2017/18 winter season. Four observations occurred near the Clongawny area in the western section of the development site. Two observations occurred during a survey in November 2017, one in January 2018 and one in March 2018. The remaining two observations occurred near the Drinagh Wetlands in the east of the development site. One observation occurred during a survey on the 25th of January 2018 while the other observation occurred on the 21st of March 2018.

Incidental Observations

There were fifteen incidental observations of buzzard between October 2017 and September 2019. Fourteen of the 15 observations occurred during Migratory Bird Surveys along the River Shannon, several kilometres to the west of the development site. Two observations occurred in September 2018 while the remaining twelve observations all occurred in January 2019. The remaining observation occurred during a Winter Transect/Waterfowl Survey on the 24th of September 2019. On this occasion, a pair of buzzard were recorded in flight travelling in a northeast direction.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** One to two buzzards were present at Clongawny Bog throughout the winter season surveys. A displaying pair was also observed in February 2015, with three birds seen together on the 16th of February before landing in conifer plantation on site. One to two buzzards were present at Drinagh Bog throughout the winter season surveys, with six birds circling over the site on 10th of March and a party of four on the 19th of March 2015.
- **2015/16 Winter Season:** One to two buzzards were present at Clongawny Bog throughout the winter season surveys. A part of four were seen in a loose group on the 21st of September, with a displaying pair on site on the 15th of February. Buzzard were recorded at Drinagh Bog during all winter months except for October and November, with a pair seen together on several dates.
- **2016 Breeding Season:** Buzzard were present at Clongawny Bog throughout the 2016 breeding season surveys, with at least one young bird and two adults seen in August 2016. One to two buzzards were present at Drinagh Bog on several dates throughout the 2016 breeding season surveys. It is considered that buzzard breed locally, though not necessarily on site.
- **2016/17 Winter Season:** Buzzard were present at Clongawny Bog throughout the winter season surveys, predominantly individual birds, but occasional in small groups. Displaying birds were recorded in February and March, indicating localised breeding. Buzzard were regularly recorded at Drinagh Bog, during every month throughout the winter season surveys. Pairs were observed on several dates with up to four birds seen in March.
- **2017 Breeding Season:** Buzzard were present at Clongawny Bog throughout the 2017 breeding season surveys, with at least one successful breeding pair on site (young heard in late July). One to two buzzards were present at Drinagh Bog on several dates throughout the 2017 breeding season surveys. It is considered that buzzard breed locally, though not necessarily on site.

7.4.23 Sparrowhawk

Raw Survey data for Sparrowhawk is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Sparrowhawk were recorded in flight on 57 occasions during Vantage Point Surveys (see Figure 7.1.20, Appendix 7.4). Twenty-six of these observations occurred during the core breeding season months between April and August, while there were 31 observations of sparrowhawk during non-breeding season months (September – March). Fourteen observations occurred during the 2018 breeding season, while the remaining twelve observations occurred during the 2019 breeding season (April - August).

Sixteen observations occurred during the 2017/18 non-breeding season (October – March) while thirteen observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019. In addition, a single sparrowhawk was recorded in flight during a VP survey on the 13th of September 2019.

The majority of the flight activity occurred within, or partially within 500m of the proposed turbines. Twenty-two of the 57 flights occurred within, or partially within, the Potential Collision Height (PCH), while the remaining 35 observations occurred below the potential lowest rotor swept height.

Breeding Bird Surveys

Sparrowhawk were recorded on nine occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.16). There were five observations from the 2018 breeding season while there were four observations of sparrowhawk during 2019 Breeding Bird Surveys.

All five observations from the 2018 Breeding Bird Surveys consisted of individual birds recorded in hunting or travelling flights, with no indication of breeding behaviour.

All four observations from the 2019 breeding season occurred around the Drinagh wetlands. On the 10th of April 2019 a pair of sparrowhawk were seen in a displaying flight over an area of cutover bog and scrub to the east of the Drinagh wetlands. Three of the four observations from the 2019 breeding season occurred in April 2019 while the remaining observation on the 13th of May 2019 consisted of a female bird recorded in flight. There were no further observations of this species during the 2019 breeding season and no further indication of breeding activity.

Breeding Raptor Surveys

Sparrowhawk were recorded on eleven occasions during Breeding Raptor Surveys (see Appendix 7.4, Figure 7.4.3). Six observations occurred during the 2018 breeding season, while the remaining five observations occurred during the 2019 breeding season (April – July). One observation occurred within the proposed development site in an area of forestry adjacent to the briquette factory. Five observations occurred to the south of the development site in areas of forestry, while three observations occurred near Noggus bog to the north of the development site.

A breeding territory was identified in June 2018 at Noggus bog to the north of the development site. A female bird was recorded carrying prey into a birch copse. A confirmed nest site was identified within the development site in July 2019. At this location three juveniles were seen and heard calling to a female sparrowhawk in an area of forestry adjacent to the briquette factory.

On the 9th of July 2018 a sparrowhawk was recorded mobbing a peregrine in an area of conifer plantation just south of the development site, approximately 500m from the nearest proposed turbine. This observation was considered defence of a breeding territory. On the 5th of June 2019 a female was recorded carrying prey while in flight before landing into an area of conifer plantation more than one kilometre to the south of the development site. This observation confirmed breeding nearby.

The location of all confirmed breeding territories and nest locations from the 2018 and 2019 breeding seasons are shown on Figure 7.4.3.1 in Appendix 7.4.

Winter Transect/Waterfowl Surveys

Sparrowhawk were recorded on four occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.18). Observations occurred between November 2018 and March 2019, as individual birds were observed in hunting/travelling flights. All four observations occurred within the development site.

In addition, there was one observation of sparrowhawk from the 2017/18 winter transect surveys. During a survey in March 2018 a single sparrowhawk was recorded at the Clongawny area in the western section of the development site.

Incidental Observations

There were seven incidental observations of sparrowhawk between October 2017 and September 2019. Four observations occurred during Migratory Bird Surveys, as individuals were seen in flight around the River Shannon, several kilometres to the west of the development site. One observation occurred in September 2019, while the remaining three observations all occurred in January 2019.

On the 7^{th} of February 2019 a male was recorded in flight and landing in an area of scrub after a VP survey at VP7 as the surveyor was walking of the site. The remaining two observations occurred during Winter Transect/Waterfowl surveys in September 2019 as a female sparrowhawk in flight.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Sparrowhawk were recorded on several dates between November and March at Clongawny Bog during winter season surveys, with some displaying observed in March, indicating that this species may be a resident to the area. Individual sparrowhawks were also observed on several occasions at Drinagh Bog throughout the winter.
- **2015/16 Winter Season:** Sparrowhawk were recorded on four dates between September and March at Clongawny Bog during the winter season surveys, including a pair seen over conifer woodland on the 24^{th} of February 2016. Sparrowhawk were recorded twice at Drinagh Bog during the winter season surveys, including an observation of a pair seen soaring over the site on 24^{th} of March.
- **2016 Breeding Season:** Sparrowhawk were recorded on two dates during the 2016 breeding season surveys at Clongawny Bog. A pair were seen circling over the site on the 16^{th} of April, while a pair with one fledged chick were seen on the 17^{th} of June 2016, indicating that sparrowhawk successfully bred on site. In addition, there was at least one breeding pair of sparrowhawk at Drinagh Bog during the 2016 breeding season. A pair were seen circling and displaying over the site in April and July.
- **2016/17 Winter Season:** Sparrowhawk were recorded on four dates during the winter season surveys at Clongawny Bog, including a displaying pair on the 18^{th} of February 2017. Sparrowhawk were recorded on nine dates during the winter season surveys at Drinagh Bog, including observations of a pair on the 11^{th} of February and a group of three on the 14^{th} of March.
- **2017 Breeding Season:** Two pairs of breeding sparrowhawk were regularly recorded at Clongawny Bog during the 2016 breeding season surveys, with young birds seen and heard. There was also evidence of a further two pairs of breeding sparrowhawk at Drinagh Bog, with birds recorded regularly throughout the breeding season, including observations of pairs.

7.4.24 Kestrel

Raw Survey data for kestrel is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Kestrel were recorded in flight on 339 occasions during Vantage Point Surveys (see Figure 7.1.21, Appendix 7.4). Two-hundred and five of these observations occurred during the core breeding season months between April and August, while there were 134 observations of kestrel during non-breeding season months (September – March). Seventy-four observations occurred during the 2018 breeding season, while the remaining 131 observations occurred during the 2019 breeding season (April - August).

Thirty observations occurred during the 2017/18 non-breeding season (October – March) while 86 observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019. In addition, there were 18 observations of kestrel in flight during VP surveys in September 2019.

A large amount of flight activity occurred over the Drinagh wetlands, more than 500m east of the proposed turbine locations. The remaining flight activity occurred predominantly within, or partially within 500m of the proposed turbines. Eighty-two of the 339 flights occurred within, or partially within, the Potential Collision Height (PCH), while the remaining 257 observations occurred below the potential lowest rotor swept height.

In addition to the 339 observations of birds in flight, there were eight observations (seen or heard) of non-flying birds during non-breeding season months. Seven of the eight observations consisted of birds perched on trees, telephone poles, etc. The remaining observation consisted of birds heard calling from off-site to the east but not seen during a survey at VP7 on the 10th of January 2018.

Breeding Bird Surveys

Kestrel were recorded on 23 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.17). There were ten observations from the 2018 breeding season while there were thirteen observations of kestrel during 2019 Breeding Bird Surveys.

All ten observations from the 2018 Breeding Bird Surveys consisted of individual birds recorded hunting or flying between April and mid-May. On the 9th of July 2019 a kestrel was recorded making a kill and carrying food on the very northern edge of the site, between Drinagh wetlands and Noggus bog. This activity confirmed breeding locally with a nest site likely nearby. On the 15th of July 2019 two adult kestrel were recorded with three recently fledged chicks near an area of cutover bog and scrub within the proposed development site. The location of both 2019 breeding territories are provided in Figure 7.3.17.1, Appendix 7.4).

Breeding Raptor Surveys

Kestrel were recorded on 23 occasions during Breeding Raptor Surveys (see Appendix 7.4, Figure 7.4.4). Fifteen observations occurred during the 2018 breeding season, while the remaining eight observations occurred during the 2019 breeding season (April – July). Observations predominantly occurred off-site, in two distinct areas. The majority of flight activity occurred either near an area of forestry directly south of the development site, or to the northeast near an area of grassland between Banagher and the development site.

On the 5th of April 2018 a pair of male kestrels were recorded hunting together. Each of the remaining 22 observations consisted of individual birds in hunting or commuting flights. No evidence of breeding activity was recorded during Breeding Raptor Surveys in either 2018 or 2019.

Winter Transect/Waterfowl Surveys

Kestrel were recorded on twelve occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.19). Observations occurred between October 2018 and March 2019, as individual birds were observed in hunting/travelling flights. Observations of this species occurred predominantly within the development site and within 500m of the proposed turbine locations.

In addition, there was one observation of a kestrel recorded during winter transect surveys from the 2017/18 winter season. The observations occurred in March 2018 near the Clongawny area in the western section of the development site.

Incidental Observations

There were 18 incidental observations of kestrel between October 2017 and September 2019. Fifteen of the 18 observations occurred during Migratory Bird Surveys along the Shannon and Little Brosna river, several kilometres to the west and south of the development site respectively. Ten of these observations occurred in January 2019, while the remaining five observations occurred during the 2019 breeding season, between April and September.

The remaining three observations were recorded during Hen Harrier Roost Surveys from winter months, consisting of individual birds in hunting flights within two kilometres of the development site. The remaining three observations occurred during Migratory Bird Surveys along the Shannon, several kilometres to the west of the development site.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Kestrel were regularly recorded during all winter months at Clongawny Bog, including an observation of a pair seen together on the 11th of December. Individual kestrels were also regularly observed on during each month at Drinagh Bog throughout the winter, including observations of both male and female.
- **2015/16 Winter Season:** Kestrel were regularly recorded during all winter months at Clongawny Bog, including an observation of a pair seen together on the 23rd of October 2015. Kestrel were recorded on site in all months between December 2015 and March 2016. Most records were of individual birds, while a pair was recorded on the 10th of February 2016.
- **2016 Breeding Season:** Kestrel were recorded on three occasions during breeding season surveys at Clongawny Bog. Each observation was of individual birds in hunting flights between late August and September. Kestrel were recorded on four occasions during breeding season surveys at Drinagh Bog. Each observation was of individual birds in hunting flights between May and September.
- **2016/17 Winter Season:** Kestrel regularly recorded during all winter months at Clongawny Bog, with the exception of March 2017. Each observation was of individual birds in hunting flights. Kestrel was regularly recorded during all winter months at Drinagh Bog. All records were of individual birds, predominantly in hunting flights.
- **2017 Breeding Season:** Kestrel were recorded on six dates during breeding season surveys at Clongawny Bog. Each observation was of individual birds in hunting

flights. Kestrel were recorded on nine dates during breeding season surveys at Drinagh Bog. A pair were seen in flight together on the 4th of April, with all other observations of individuals in hunting flights.

7.4.25 Snipe

Raw Survey data for snipe is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Snipe were recorded in flight on 29 occasions during Vantage Point Surveys (see Figure 7.1.22, Appendix 7.4). Eighteen of these observations occurred during the core breeding season months between April and August, while there were eleven observations of snipe recorded during non-breeding season months (September – March). Twelve observations occurred during the 2018 breeding season, while the remaining six observations occurred during the 2019 breeding season (April - August).

Only one flight occurred during the 2017/18 non-breeding season (October – March) while ten observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019.

The majority of flight activity occurred over the Drinagh wetlands, more than 500m east of the proposed turbine locations. Nine observations occurred within, or partially within 500m of the proposed turbines. Ten of the 29 flights occurred within, or partially within, the Potential Collision Height (PCH), although four of these occurred more than 500m from the proposed turbines over the Drinagh wetlands and hence were not included in Collision Risk Modelling (CRM). The remaining 19 observations occurred below the potential lowest rotor swept height.

In addition to the 29 observations of birds in flight, there were thirteen observations of birds heard calling, chipping or drumming around dusk or dawn but not were seen.

Breeding Bird Surveys

Snipe were recorded on 76 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.18). There were 44 observations from the 2018 breeding season while there were 32 observations of snipe during 2019 Breeding Bird Surveys.

Thirty-seven observations related to birds calling, drumming, chipping or displaying or pairs recorded in areas of suitable breeding habitat. Several breeding territories were identified during both the 2018 and 2019 Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.18.1). In 2018, 18 breeding territories were recorded. Of these 13 were recorded within 400m of the turbines (Pearce-Higgins 2009), while four were recorded within the Drinagh wetlands to the east of the proposed turbines. The remaining breeding territory was to the south of the Cloneen wetlands. In 2019 ten breeding territories were recorded. Five of these were within 400m of the turbines (all in Clongawny/west of the briquette factory). The remaining four territories were recorded within the Drinagh wetlands to the east of the proposed turbines.

Winter Transect/Waterfowl Surveys

Snipe were recorded on 139 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.20). Observations occurred between October 2018 and May 2019. Observations of this species occurred predominantly within the development site during winter months, near Clongawny on the western side of the development. Observations ranged from individual birds to a flock of eight snipe.

In addition, there were twenty observations of snipe during winter transect surveys from the 2017/18 winter season. Six observations occurred near the Clongawny area in the western section of the development site. Two observations occurred during a survey in November 2017, three observations occurred in January 2018, while the remaining observation occurred in March 2018.

The remaining 14 observations occurred near the Drinagh Wetlands in the east of the development site. Five observations occurred during a survey on the 11th of November 2017, while there were two observations from the 25th of January 2018 and seven observations from the 21st of March 2018.

Incidental Observations

There were eleven incidental observations of snipe recorded between October 2017 and September 2019. Five of these observations were recorded during Hen Harrier Roost Surveys from winter months within two kilometres of the development site. Three observations occurred during Migratory Bird Surveys in January 2019 at the River Shannon and Little Brosna River, several kilometres to the west and south of the development site respectively. The remaining two observations of snipe occurred during Crane Dusk Surveys in March 2019, consisting of birds chipping around an area of cutover bog, close to VP4 at dusk.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Snipe were regularly recorded during surveys at Clongawny Bog during winter months, with a total of 116 birds flushed during a walked transect on the 1st of December 2014. Snipe were also regularly recorded during surveys at Drinagh Bog, with most observations consisting of individuals and a peak count of seven birds recorded on the 27th of December.
- **2015/16 Winter Season:** Snipe were regularly recorded during surveys at Clongawny Bog during winter months, in small numbers (1-10 birds). A maximum of 38 birds was recorded during surveys on the 24th of November 2015. Snipe were also regularly recorded during surveys at Drinagh Bog, with most observations consisting of individuals and a peak count of fourteen flushed during a survey on the 20th of September 2015.
- **2016 Breeding Season:** Two snipe were recorded displaying during surveys in May 2016 at Clongawny Bog. There were a total of seven breeding snipe territories estimated at Drinagh Bog during the 2016 breeding season.
- **2016/17 Winter Season:** Snipe were recorded in small numbers (>10 birds) on all site visits, with a peak count of sixteen birds recorded on the 14th of November 2016. Snipe were also regularly recorded during surveys at Drinagh Bog, with most observations consisting of individuals or small flocks (>5 birds) and a peak count of 22 flushed during a survey on the 11th of February 2017.
- **2017 Breeding Season:** There were up to three territorial snipe recorded at Clongawny Bog, in areas of wet bog in April and May. There were a total of five breeding snipe territories estimated at Drinagh Bog during the 2017 breeding season.

7.4.26 Ringed Plover

Raw Survey data for ringed plover is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Ringed plover were recorded in flight on seven occasions during Vantage Point Surveys (see Figure 7.1.23, Appendix 7.4). All seven observations occurred during May 2019. Observations of pairs, in suitable breeding habitat, alarm calling birds and birds seen in territorial defence of breeding territories. Twelve observations occurred during the 2018 breeding season, while the remaining six observations occurred during the 2019 breeding season (April - August). All flights occurred below the potential collision risk height.

In addition, there was also on observation of an individual bird seen perched on the ground near a flooded area of cutover bog, to the north of VP1 on the 2nd of August 2019. The location of all breeding territories identified during vantage point surveys can be found on Figure 7.1.23.1 in Appendix 7.4.

Breeding Bird Surveys

Ringed plover were recorded on 19 occasions during Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.19). There were eight observations from the 2018 breeding season while there were eleven observations of ringed plover during 2019 Breeding Bird Surveys.

Fourteen of the 19 observations related to birds calling, displaying, incubating eggs or pairs recorded in areas of suitable breeding habitat. There were six breeding areas identified in total across both the 2018 and 2019 Breeding Bird Surveys (see Appendix 7.4, Figure 7.3.19.1). Only three of the six breeding areas were located with proximity of the development infrastructure (i.e. turbines and road networks) while there were two breeding territories at Derrybrat to the east of the proposed turbines and one breeding territory at Noggus to the north.

Winter Transect/Waterfowl Surveys

Ringed plover were recorded on four occasions during Winter Transect/Waterfowl Surveys (see Appendix 7.4, Figure 7.7.21). Observations occurred between April 2019 and September 2019. All observations of this species occurred at Noggus bog to the north of the development site during the core breeding season.

Three of the four observations occurred between late April and May 2019, consisting of the known breeding pair at Noggus. The remaining observation occurred on the 3rd of September 2019 as an individual was seen foraging at Noggus around the known breeding territory.

Incidental Observations

There was only one incidental observation of ringed plover recorded between October 2017 and September 2019. On the 7th of March 2019 a ringed plover was heard calling around dusk, but not seen during a Crane Dusk Survey.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Ringed plover were recorded once during surveys at Clongawny Bog during winter months. On the 15th of March 2015 an individual was seen at a flooded area of cutover bog. Ringed plover were recorded twice during surveys at Drinagh Bog during winter months, with at least one bird present in November and two birds present in late March.

- **2015/16 Winter Season:** Ringed plover were recorded once during surveys at Drinagh Bog during winter months. A single bird was recorded on the 21st of March 2016. This species was not recorded at Clongawny Bog.
- **2016 Breeding Season:** A pair of ringed plover were recorded at Clongawny Bog from mid-April onwards. These observations were noted as probable breeding. At least one pair of ringed plover bred at Drinagh Bog during the 2016 breeding season.
- **2017 Breeding Season:** A ringed plover was recorded at Clongawny Bog in April 2017 in an area of suitable breeding habitat. In addition, a single bird was seen perched on bog in September before being chased and killed by a merlin. A pair of ringed plover were recorded at Drinagh Bog in April 2016, but no evidence of breeding was observed.

7.4.27 Teal

Raw Survey data for teal is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Teal were recorded in flight on three occasions during Vantage Point Surveys (see Figure 7.1.24, Appendix 7.4). All three flights occurred more than 500m from the proposed turbines locations around the Drinagh wetlands to the east of the proposed turbines. None of the flights occurred within the potential collision risk zone. One flight occurred during a survey at VP8 in December 2018, while the other two observations occurred during the core breeding season between May and July 2019.

In addition, there was also on observation of a flock of four teal seen feeding on a flooded area of cutover bog within the Drinagh wetlands on the 10th of January 2018.

Winter Transect/Waterfowl Surveys

Teal were recorded on 24 occasions during winter transect surveys from the 2017/18 winter season. Seven observations occurred around Clongawny to the west of the briquette factory, while there were 17 observations around the Drinagh Wetlands east of the proposed turbines. Six observations at Drinagh occurred during a survey on the 11th of November 2017 while there were eleven observations from the 25th of January 2018. At Clongawny, three observations occurred in November 2017 while there four observations in January 2018.

There were no observations of teal during the MKO Winter Transect/Waterfowl surveys from the 2018/19 winter season.

Incidental Observations

There was only one incidental observation of teal recorded between October 2017 and September 2019. On the 12th of February 2019 a teal was heard calling around dusk, but not seen after a Vantage Point Survey at VP3.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2014/15 Winter Season:** Teal were recorded on a regular basis at Clongawny Bog during the 2014/15 winter season, with observations mostly of small flocks (>10 birds) and with a peak count of c.65 birds on the 19th of December. Teal were regularly recorded at Drinagh Bog during winter surveys, with a peak count of 22 birds on the 23rd of January 2015.
- **2015/16 Winter Season:** Teal were recorded on five dates at Clongawny Bog, with observations mostly of small flocks and with a peak count of 28 birds on the 20th of October. Teal were only recorded on two dates in December at Drinagh Bog, with a flock of ten and a flock of 25 birds observed.
- **2016 Breeding Season:** A group of five teal were recorded on a flooded area at Clongawny Bog on the 21st of September 2016. A flock of twelve teal were flushed during a survey at Drinagh Bog on the 4th of September 2016.
- **2016/17 Winter Season:** Teal were recorded on five dates at Clongawny Bog, with observations mostly of small flocks and with a peak count of 28 birds on the 12th of November. Teal were recorded in small numbers throughout the winter at Drinagh Bog, with a maximum flock of c.60 birds recorded on the 8th of December 2016.
- **2017 Breeding Season:** Teal were recorded on three dates at Clongawny Bog between August and September, with observations consisting of small flocks (maximum of seven birds). A pair of teal were observed at Drinagh Bog in April 2017 but were not seen in subsequent visits.

7.4.28 Black-tailed Godwit

Raw Survey data for black-tailed godwit is provided in Appendix 7.4. Results summary tables are present in Appendix 7.3.

Vantage Point Surveys

Black-tailed godwit were only recorded once during Vantage Point Surveys (see Figure 7.1.25, Appendix 7.4). On the 6th of August 2019 a flock of five black-tailed godwit were seen in flight travelling over the Drinagh wetlands to the east of the proposed turbines. The observation occurred more than 500m east of the proposed turbine locations and was outside any potential collision risk zone.

Incidental Observations

There were six incidental observations of black-tailed godwit recorded between October 2017 and September 2019. All six observations occurred during Migratory Bird Surveys between March and September 2019. Flocks ranging from 140 to 350 birds were seen on five occasions during surveys at CMVP5 along the Shannon in March 2019. In addition, a flock of four birds were seen at the Shannon Callows during a survey at CMVP3 in September 2019.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7.7 and Appendix 7.5.

- **2015/16 Winter Season:** A single black-tailed godwit was recorded on migration at Drinagh Bog on the 21st of March 2016.

7.4.29 Passerines (Red Listed)

The BoCCI Red listed species meadow pipit, grey wagtail and yellowhammer were all recorded during the surveys undertaken. None of these were regularly recorded within the development site with the majority of observations and breeding evidence occurring in areas of improved agricultural grassland adjacent to the development site.

7.5 Evaluation

A determination of population importance of birds within the likely zone of influence is provided in the sections below following criteria described in Section 7.2.5. Estimates of National population sizes were obtained from the NPWS Article 12 Reporting (2008-2012) which details the status and trends of Irelands Bird species. Where relevant, estimates for mean county populations have been derived following a review of I-WeBS sites in County Offaly.

7.5.1 Whooper Swan

Wintering

As per the latest national wintering estimates provided in Burke et al (2018), the national wintering population of Whooper Swan in the Republic of Ireland is 11,852. Using these latest I-WeBS figures, 1% of the National population of Whooper Swans is 119. Therefore, as per NRA 2009, a regularly occurring population of 119 Whooper Swans is required for classification as Nationally Important.

The Swan Census 2015 (Crowe et. al., 2015) was consulted regarding the population data for Whooper Swans in County Offaly. Based on the 2015 Swan Census data, in January 2015 the County Offaly population was 489 individuals. Based on the above, a population of 4-5 Whooper Swans is required for County Importance classification in the Offaly area.

Whooper swan is an SCI of both the Middle Shannon Callows SPA (004096) and the River Little Brosna Callows SPA (004086) with respect to wintering populations. Both SPAs are located within 5km of the development site, to the southwest. The core foraging range of whooper swan is 5km (SNH, 2016). The whooper population associated with the Middle Shannon Callows SPA is 407 birds, while the population associated within The River Little Brosna Callow SPA is 326 birds (IWeBS 5-year mean peak counts 2010/11 -2014/15). During the 2018/19 winter season, migratory bird surveys were undertaken which were specifically designed to determine if there was any connectivity between these SPAs and the proposed development site. No regular commuting/migratory flights were recorded that would constitute evidence of connectivity between the SPAs and the proposed development area. Furthermore, large numbers of whooper swan were recorded foraging and roosting within flooded sections of bog adjacent to the proposed development area. The evidence of surveys was that the local population was largely resident during the winter months in local areas of flooded bog.

During the 2017-2019 surveys, whooper swan flocks of county importance, as per NRA criteria (Crowe et al, 2015), were observed on 81 occasions. Flocks of National importance, as per NRA criteria (Burke et al, 2018), were observed on four occasions during vantage point surveys from the 2017/2018 winter season. All four of these observations occurred at the Drinagh wetlands, more than 500m east of the nearest proposed turbine. Five distinct roosting/foraging areas for whooper swan were recorded within one kilometre of the development site, although the majority of roosting and foraging activity occurred around the Drinagh wetlands to the east of the proposed turbines. The use of areas that overlap with development infrastructure was found to be secondary to the Drinagh wetlands were the majority of large flocks were recorded. Only two roosting/foraging areas were identified within proximity of the proposed turbines/development footprint with twelve swans being the maximum flock size observed in these areas. Large flocks c.200 birds were observed roosting at the Drinagh wetlands during the 2017/18 winter season, although numbers seen feeding and roosting in these areas in 2018/2019 were much lower with a maximum of 24 birds recorded here. Large whooper swan flocks were recorded at Noggus bog to the north of the Drinagh wetlands, away from the development site, during the 2018/2019 winter season.

While flocks of national importance were recorded on four occasions in 2017/18 this was the exception, with the vast majority of observations involving flocks of no greater than county importance. Therefore, the population recorded at the development site was assigned **County Importance.**

Breeding

The species is not dependent of the development site for breeding.

7.5.2 Golden Plover

Wintering

The estimated national wintering population of golden plover in Ireland is 80,707 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of golden plover is 807 bird. As per NRA 2009, a regularly occurring population of 807 golden plover is required for classification as Nationally Important. The maximum number of birds recorded from the winter season was 270 birds. This maximum number does not correspond with the classification criteria for National or International Importance (Burke et al. 2018).

Golden plover is an SCI of both the Middle Shannon Callows SPA (004096) and the River Little Brosna Callows SPA (004086) with respect to wintering populations. Both SPAs are located within 5km to the development site, to the southwest. The golden plover population associated with the Middle Shannon Callows SPA is 5,915 birds, while the population associated within The River Little Brosna Callow SPA is 8,045 birds (I-WeBS 5-year mean peak counts 2010/11 -2014/15). As both SPAs are within the core foraging range of golden plover during winter months (Gillings and Fuller, 1999) the birds observed during surveys at the proposed development site have the potential to be associated with either or both SPAs. However, during the 2018/19 winter season, migratory bird surveys were undertaken which were specifically designed to determine if there was any connectivity between these SPAs and the proposed development site. No regular commuting/migratory flights were recorded that would constitute evidence of connectivity between the SPAs and the proposed development area.

To estimate the county population, a review of all County Offaly I-WeBS sites was conducted. It should be noted that wintering golden plover will utilise agricultural grasslands and other habitats not typically surveyed during I-WeBS counts. Therefore, the population estimate provided based on I-WeBS figures below is likely to be an underestimate of the county population. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 1,925)
- Cloghanhill (mean = 12)
- *Little Brosna Callows (mean = 5,845)
- *Little Brosna Callows (aerial) (mean = 2,200)
- Raheen Lough (mean = 0)
- *Shannon Callows (mean = 1,235)
- *Shannon Callows (aerial) (mean = 4,680)
- Turraun Nature Reserve (mean = 1)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly I-WeBS sites is 12,463.

Therefore, taking a precautionary approach, a regularly occurring population of 125 birds (1% of Offaly county population) is considered of County Importance in the context of the development site.

Flocks of 125 birds or more (County Importance) were recorded flying over the development site on six occasions, across five different survey dates, during the extensive suite of surveys undertaken. The population recorded at the development site was therefore assigned **County Importance** on the basis of a resident/regularly occurring wintering population assessed to be important to the county level.

Breeding

Golden plover were observed in flight over the development site in April 2018 and April 2019. There were no further observations during the remainder of either the 2018 or 2019 breeding seasons. No evidence of breeding was recorded. Breeding golden plover are now restricted to the west and north west of the country, making the possibility of breeding activity in this area highly unlikely. Observations of this species in April of both years is likely to be associated with a lingering winter population.

The species is not dependent on the development site for breeding.

7.5.3 Red-necked Phalarope

Red-necked phalarope is a rare summer visitor to Ireland between the months of May and October. Further detail regarding observations of this species and more detailed evaluation can be found in Confidential Appendix 7.5.

In acknowledgement of the rarity of the species in Ireland, the population recorded during surveys has been considered of **National Importance** on a precautionary basis.

7.5.4 Hen Harrier

Wintering

The estimated national wintering population of Hen Harrier in Ireland is 269-349 therefore 1% of the ROI National wintering population is 2-3 birds. As per NRA 2009, a regularly occurring wintering population of 2-3 Hen Harrier is required for classification as Nationally/Internationally Importance.

Hen harrier were recorded on 20 occasions during winter months (September – March). Two separately used hen harrier wintering night roosts were identified. One of which was approximately 4km from the nearest proposed turbine, while the other occurred within the development site, approximately 500m from the nearest turbine. Hen harrier were only observed entering these roosts on one occasion in each instance and there were no observations of birds roosting at any other location within 2km of the development site throughout the 2018/19 winter season. There is a large communal hen harrier roost within the Lough Boora Parklands. The wintering hen harrier recorded within the proposed development are likely to be associated with this roost

Taking a precautionary approach, it is assumed that the individuals recorded during the winter season are associated with a **Nationally/Internationally Important** wintering population from the wider area.

Breeding

Based on the latest Breeding Hen Harrier Survey (NPWS 2015), the ROI National breeding population is in the range of 108-157 pairs. Therefore, a single breeding pair in Ireland conforms to National/International Importance as per NRA criteria.

This species was infrequently recorded during the breeding season, i.e. hen harrier were recorded on eight occasions during the breeding season. All observations from the core breeding season consisted of ringtails (female or juvenile birds). No males were observed during this survey period. Four of these observations were recorded in August, which is considered to be outside the core breeding season of April to July. No indication of breeding behaviour was observed either on site or within 2km of same.

Numbers of ecological importance were not recorded during the breeding season. The development site is of no importance to breeding hen harrier.

7.5.5 Common Crane

Common crane were once a widespread and common resident bird species in Ireland but went extinct in this country towards the end of the 16th Century. There is a small breeding population of common crane in Norfolk as well as a re-introduction population in Somerset, England. However, this species is largely restricted to breeding grounds in eastern Europe and Asia, while their wintering grounds are predominantly located in France, Spain and North Africa. Common crane are currently a rare vagrant species recorded in Ireland predominantly during winter months.

Common crane were recorded in flight over the developments site on five occasions during the 2018/19 winter season, between December 2018 and March 2019, while regular roosting activity was not recorded within the development site. These observations are considered to be sightings of vagrant birds.

The development site is not of significance to the species.

7.5.6 Kingfisher

As reported (2008-2012) under Article 12 of the Birds Directive (Directive 2009/147/EC), the estimated national population of kingfisher is between 368 – 1,031 breeding pairs.

Kingfisher were only recorded on five occasions during surveys between October 2017 and September 2019 at the development site. All five observations occurred more than 2.5km east of the nearest proposed turbine over the Drinagh wetlands.

The development site is not of significance to the species.

7.5.7 Little Egret

Little egret have an estimated national wintering population of 1,274 birds based on the most recent I-WeBS 5-year mean peak counts (Burke et al. 2018). Therefore, 1% of the ROI National wintering population is c.13 birds. As per NRA 2009, a regularly occurring wintering population of 13 little egret is required for classification as Nationally/Internationally Importance. The maximum number of little egret recorded during a survey was five birds. This number does not correspond to numbers of National Importance.

Little egret were regularly recorded during both the breeding and wintering seasons during surveys at the development site. While this species was recorded during the breeding seasons, no evidence of breeding activity was recorded. The majority of observations occurred around the Drinagh wetlands, more than 500m to the east of the proposed turbine locations (Burke et al. 2018).

To estimate the county population, a review of all County Offaly IWeBS sites was conducted. It should be noted that little egret will utilise flooded fields/bogs, river banks and other habitats not typically surveyed during IWeBS counts. Therefore, the population estimate provided based on IWeBS figures below is likely to be an underestimate of the county population. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 1)
- Cloghanhill (mean = 0)
- *Little Brosna Callows (mean = 6)
- *Little Brosna Callows (aerial) (mean = 1)
- Raheen Lough (mean = 1)
- *Shannon Callows (mean = 0)
- *Shannon Callows (aerial) (mean = 0)
- Turraun Nature Reserve (mean = 2)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly IWeBS sites is ten birds.

Therefore, taking a precautionary approach, a regularly occurring population of a single bird (1% of Offaly county population) is considered of County Importance in the context of the development site. The population recorded at the development site was therefore assigned **County Importance** on the basis of a resident/regularly occurring wintering population assessed to be important to the county level.

7.5.8 Marsh Harrier

Marsh harrier is a rare winter visitor to well-vegetated wetlands from March to September throughout Ireland, with observations consisting almost always of young non-breeding birds.

There were only two observations of marsh harrier during surveys between October 2017 and September 2019 at the development site. Both observations were of a juvenile bird recorded hunting over the Drinagh wetlands on the 25th of April 2019, more than 1.5km from the nearest proposed turbine.

The development site is not of ecological significance for this species.

7.5.9 Merlin

As reported (2008-2012) under Article 12 of the Birds Directive (Directive 2009/147/EC), the estimated population of Merlin is between 200 – 400 pairs based on Hardy et al (2009).

Merlin were only recorded on four occasions during surveys between October 2017 and September 2019. All four observations were of individual birds recorded in flight during the 2017/18 winter season between December 2017 and March 2018. Three of the four observations occurred within, or partially within, 500m of the proposed turbine layout.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)**.

7.5.10 Peregrine

The estimated national breeding population of peregrine in Ireland is 425 breeding pairs as per the National Breeding Peregrine Survey 2017 (IRSG 2018, Unpublished Report). Peregrine were recorded on 28 occasions during surveys between October 2017 and September 2019. Only nine of these observations occurred during the core breeding season for this species (April – August), while there was no evidence of breeding activity either on site or within 2km of same, this species was regularly recorded foraging over the development site during winter months.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)** on the basis of regularly occurring wintering population assessed to be important at the local level.

7.5.11 Lapwing

Wintering

The estimated national wintering population of lapwing in Ireland is 69,823 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of lapwing is 698 birds. As per NRA 2009, a regularly occurring population of 698 lapwing is required for classification as Nationally Important. The maximum number of birds recorded from the winter season was 400 birds. This maximum number does not correspond with the classification criteria for National or International Importance (Burke et al. 2018).

Lapwing is an SCI of both the Middle Shannon Callows SPA (004096) and the River Little Brosna Callows SPA (004086) with respect to wintering populations. Both SPAs are located within 5km to the development site, to the southwest. The lapwing population associated with the Middle Shannon Callows SPA is 5,988 birds, while the population associated within The River Little Brosna Callow SPA is 4,067 birds (IWeBS 5-year mean peak counts 2010/11 -2014/15). As both SPAs are within the core foraging range of lapwing during winter months (Gillings and Fuller, 1999) the birds observed during surveys at the proposed development site have the potential to be associated with either or both SPAs. However, during the 2018/19 winter season, migratory bird surveys were undertaken which were specifically designed to determine if there was any connectivity between these SPAs and the proposed development site. No regular commuting/migratory flights were recorded that would constitute evidence of connectivity between the SPAs and the proposed development area.

To estimate the county population, a review of all County Offaly I-WeBS sites was conducted. It should be noted that wintering lapwing will utilise agricultural grasslands and other habitats not typically surveyed during I-WeBS counts. Therefore, the population estimate provided based on I-WeBS figures below is likely to be an underestimate of the county population. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 1,138)
- Cloghanhill (mean = 24)
- *Little Brosna Callows (mean = 3,092)
- *Little Brosna Callows (aerial) (mean = 975)
- Raheen Lough (mean = 42)
- *Shannon Callows (mean = 1,078)
- *Shannon Callows (aerial) (mean = 4,910)
- Turraun Nature Reserve (mean = 6)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly IWeBS sites is 9,212.

Therefore, taking a precautionary approach, a regularly occurring population of 92 birds (1% of Offaly county population) is considered of County Importance in the context of the development site. Flocks of County Importance were recorded flying over the site on six occasions between October 2017 and November 2018, during the extensive suite of VP surveys undertaken. Furthermore, flocks of county importance were observed on three occasions during Winter Transect/Waterfowl surveys in November 2018.

Therefore, taking a precautionary approach, the population recorded at the development site was assigned **County Importance** on the basis of a resident/regularly occurring wintering population assessed to be important to the county level.

Breeding

As reported (2008-2012) under Article 12 of the Birds Directive (Directive 2009/147/EC), the estimated population of breeding lapwing is 2,000 pairs based on Lauder & Donaghy (2008). Therefore, 1% of the National breeding population is 20 breeding pairs. As per NRA 2009, a regularly occurring population of 20 pairs of breeding lapwing is required for classification as Nationally Important.

During both the 2018 and 2019 breeding season the number of breeding lapwing recorded onsite or within 500m of the development site, was sixteen breeding pairs. In addition, there were a number of breeding pairs at Noggus bog and Derrybrat within proximity of the development site to the north and east of the Drinagh wetlands respectively. Therefore, taking a precautionary approach, the breeding lapwing population recorded during the breeding season are deemed to be of **National Importance**.

7.5.12 Black-headed Gull

Breeding

As per the latest NPWS Article 12 reporting document, the estimated population of breeding black-headed gull is 9,318 pairs. Therefore, 1% of the National breeding population is 93 breeding pairs. As per NRA 2009, a regularly occurring population of 93 pairs of breeding black-headed gull is required for classification as Nationally Important.

The National Seabird 2000 survey data was consulted in order to determine numbers of breeding black-headed gull in the wider area, in the absence of more recently available data. All records of black-headed gull, both on-site and in the wider area, were recorded in June 2002. There were two separate black-headed gull colonies within the development site, consisting of 30 and 20 occupied nests. There were four observations of black-headed gull colonies between 5 – 10 kilometres from the development site. The census was completed with respect to number of occupied nests (i.e. breeding pairs). Taking a highly conservative approach it has been assumed that the number of birds was double the number of occupied nests, although it is likely that there were also non-breeding or juvenile birds in the area which were not accounted for. The total number of black-headed gull within the wider area has therefore been assumed as 126 birds (i.e. 63 occupied nests).

A breeding colony of approximately 300 black-headed gull have regularly established within the development site and surrounding areas in previous years. During the 2017 breeding season a colony of approximately 30 pairs of black-headed gulls held a breeding territory on a flooded area of cutover bog at Clooneen, northeast of VP1.

During the 2018 breeding season approximately 300 birds (i.e. potentially up to 150 pairs) were observed attempting to establish a breeding colony on a large area of flooded cutover bog within the development site and 500m of proposed turbines, just west of VP7, on the 2nd of May 2018. On a subsequent visit to the area, approximately one week later, the colony had abandoned this area, possibly due to the disturbances caused by peat extraction close to the breeding territory. There were also an additional five probable black-headed gull breeding territories onsite or within 500m of the development site. There was one probable breeding pair in the Clooneen area, three probable breeding pairs west of the briquette factory and one probable breeding to the east of the briquette factory.

During the 2019 breeding season the breeding colony was established at Noggus Bog, to the north of the development site. Numbers within the colony ranged from approximately 120 to 150 birds (i.e. 60-75 breeding pairs), while there were also six breeding pairs of black-headed gull onsite or within 500m the development area. Two breeding pairs were recorded within the Clooneen area, three breeding pairs were recorded within an area of flooded bog just west of the briquette factory and VP4, while there was also one possible breeding pair within the Drinagh wetlands.

Numbers recorded to have successfully bred onsite were low, however, the population within the wider study area was considered of national importance. Therefore, taking a precautionary approach, the breeding black-headed gull population recorded during the breeding season are deemed to be of **National Importance**.

Wintering

Black-headed gull were not regularly observed during surveys at the development site during winter months. Only thirteen observations occurred outside of the core breeding season months for this species. These observations are all likely to be associated with a lingering or an early establishing breeding population.

Wintering populations of this species are not dependent on the development site.

7.5.13 Herring Gull

Herring gull is Red listed during the breeding season only in Ireland (BoCCI). The species in not Red listed with regard to wintering populations.

Herring gull were only recorded on ten occasions during surveys between October 2017 and September 2019. Nine of the ten observations occurred between July and August 2018 as individuals to a maximum flock of five birds were recorded travelling over the development site, while the remaining observation occurred during November 2018. This species was not observed to utilise the development site or surrounding areas for foraging or breeding. Observations of this species were restricted to the end of the summer or winter months, given the timing of these observations these birds were considered to have been on passage through the area.

Numbers of ecological significance were not recorded. The development site is not significance for this species.

7.5.14 Woodcock

Woodcock is Red listed during the breeding season in Ireland. The species in not Red listed with regard to wintering populations.

This species was regularly recorded during both the 2018 and 2019 breeding seasons at Derrinlough. Numerous roding male woodcock were recorded in displaying flights over five distinct areas. Three of these areas were within 500m of the proposed turbine locations, while the other two were east of the development infrastructure at the Drinagh wetlands and Derrybrat bog.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident breeding population assessed to be important at the local level.

7.5.15 Curlew

Curlew is Red listed during both the breeding and wintering seasons in Ireland. The estimated national wintering population of curlew in Ireland is 28,300 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of curlew is 283 birds. As per NRA 2009, a regularly occurring population of 283 curlew is required for classification as Nationally Important. A population of national importance was not recorded within the proposed development area.

This species was only recorded occasionally during the winter months and between June and September 2019. The lack of observations of curlew earlier in the season (i.e. March to May inclusive), is a strong indication that these individuals were not associated with a breeding attempt on or near the site. Similarly surveying of the proposed development area prior to October 2017, did not record the site to be used by breeding curlew. On this basis, the birds recorded at the proposed development site are considered to be non-breeding individuals.

To estimate the county population, a review of all County Offaly I-WeBS sites was conducted. It should be noted that wintering curlew will utilise agricultural grasslands and other habitats not typically surveyed during I-WeBS counts. Therefore, the population estimate provided based on I-WeBS figures below is likely to be an underestimate of the county population. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 142)
- Cloghanhill (mean = 0)
- *Little Brosna Callows (mean = 5)
- *Little Brosna Callows (aerial) (mean = 0)
- Raheen Lough (mean = 0)
- *Shannon Callows (mean = 10)
- *Shannon Callows (aerial) (mean = 2)
- Turraun Nature Reserve (mean = 10)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly I-WeBS sites is 167.

Therefore, taking a precautionary approach, a regularly occurring population of 1-2 birds (1% of Offaly county population) is considered of County Importance in the context of the development site.

Therefore, populations of County Importance (i.e. one bird) were seen or heard during surveys at the development site on eights occasions, across eight different survey dates, during the extensive suite of surveys undertaken. The population recorded at the development site was therefore assigned **County Importance** on a precautionary basis.

7.5.16 Dunlin

Dunlin is Red listed during both the breeding and wintering seasons in Ireland.

This species was only recorded twice during extensive surveys between October 2017 and September 2019. On the 25th of May 2018 an individual bird was seen circling low over southern corner of the flooded area just north of VP1 before travelling away from the development site in a south-westerly direction. On the 23rd of May 2019 as a flock of four birds were seen foraging over an area of flooded cutover bog at Noggus to the northeast of the proposed development site.

No evidence of breeding activity was recorded during either the 2018 or 2019 season. Numbers of ecological significance were not recorded. The development site is not of significance to the species.

7.5.17 Redshank

Breeding

As per the latest NPWS Article 12 reporting document, the estimated population of breeding redshank is 500 pairs. Therefore, 1% of the National breeding population is 5 breeding pairs. As per NRA 2009, a regularly occurring population of 5 pairs of breeding redshank is required for classification as Nationally Important.

Redshank were recorded on 28 occasions onsite or within 500m of the development site, during extensive surveys between October 2017 and September 2019. Ten observations occurred during the 2018 breeding season while there were 17 observations from the 2019 breeding season. The remaining observation consisted of a single bird recorded foraging in September 2018. There were two confirmed breeding pairs in 2018, both of which were located within the Drinagh wetlands and in close proximity to one another. There were three confirmed breeding pairs in 2019. One breeding pair established in the same area of the Drinagh wetlands from 2018, while there was also a breeding pair at Derrybrat to the east of the development infrastructure and one breeding pair at Noggus to the north. These numbers do not correspond with the classification criteria for National Importance.

This species was not recorded during the winter season; therefore, the site is not of significance to a wintering population.

An estimate of the county population was not available. However, taking a precautionary approach the population recorded was assigned **County Importance** on the basis of a resident breeding population assessed to be important at the County level.

7.5.18 Shoveler

Shoveler is Red listed during the wintering season only in Ireland. The species in not Red listed with regard to breeding populations.

This species was only recorded on eight occasions during extensive surveys between October 2017 and September 2019. Six observations occurred between April and May 2019, while there were also two observations of this species during January 2019. There were three observations around the Drinagh wetlands, three observations at Noggus to the north of the development site and one observation at Derrybrat to the east of the development infrastructure. The remaining observation consisted of a flock of five birds recorded within the Clooneen wetland within the development site on the 9th of January 2019.

No evidence of breeding activity was recorded. Numbers of ecological significance were not recorded. The development site is not of significance to the species.

7.5.19 Tufted Duck

Tufted duck is Red listed during the wintering season only in Ireland. The species in not Red listed with regard to breeding populations.

The estimated national wintering population of tufted duck in Ireland is 16,927 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of tufted duck is 169 birds. As per NRA 2009, a regularly occurring population of 169 tufted duck is required for classification as Nationally Important. The maximum number of birds recorded from the winter season was seven birds. This maximum number does not correspond with the classification criteria for National or International Importance (Burke et al. 2018).

To estimate the county population, a review of all County Offaly IWeBS sites was conducted. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 5)
- Cloghanhill (mean = 4)
- *Little Brosna Callows (mean = 76)
- *Little Brosna Callows (aerial) (mean = 0)
- Raheen Lough (mean = 14)
- *Shannon Callows (mean = 2)
- *Shannon Callows (aerial) (mean = 10)
- Turraun Nature Reserve (mean = 0)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly IWeBS sites is 109 birds.

Therefore, taking a precautionary approach, a regularly occurring population of a single bird (1% of Offaly county population) is considered of County Importance in the context of the development site.

This species was regularly recorded during both the breeding and wintering season surveys between October 2017 and September 2019. Numbers recorded ranged from individuals to a flock of eight birds. Evidence of breeding was recorded at the Drinagh wetlands to the east of proposed turbines.

Taking a highly precautionary approach, the population recorded was assigned **County Importance** on the basis of a resident/regularly occurring wintering population assessed to be important at the County level.

7.5.20 Wigeon

Wigeon is Red listed during the wintering season only in Ireland. The species in not Red listed with regard to breeding populations.

The estimated national wintering population of wigeon in Ireland is 50,452 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of wigeon is 505 birds. As per NRA 2009, a regularly occurring population of 505 wigeon is required for classification as Nationally Important. The maximum number of birds recorded from the winter season was 13 birds. This maximum number does not correspond with the classification criteria for National or International Importance (Burke et al. 2018).

Wigeon is an SCI of the Middle Shannon Callows SPA (004096) with respect to wintering populations. This SPA is located within the core foraging range of 2.5km for wintering wigeon (Johnson et al., 2014). The wigeon population associated with the Middle Shannon Callows SPA is 3,837 birds (IWeBS 5-year mean peak counts 2010/11 -2014/15). During the 2018/19 winter season, migratory bird surveys were undertaken which were specifically designed to determine if there was any connectivity between these SPAs and the proposed development site. No regular commuting/migratory flights were recorded that would constitute evidence of connectivity between the SPAs and the proposed development area.

To estimate the county population, a review of all County Offaly IWeBS sites was conducted. The following mean count values have been recorded for Offaly I-WeBS sites over the most recent 5-season period, i.e. for the period 2011/12 – 2015/16:

- Blackwater Railway Lake (mean = 0)
- Boora Lakes – Back Lakes Finnamores (mean = 49)
- Cloghanhill (mean = 225)
- *Little Brosna Callows (mean = 4,294)
- *Little Brosna Callows (aerial) (mean = 4,025)
- Raheen Lough (mean = 62)
- *Shannon Callows (mean = 987)
- *Shannon Callows (aerial) (mean = 2,850)
- Turraun Nature Reserve (mean = 0)

In the case of both the Shannon Callows and Little Brosna Callows, estimates are provided for both land counts and aerial counts. It is unclear whether aerial surveys only covered previously un-surveyed areas that were inaccessible from land counts or the entire site, which would therefore lead to a double count/overestimation. The bird populations for Little Brosna Callows and Shannon Callows utilised whichever peak count value was the highest (Aerial or Land Count) while disregarding the lower figure to avoid overestimating these populations. Based on the above, the mean wintering population from Offaly IWeBS sites is 7,480 birds.

Therefore, taking a precautionary approach, a regularly occurring population of 75 birds (1% of Offaly county population) is considered of County Importance in the context of the development site.

Wigeon were only recorded on ten occasions during extensive surveys between October 2017 and September 2019. Numbers recorded ranged from an individual duck to a flock of 35 birds, which does not correspond to numbers of County Importance. This species was only recorded on a single occasion within 500m of a proposed turbine. Nineteen birds were recorded on this occasion.

Numbers of ecological significance were not recorded. The development site is not of significance to the species. Populations recorded of each species were deemed to be of no greater than **Local Importance (Lower Value)**.

7.5.21 Long-eared Owl

Long-eared owl is not listed on Annex I of the Birds Directive. The species is Green listed in Ireland (BoCCI). This species was only recorded twice during extensive surveys between October 2017 and September 2019.

Numbers of ecological significance were not recorded. The development site is not of significance to the species.

7.5.22 Buzzard

Buzzard is not listed on Annex I of the Birds Directive. The species is Green listed in Ireland (BoCCI). The population recorded across the seasons was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.5.23 Sparrowhawk

Sparrowhawk is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during the breeding season only. The population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.5.24 Kestrel

Kestrel is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during the breeding season only. The population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.5.25 Snipe

Snipe are amber listed in Ireland during both the breeding and winter seasons (BoCCI). The population recorded within the development site was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.5.26 Ringed Plover

Ringed plover are green listed in Ireland during both the breeding and winter seasons (BoCCI). The population recorded within the development site was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring breeding population assessed to be important at the local level.

7.5.27 Teal

Teal is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during both the breeding and wintering seasons. The species was infrequently recorded within proximity of the development site during the extensive two-year survey period. The population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.5.28 Black-tailed Godwit

Black-tailed Godwit is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during the wintering season only. The species was only recorded within close proximity of the development site on one occasion during the extensive two-year survey period. Numbers of ecological significance were not recorded. The development site is not of significance to the species.

7.5.29 Passerines (Red Listed)

Meadow pipit, grey wagtail and yellowhammer are Red listed in Ireland during the breeding season. Populations recorded of each species were deemed to be of no greater than **Local Importance (Lower Value)**.

7.6 Identification of Key Ornithological Receptors

Table 7-11 Avifaunal Receptor Evaluation and Selection Criteria Rationale

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Whooper Swan	Annex I, EU Birds Directive; SCI species of nearby SPAs	**<u>Wintering</u>** County Importance	This species was regularly recorded utilising habitats within the site boundary for foraging and roosting. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded flying over the development site and within 500m of the turbine layout. Taking a precautionary approach, **the potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Golden Plover	Annex I, EU Birds Directive; SCI species of nearby SPAs; BoCCI Red List & Irish Wildlife Act.	**<u>Wintering</u>** Flocks of County Importance recorded	This species was occasionally recorded loafing/roosting within the development site and within 500m of same during winter months. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Red-necked Phalarope	Annex I, EU Birds Directive	**Breeding** National Importance	This species was recorded within the development site. The potential for direct habitat loss cannot be excluded. Taking a precautionary approach **an assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**Yes**
Hen Harrier	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**Wintering** National/International Importance recorded	No evidence of breeding was recorded on or near the site. This species was only observed entering or leaving a winter roost site within the development site on one occasion, approximately 500m from the nearest proposed turbine. This species was occasionally recorded foraging within the development site. The potential for direct habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Common Crane	Annex I, EU Birds Directive	**NA**	Common crane are currently a rare vagrant species recorded in Ireland predominantly during winter months. These observations at the site are considered an anomaly that are highly unlikely to be repeated. As discussed in Section 7.5.5.	**No**
Kingfisher	Annex I, EU Birds Directive & Irish Wildlife Act.	All Seasons No population of ecological significance recorded	This species was not recorded within 200m of the proposed turbines or development footprint with only two observations occurring within 500m of the proposed turbines (Please refer to section 7.5.6 for further details). There is no evidence to suggest that the development site is of significance to this species. There is no potential for direct habitat loss or displacement, given the separation distances involved. No flights were recorded within PCH during VP surveys. Therefore, there is no evidence that collision risk will be a significant impact for this species.	**No**
Little Egret	Annex I, EU Birds Directive & Irish Wildlife Act.	All Seasons Flocks of County Importance recorded	This species was occasionally recorded utilising habitats within the site boundary for foraging and roosting. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded flying over the development site and within 500m of the turbine layout. Taking a precautionary approach, **the potential for displacement exists.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
			This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	
Marsh Harrier	Annex I, EU Birds Directive	No population of ecological significance recorded	This species was only recorded twice during the extensive two-year survey period, more than 1.5km from the nearest proposed turbine. No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**No**
Merlin	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	This species was only recorded on three occasions within 500m of the turbine layout during surveys between October 2017 and September 2019. This species was observed foraging/hunting within the development site on two occasions in February 2018. The potential for direct habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** This species was only on three occasions within 500m of the turbine layout during surveys between October 2017 and September 2019. Taking a precautionary approach, **an assessment of displacement effects is required.** No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Peregrine	Annex I, EU Birds Directive; BoCCI Green List & Irish Wildlife Act.	**<u>All Seasons</u>** Local Importance (Higher Value)	This species was occasionally recorded foraging within the development site. The potential for direct habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Lapwing	BoCCI Red Listed (Breeding Populations) & Irish Wildlife Act.	**<u>Breeding</u>** County Importance	Several breeding lapwing pairs were recorded within the site boundary in both 2018 and 2019. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Several pairs of lapwing were recorded breeding within the development site and within 500m of onsite infrastructure. **The potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Lapwing	BoCCI Red Listed (Winter Populations) & Irish Wildlife Act.	**<u>Wintering</u>** Flocks of National Importance recorded	This species was occasionally recorded utilising habitats within the site boundary for foraging and roosting. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
			Birds were recorded within the development site and within 500m of the turbine layout. **The potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	
Black-headed Gull	BoCCI Red Listed (Breeding Populations) & Irish Wildlife Act.	**Breeding** Flocks of National Importance recorded	Black-headed gull bred within the site boundary in both 2018 and 2019. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** This species was recorded breeding within the development site and within 500m of development infrastructure. Taking a precautionary approach, **the potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Herring Gull	BoCCI Red Listed (Breeding Populations) & Irish Wildlife Act.	**Breeding** No population of ecological significance recorded	Herring gull were recorded infrequently and in low numbers. There is no evidence to suggest that the development site is of significance to this species. Please refer to Section 7.5.13 for further detailed discussion. No pathways for significant effects were identified.	**No**
Woodcock	BoCCI Red Listed (Breeding	**Breeding**	There was a minimum of four distinct breeding territories identified within the proposed development site. The potential	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
	Populations) & Irish Wildlife Act.	Local Importance (Higher Value)	for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary and within 500m of the proposed turbine layout. **The potential for displacement exists.** No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	
Curlew	BoCCI Red List (breeding and wintering) & Irish Wildlife Act	**All Seasons** No population of ecological significance recorded	This species was occasionally recorded utilising habitats within the site boundary for foraging. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded flying over the development site and within 500m of the turbine layout. Taking a precautionary approach, **the potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Dunlin	BoCCI Red List (breeding and wintering)	**Breeding** No population of ecological significance recorded	This species was only recorded twice during extensive surveys between October 2017 and September 2019. The only observation of the species onsite involved an individual bird that was recorded circling a section of flooded bog. Numbers of	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
			ecological significance were not recorded. Please refer to Section 7.5.16 for further detailed discussion. No pathways for significant effects were identified.	
Redshank	BoCCI Red List (breeding and wintering) & Irish Wildlife Act	**Breeding** County Importance	Several breeding redshank pairs were recorded within the site boundary in both 2018 and 2019. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Several pairs of redshank were recorded breeding within the development site. **The potential for displacement exists.** No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**Yes**
Shoveler	BoCCI Red Listed (Wintering Populations) & Irish Wildlife Act	**All Seasons** No population of ecological significance recorded	Shoveler were not recorded within 500m of the proposed turbine locations. There is no potential for direct habitat loss or displacement to occur. Please refer to Section 7.5.18 for further detailed discussion. No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Tufted Duck	BoCCI Red Listed (Wintering Populations) & Irish Wildlife Act	**All Seasons** County Importance	This species was only recorded on one occasion within 500m of the proposed turbine layout. There is no potential for direct habitat loss or displacement to occur. No flights were recorded within PCH during VP surveys. Therefore, there is no evidence that collision risk will be a significant impact for this species. No pathways for significant effects were identified.	**No**
Wigeon	BoCCI Red Listed (Wintering Populations) & Irish Wildlife Act	**Wintering** No population of ecological significance recorded	The vast majority of observations occurred either within Noggus bog to the north of the site, or the Drinagh wetlands to the east of the proposed turbines. Wigeon were not recorded within 500m of the proposed turbine locations. There is no potential for direct habitat loss or displacement to occur. Please refer to Section 7.5.20 for further detailed discussion. No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**No**
Long-eared Owl	Irish Wildlife Act	**All Seasons** Local Importance (Higher Value)	The favourable conservation status of this species (Green Listed BoCCI) limits the potential ecologically significant impacts to result from the proposed development. This species was recorded infrequently in low numbers. Please refer to Section 7.5.21 for further detailed discussion. Significant impacts are not predicted.	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Buzzard	Irish Wildlife Act	<u>All Seasons</u> Local Importance (Higher Value)	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	Yes
Sparrowhawk	BoCCI Amber List & Irish Wildlife Act.	<u>All Seasons</u> Local Importance (Higher Value)	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	Yes
Kestrel	BoCCI Amber List & Irish Wildlife Act.	<u>All Seasons</u> Local Importance (Higher Value)	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	Yes

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
Snipe	BoCCI Amber List & Irish Wildlife Act.	<u>**All Seasons**</u> Local Importance (Higher Value)	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Ringed Plover	BoCCI Green List & Irish Wildlife Act.	<u>**Breeding**</u> Local Importance (Higher Value)	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**Yes**
Teal	BoCCI Amber List.	<u>**All Seasons**</u> No population of ecological significance recorded	The potential for habitat loss, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rationale for inclusion/exclusion as KOR	KOR Yes/No
			this species, within the accuracy levels available to the assessment, is zero.	
Black-tailed Godwit	BoCCI Amber List.	<u>**All Seasons**</u> No population of ecological significance recorded	This species was only recorded on one occasion during the extensive two-year survey period, consisting of a small flock in flight over the Drinagh wetlands to the east of the development infrastructure. There is no potential for direct habitat loss or displacement to occur. No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.	**No**
Passerines (Red Listed)	BoCCI Red List & Irish Wildlife Act	<u>**All Seasons**</u> Local Importance (Lower Value)	As per SNH guidance, it is considered that passerine species are not significantly impacted by wind farms. Significant impacts are not predicted.	**No**

7.7 KOR Sensitivity Determination

Criteria developed by Percival (2003) is presented in Table 7-3 (Section 7.2.5.3) for assessing bird sensitivity within the study area. The sensitivity of KOR as per Percival are listed below and include the rationale for their respective sensitivity classification included in brackets.

None of the KORs recorded during surveys at Derrinlough were classified as Very High Sensitivity.

High Sensitivity KORs include:

- Whooper Swan (A flock of national importance was recorded)[1]
- Lapwing (Breeding Populations) (>1% Irish breeding population)
- Black-headed Gull (Breeding Populations) (>1% Irish breeding population)
- Hen Harrier (Ecologically Sensitive Species)
- Red-necked Phalarope (Ecologically Sensitive Species)

Medium Sensitivity KORs include:

- Golden Plover (Winter Populations) (Annex I; EU Birds Directive)
- Lapwing (Winter Populations) (BoCCI; Red Listed)
- Little Egret (Annex I; EU Birds Directive)
- Merlin (Annex I; EU Birds Directive)
- Peregrine (Annex I; EU Birds Directive)
- Woodcock (BoCCI; Red Listed)
- Redshank (BoCCI; Red Listed)

The remaining KORs identified in the study area were classified as **Low Sensitivity**:

- Buzzard (Schedule IV of Wildlife Act; 1976)
- Sparrowhawk (Schedule IV of Wildlife Act; 1976)
- Kestrel (Schedule IV of Wildlife Act; 1976)
- Snipe (BoCCI; Amber Listed)

7.8 Likely and Significant Effects

This section of the assessment of effects is structured as follows:

- Assessment of 'Do nothing' Effect.
- Assessment of effects in relation to Key Ornithological Receptors
- Assessment of effects in relation to sites designated for nature conservation.
- Summary of potential effects associated with proposed infrastructure

All elements of the Proposed Development have been considered in assessing effects on ornithological receptors, including:

- Site preparation works, upgrades to existing roads and tracks, construction of new site roads.
- Drainage works.

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[1] *Flocks of National importance were observed on four occasions during vantage point surveys from the 2017/2018 winter season. Whilst these flock were considered the exception and were not regularly occurring Percival criteria does not differentiate between regularly occurring and not regularly occurring. Therefore, on a precautionary basis whooper swan have been classed as a high sensitivity species as per Percival (2003).*

- Machinery access to the turbine locations.
- Excavation of turbine base foundations.
- Erection of turbines.
- Laying of internal and grid connection cables.
- Construction of other site infrastructure including substations and control buildings, amenity links, public carpark, met masts and temporary construction compounds.
- Operational Maintenance.
- Decommissioning works and turbine removal.

7.8.1 Do-Nothing Effect

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

The avian communities on the site would likely remain similar to its current state as activity levels and land use would not change significantly.

When the peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

The Rehabilitation Plan is designed to result in an overall increase in biodiversity on the site (i.e. including birds) when compared to the existing situation, following cessation of peat extraction.

7.8.2 Effects on Key Ornithological Receptors during Construction and Operation

7.8.2.1 Whooper Swan (*Wintering*)

Table 7-12 Impact Characterisation for Whooper Swan based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Surveys conducted to inform the design layout and this impact assessment have identified that the majority of activity and greatest concentrations of swans (max. site count 227) were centred on the Drinagh wetlands. The turbine layout avoids the Drinagh wetlands with the closest turbine located c.900m to the west of the wetlands. The proposed amenity pathway is the only element of the project located in proximity to wetland habitat within Drinagh. The pathway follows an existing track at this location and no habitat loss is predicted. During the winter of 2018/19, small numbers of birds (Max 19 recorded on one occasion) were occasionally recorded roosting/foraging at three locations which overlap with the development footprint (see Figure 7.7.1.1 in Appendix 7.4). Whooper Swan are opportunistic, and studies have shown that the species may not remain loyal to specific habitat areas (Boland & Crowe 2012; Boland et al. 2010). Due to the nature of the species, the sympathetic design of the development and the proposed retention and preservation of key habitat areas for the species in the wider area no significant effects are predicted in relation to direct habitat loss. Significant effects with regard to direct habitat loss are not predicted.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *High* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	In addition, enhancement measures are proposed for the Drinagh wetlands are predicted to be beneficial for this species. Please see Section 7.11 for further details.		
Displacement	The largest flocks of whooper swan were recorded during the 2017/18 winter season (max. site count 227). These flocks were concentrated in the Drinagh wetlands. A similar pattern of occurrence was recorded during the subsequent winter season (2018/19). The turbine layout avoids the Drinagh wetlands with the closest turbine located c.900m to the west of the wetlands. This exceeds the 600m zone of sensitivity for this species as identified in McGuinness et. al 2015. The proposed amenity pathway is the only element of the project located in proximity to wetland habitat within Drinagh. The pathway follows an existing track at this location and no significant displacement is predicted. During the winter of 2018/19, small numbers of birds (Max 19 recorded on one occasion) were occasionally recorded roosting/foraging at three locations which overlap with the development footprint (see Figure 7.7.1.1 in Appendix 7.4). Whooper Swan are an opportunistic species and studies have shown that species may not remain loyal to specific areas of suitable habitat (Boland & Crowe 2012; Boland et al. 2010). Any potential construction related displacement will be temporary and insignificant. This is due to the nature of the species, the sympathetic design of the development and the proposed retention, and preservation of key habitat areas for the species in the wider area.	The magnitude of the effect is assessed as *Low.* The cross tablature of a *High* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Displacement & Barrier Effect	Literature has identified exclusion from habitat around wind turbines as a displacement effect which can impact the availability of supporting habitat for whooper swan (Larsen & Clausen 2002). In some cases, disturbance distances of up to 300 m from wind energy installations have been cited (Percival 2003). Observations of swan non- breeding activity (i.e. consistent with the current project) from eight European studies have given a mean minimum disturbance distance of 150 m from the base of wind turbines (Hötker et al. 2006). The largest flocks recorded at the proposed development site were recorded during the 2017/18 winter season (max. site count 227). These flocks were concentrated in the Drinagh wetlands. A similar pattern of occurrence was recorded during the subsequent winter season surveyed (2018/19). The turbine layout avoids the Drinagh wetlands with the closest turbine located c.900m to the west of the wetlands. This exceeds the 600m zone of sensitivity for this species as identified in McGuinness et. al 2016. Survey results, including migratory VPs, indicated that the development site does not lie on a migratory corridor for Whooper Swan. Therefore, no barrier effect is predicted. The proposed amenity pathway is the only element of the project located in proximity to wetland habitat within Drinagh. The pathway follows an existing track at this location and no significant displacement is predicted. During the winter of 2018/19, small numbers of birds (Max 19 recorded on one occasion) were occasionally recorded roosting/foraging at three locations which overlap with the development footprint (see Figure 7.7.1.1 in Appendix 7.4). Studies have shown that whooper swan have a reasonably broad habitat preference (Boland et al. 2010). In addition, the recently observed flux of sites indicates that this species may not remain loyal to specific areas of suitable habitat (Boland & Crowe 2012; Boland et al. 2010). In addition, there are	The magnitude of the effect is assessed as *Low*. The cross tablature of a *High* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	extensive areas of suitable habitat in the wider area, outside any potential displacement buffer, should any potential displacement effect occur. Due to the nature of the species, the sympathetic design of the development and the proposed retention, preservation and enhancement of key habitat areas for the species in the wider area no significant displacement effects are predicted.		
Collision Mortality	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.21 collisions per year or one bird every 6.3 years. Annual mortality of adult whooper swan has been calculated at 20% per annum (Brazil, 2003). If 0.21 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the county population (i.e. 489) by 0.21%. The predicted collision risk is therefore negligible (>1%) in the context of recorded population. No significant effects are anticipated regarding collision risk at any geographical scale.	The magnitude of the effect is assessed as *Negligible*. The cross tablature of a *High* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**

7.8.2.2 Golden Plover (*Wintering*)

Table 7-13 Impact Characterisation for Golden Plover based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Birds were predominantly recorded flying over the development site This species was not regularly recorded utilising habitats within the proposed site boundary for roosting (2 occasions only). No evidence of foraging activity was recorded within the development footprint. Significant effects with regard to direct habitat loss are not anticipated.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Long-term Slight Negative Effect**
Displacement	As per McGuinness et al (2015) the zone of sensitivity for the species is 800m during the breeding season only. However, only wintering populations were recorded and the species is not identified as being particularly sensitive to wind farm developments during this period. This species was not regularly recorded utilising habitats within the site boundary for roosting or foraging. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will be retained. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Displacement	A study by (Pearce-Higgins et al. 2009) found reduced use of habitat surrounding operating turbines, to within 200m of the turbine base. A review of 29 other studies suggests Golden Plover will approach wind turbines to an average distance of 175 m in non-breeding season (Hötker et al. 2006). Furthermore, post-construction monitoring at 15 upland wind farms showed no significant decline in populations post construction (Pearce-Higgins et al. 2012). There are extensive areas of suitable habitat in the wider area should any potential displacement effect occur. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Long-term Slight Negative Effect**
Collision	Collision risk for waders is generally deemed to be low, due to a relatively low cursory flight path, coupled with high flight manoeuvrability (McGuinness et.al 2015). A review of pan-European collision assessments revealed much lower Golden Plover collision records than other species, though this was not controlled for survey effort or corpse recovery rates (Hötker et al. 2006). The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk assessment has followed a precautionary approach and utilises flight observations recorded across all seasons and includes flights several hundred meters from the proposed turbine layout. Therefore, the assessment provided below is highly conservative. The collision risk has been calculated at a rate of 14.9 collisions per year. Annual mortality of adult golden plover has been calculated at 27% per annum (Sandercock, 2003). If 14.9 collisions were to occur per year, it would mean	The magnitude of the effect is assessed as *negligible*. The cross tablature of a *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	that the losses at the proposed wind farm would increase the annual mortality for the county population (i.e. 12,463 birds (please see Section 7.5.2 for further details)) by 0.44%. The predicted collision risk is therefore negligible (>1%) in the context of recorded population. No significant effects are anticipated regarding collision risk at any geographical scale.		

7.8.2.3 Red-necked Phalarope (Breed*ing*)

Table 7-14 Impact Characterisation for Red-necked Phalarope based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	To undertake an analysis of potential effect it was necessary to discuss information of a sensitive nature. This text has been redacted and is provided in confidential Appendix 7.5. In summary: significant effects are not anticipated.	The magnitude of the effect is assessed as *negligible,* as per Appendix 7.5. The cross tablature of a *High* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect,** as per Appendix 7.5.
Displacement	To undertake an analysis of potential effect it was necessary to discuss information of a sensitive nature. This text has been redacted and is provided in confidential Appendix 7.5.	The magnitude of the effect is assessed as *negligible,* as per Appendix 7.5.	**Short term Slight Effect,** as per Appendix 7.5.

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	In summary: significant effects are not anticipated.	The cross tablature of a *High* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	To undertake an analysis of potential effect it was necessary to discuss information of a sensitive nature. This text has been redacted and is provided in confidential Appendix 7.5. In summary: significant effects are not anticipated.	The magnitude of the effect is assessed as *negligible,* as per Appendix 7.5. The cross tablature of a *High* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Effect,** as per Appendix 7.5.
Collision	This species was not recorded in flight during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.2.4 Hen Harrier (*Wintering*)

Table 7-15 Impact Characterisation for Hen Harrier based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	No breeding or (regular) roosting sites were recorded within the study area between October 2017 and September 2019. Two separately used hen harrier wintering night roosts were identified. One of which was approximately 4km from the nearest proposed turbine, while the other occurred within the development site, approximately 500m from the nearest turbine. Hen harrier were only observed entering these roosts on one occasion in each instance and there were no observations of birds roosting at any other location within 2km of the development site throughout the 2018/19 winter season. The majority of observations of this species consisted of individuals foraging over the Drinagh wetlands to the east of the proposed turbines during winter months. Occasional foraging activity was recorded within the development site and 500m of the proposed turbine locations. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	An assessment of the effects of a wind farm on an existing population of breeding hen harriers reported that, although reductions in flight activity around turbines were observed during the construction phase, the activity of	The magnitude of the effect is assessed as *low*.	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	bird populations quickly returned to pre-construction levels (Madden & Porter 2007). Two, infrequently used, winter roost sites were identified, one within the development site and 500m from the proposed turbines, while the other was located at Derrybrat more than two kilometres to the east of the development infrastructure. The majority of foraging activity was recorded over the Drinagh wetlands to the east of the proposed turbines. Therefore, based on the core dataset there is no potential for significant displacement effects given that hen harrier were not dependent on the habitats located in close proximity to development infrastructure for foraging, roosting or breeding.	The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Turbine avoidance has been observed in hen harrier at one wind farm installation to extend to within 250 m of turbines (Pearce-Higgins et al. 2009). This study predicted a 52% reduction in breeding population within 500 m of a wind energy array but found no significant modification in flight height near turbines. A possible, infrequently used, winter roost site was identified within the development site and 500m of the proposed turbine locations. However, a hen harrier was only recorded to use this roost on a single occasion. The species was not found to be dependent on habitat located in close proximity to development infrastructure for foraging at any time of the year, with the majority of foraging activity recorded over the Drinagh wetlands c.900m to the east from the nearest proposed turbine.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	Significant displacement impacts are not predicted.		
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.005 collisions per year, or one bird every 213 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of a *High* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

7.8.2.5 Little Egret (*All Seasons*)

Table 7-16 Impact Characterisation for Little Egret based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The majority of observations of this species consisted of individuals foraging, roosting/loafing and flying over the Drinagh wetlands during winter months. Little egret was not regularly recorded within 500m of the proposed turbine locations. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the wider area. Significant effects with regard to direct habitat loss are not predicted.	The magnitude of the effect is assessed as *low*. The cross tablature of a *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Displacement	The majority of observations of this species consisted of individuals foraging, roosting/loafing and flying over the Drinagh wetlands during winter months. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low*. The cross tablature of a *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The majority of observations of this species consisted of individuals foraging, roosting/loafing and flying over the Drinagh wetlands during winter months. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low*. The cross tablature of a *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.02 collisions per year or one bird every 61 years. Annual mortality of adult little egret has been calculated at 28.8% per annum (Hafner et al., 1998). If 0.02 collisions were to	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the County population (i.e. 10 birds) by 0.69%. The predicted collision risk is therefore negligible in the context of County populations. The predicted collision risk is insignificant in the context of the county, national and international population.		

7.8.2.6 Merlin (*All Seasons*)

Table 7-17 Impact Characterisation for Merlin based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Merlin were only recorded on four occasions during surveys between October 2017 and September 2019. All four observations were of individual birds recorded in flight during the 2017/18 winter season between December 2017 and March 2018. Three of the four observations occurred within, or partially within, 500m of the proposed turbine layout. This species was not recorded utilising habitat within the site boundary for roosting or breeding. This species was only observed hunting within the development site twice, with both observations occurring in February 2018. Significant effects are not predicted particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Displacement	This species was not observed during either the 2018 or 2019 breeding seasons and no evidence of breeding activity was recorded within the study area. Observations were confined to the non-breeding period. Disturbance during construction is unlikely to discourage flight activity or foraging in the vicinity of the Proposed Development particularly given the low levels of activity recorded. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	This species was not recorded flying at the potential collision risk height during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.2.7 Peregrine (*All Seasons*)

Table 7-18 Impact Characterisation for Peregrine based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Peregrine were regularly recorded foraging over the development site during winter months. While there were occasional observations of this species foraging within the development site during the breeding season, no evidence of breeding activity was recorded. Furthermore, there is no suitable breeding habitat for this species on site or in the surrounding areas. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	Foraging was most commonly observed during the winter months. While there were occasional observations of this species foraging within the development site during the breeding season, no evidence of breeding activity was recorded. Furthermore, there is no suitable breeding habitat for this species on site or in the surrounding areas. Disturbance during construction is unlikely to discourage flight activity or foraging in the vicinity of the Proposed Development particularly given the low levels of activity recorded. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Furthermore, peregrine has been documented to become accustomed to various sources of human disturbance (Ruddock et. al 2007). It is therefore reasonable to conclude that following a period of habituation, the wintering population, which accounts for the majority of foraging within the development site will become accustomed to the wind farm in the landscape.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.07 collisions per year or one bird every 14 years. Annual mortality of adult peregrine has been calculated at 20% per annum (Craig, 2004). If 0.07 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the National population (i.e. c.850 birds) by 0.04%. The predicted collision risk is therefore negligible in the context of the National peregrine population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.8 Lapwing

7.8.2.8.1 Breeding Population

Table 7-19 Impact Characterisation for Breeding Lapwing based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Lapwing breed on open grasslands and prefer nesting in fields that are relatively well grazed and/or flooded in winter, the nest consisting of a shallow scrape in this short grass (Snow & Perrins 1998). However, in the absence of optimal habitat, the species will breed in cutover bog. During both the 2018 and 2019 breeding seasons the maximum number of breeding lapwing onsite or within 500m of the proposed development area, was 16 breeding pairs. There were seven breeding lapwing pairs which held territories in areas which overlap with the development footprint (see Figure 7.3.7.1 and Figure 7.3.7.2 in Appendix 7.4). However, the development footprint is restricted to a narrow corridor in these areas and the direct loss of habitat will be minimal. In addition, extensive areas of suitable foraging and nesting habitat will remain post construction. Significant effects with regard to habitat loss are not predicted. Although no significant habitat loss is predicted; a habitat enhancement plan has been devised with the aim of creating suitable foraging and breeding habitat for the species locally (See Section 7.11 below).	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**On a precautionary basis, Long-term Moderate Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Displacement	During both the 2018 and 2019 breeding seasons the maximum number of breeding lapwing onsite or within 500m of the proposed development area, was 16 breeding pairs. There were seven breeding lapwing pairs which held territories in areas which overlap with the development footprint (see (see Figure 7.3.7.1 and Figure 7.3.7.2 in Appendix 7.4). However, the development footprint is restricted to a narrow corridor in these areas and any potential disturbance/displacement during construction will be temporary in nature. In addition, extensive areas of suitable foraging and nesting habitat will remain in the wider area should any temporary and localised effect occur. Overall, significant displacement of breeding lapwing is not predicted Following construction works, it is expected that Lapwing will continue to establish breeding territories within the site. Although no significant displacement is predicted; a habitat enhancement plan has been devised with the aim of creating suitable foraging and breeding habitat for the species locally (See Section 7.11).	The magnitude of the effect is assessed as *low.* The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**On a precautionary basis, Short-term Moderate Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	No Effect	No Effect
Displacement	Several studies of wind energy infrastructure and its impact on bird populations have found no discernible impact on populations of breeding Lapwings, either through collision, disturbance displacement or avoidance (Winkelman 1992; Ketzenberg et al. 2002; Pearce-Higgins et al. 2009).	The magnitude of the effect is assessed as *low.* The cross tablature of a *High* sensitivity species and *low*	**On a precautionary basis, Long-term Moderate Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	Hotker et al. (2006) undertook a meta-analysis of existing literature on disturbance distances. This review reported from the 13 studies examined the mean disturbance distance for breeding lapwing was 108m. Pearce-Higgins et al. (2009) found no significant relationship between distance to wind farms and changes on occurrence. There were seven breeding lapwing pairs which held territories in areas which overlap with the development footprint (see Figure 7.3.7.1 and Figure 7.3.7.2 in Appendix 7.4). However, the development footprint is restricted to a narrow corridor in these areas and extensive areas of suitable foraging and nesting habitat will remain post construction. The presence of the wind farm is not expected to deter Lapwing from breeding within the study during the operational phase of the wind farm development. Langston et al. (2003) found that Lapwing nesting occurred slightly closer to turbines possibly as a result of the creation of preferred areas of shorter vegetation. Overall, significant displacement of breeding lapwing is not predicted. Although no significant habitat loss is predicted; a habitat enhancement plan has been devised with the aim of creating suitable foraging and breeding habitat for the species locally (See section 7.11 below).	Impact corresponds to a ***Low*** effect significance	
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6.	The magnitude of the effect is assessed as *negligible*. The cross tablature of a *High* sensitivity species and *Negligible*	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	The collision risk has been calculated at a ratio of 0.20 collisions per year or one bird every 5 years. Annual mortality of adult lapwing has been calculated at 29.5% per annum (Peach et al., 1994). If 0.20 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the local population (i.e. 228 birds)[2] by 0.3%. The predicted collision risk is therefore negligible in the context of the local breeding lapwing population.	Impact corresponds to a ***Very Low*** effect significance	

7.8.2.8.2 Wintering Population

Table 7-20 Impact Characterisation for Wintering Lapwing based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Lapwing were observed on 78 occasions during non-breeding season months (September – March). The majority of flight activity from the winter seasons was of large flocks flying over the development site en-route to winter foraging habitat in nearby agricultural land. This species was occasionally observed roosting or foraging in close proximity of the development footprint during winter months, although the majority of observations were of large flocks commuting across the site.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Long-term Slight Negative Effect**

[2] *Local population: Lough Boora Parklands contained 85 pairs in 2015 (Newton, 2015) plus the 29 pairs recorded within the study area equals 228 individuals.*

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	The species was not dependent on the site for foraging or roosting during the wintering period. Extensive areas of suitable foraging and roosting habitat will remain post construction and no significant impacts are predicted.		
Displacement	Wintering lapwing favour agricultural grassland for foraging during the winter months. The dominant habitat onsite is cutover bog this habitat is considered to provide sub-optimal foraging habitat for lapwing. This species was not observed to regularly utilise any areas of the development site during winter months but was primarily recorded travelling over the site. The surrounding agricultural land is considered to provided more favourable winter foraging habitat. The sections of the site where wintering lapwing were most frequently recorded were more than 500m from the proposed turbines within the Clooneen wetland and the northeast Drinagh wetland (see Appendix 7.4, Figure 7.1.10b and Figure 7.7.7). Disturbance during construction is unlikely to discourage flight activity in the vicinity of the proposed development. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance.	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Hotker et al. (2006) undertook a meta-analysis of existing literature on disturbance distances. This review reported from the 32 studies examined the mean disturbance distance for wintering lapwing was 260m.	The magnitude of the effect is assessed as *Low*. The cross tablature of a *Medium* Sensitivity species and	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	This species was not observed to regularly utilise any areas of the development site during winter months but was primarily recorded travelling over the site. Flocks of County Importance were recorded flying over the site on four occasions between November and December 2017. This species was recorded in flight, foraging or roosting within 260m of the proposed turbines on 21 occasions, during winter months. The majority of flight activity occurred more than 500m from the proposed turbines and was associated with the Clooneen wetland and northeast Drinagh wetland. There are extensive areas of suitable habitat in the wider area, outside any potential displacement buffer, should any potential displacement effect occur. Significant displacement effects are not anticipated.	*Low* Impact corresponds to a ***Low*** effect significance.	
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 3.55 collisions per year. Annual mortality of adult lapwing has been calculated at 29.5% per annum (Peach et al., 1994). If 3.55 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the County population (i.e. 9,212 birds) by 0.13%. The predicted collision risk is therefore negligible in the context of the county population. No significant effects are anticipated regarding collision risk at any geographical scale.	The magnitude of the effect is assessed as *negligible*. The cross tablature of a *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.9 Black-headed Gull (*Breeding*)

Table 7-21 Impact Characterisation for Black-headed Gull based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Within the wider study area, a population black-headed gull were found to opportunistically nest on islands within flooded sections of bog (outside the development site) No active breeding colony was recorded within the development site during the 2 years of comprehensive surveys undertaken to inform this assessment. During the 2018 breeding season, approximately 300 birds (i.e. potentially up to 150 pairs) were observed attempting to establish a breeding colony on a large area of flooded cutover bog within the development site. However, this colony did not establish at this location. They had relocated to Noggus bog in 2019. Between 2018 and 2019 only five-six probable breeding pairs of black-headed gull recorded onsite or within 500m the development area. Two breeding areas overlapped with the development footprint. The potential loss of breeding habitat will be minimal as the infrastructure, in the identified breeding areas, is confined to a narrow corridor. Significant areas of suitable nesting and foraging habitat will continue to remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant habitat loss effects are not predicted.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	No active breeding colony was recorded within the development site during the 2 years of comprehensive surveys undertaken to inform this assessment.	The magnitude of the effect is assessed as *low*.	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	Between 2018 and 2019 only five-six probable breeding pairs of black-headed gull recorded onsite or within 500m the development area. Two breeding areas overlapped with the development footprint. On a precautionary basis it is assumed that some temporary displacement may occur. However, given the extent of suitable habitat in the wider area; significant displacement during the construction phase is not anticipated. Furthermore, previous studies have shown increases in populations of this species around wind farm developments (Winkelman, 1989). Significant displacement effects are not anticipated.	The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	No active breeding colony was recorded within the development site during the 2 years of comprehensive surveys undertaken in compliance with SNH guidelines (SNH 2017) that form the core data set to inform this assessment. Between 2018 and 2019 only five-six probable breeding pairs of black-headed gull recorded onsite or within 500m the development area. Two breeding areas overlapped with the development footprint. Winkelman (1992), found no associated disturbance effect for black-headed gull due to the presence of operational windfarms. Furthermore, previous studies have shown increases in populations of this species around wind farm developments (Winkelman, 1989).	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	Extensive areas of suitable habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. There are extensive areas of suitable habitat in the wider area should any potential displacement effect occur. Significant displacement effects are not anticipated. In addition, enhancement measures are proposed for the Drinagh wetlands that are predicted to be beneficial for this species at the local level. Please see Section 7.11 for details.		
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 1.97 collisions per year. Annual mortality of adult black-headed gull has been calculated at 10% per annum (Prévot-Julliard et al., 1998). If 1.97 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the National population (i.e. c.18,636 birds) by 0.11%. The predicted collision risk is therefore negligible in the context of the National breeding black-headed gull population. The number of individuals within proximity of the development site was estimated to be 300 birds, while it has been estimated that there are c.126 birds in the wider area using the National Seabird 2000 survey data (see Section 7.5.12 for more detail). If 1.97 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the local breeding population (i.e. c.426 birds) by 4.62%. The predicted collision risk is therefore *low* (i.e. 1-5% increase) in the context of the local breeding black-headed gull population.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.10 Woodcock (*Breeding*)

Table 7-22 Impact Characterisation for Woodcock based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was regularly recorded during both the 2018 and 2019 breeding seasons at Derrinlough. Numerous roding male woodcock were recorded. These observations indicate that woodcock bred within the development site. Sections of the site are dominated by scrub and immature birch woodland which provide suitable breeding habitat for woodcock. Five distinct breeding areas were identified, three of which overlap with the development footprint (see Appendix 7.4, Figure 7.1.13.1). However, the dominant area of activity was at the at Drinagh and this area has been avoided by turbine infrastructure. Elsewhere, the development footprint is restricted to a narrow corridor and direct loss of habitat will be minimal. In addition, extensive areas of suitable foraging and nesting habitat will remain post construction. Considering the above, no significant habitat loss is predicted. In addition, enhancement measures are proposed for the Drinagh wetlands and additional native woodland planting are predicted to be beneficial for this species. Please see Section 7.11 for further details.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Medium* sensitivity species and *Medium* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	This species was regularly recorded during both the 2018 and 2019 breeding seasons at Derrinlough. Numerous roding male woodcock were recorded. These observations indicate that woodcock bred within the development site.	The magnitude of the effect is assessed as *Medium*.	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	On a precautionary basis it is assumed that some temporary displacement may occur but given the extent of suitable habitat in the wider area and the crepuscular/nocturnal habitat of the species; significant displacement during the construction phase is not anticipated.	The cross tablature of *Medium* sensitivity species and *Medium* Impact corresponds to a ***Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The species is not identified, in McGuinness et. al 2015, as particularly sensitive to wind energy developments. Sections of the site are dominated by scrub and immature birch woodland which provide suitable breeding habitat for woodcock. Five distinct breeding areas were identified, three of which overlap with the development footprint (see Appendix 7.4, Figure 7.1.13.1). However, the dominant area of activity was at the at Drinagh and this area has been avoided by turbine infrastructure. On a precautionary basis it is assumed that some initial displacement may occur but given the extent of suitable habitat in the wider area and the crepuscular/nocturnal habitat of the species; significant ongoing displacement during operation is not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Medium* sensitivity species and *Medium* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	This species was not recorded flying at the potential collision risk height during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.2.11 Curlew (Non-Breeding)

Table 7-23 Impact Characterisation for Curlew based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was only recorded occasionally during the winter months and between June and September 2019. The lack of observations of curlew earlier in the season (i.e. March to May inclusive), is a strong indication that these individuals were not associated with a breeding attempt on or near the site. No breeding population was recorded during the comprehensive suite of surveys undertaken. This species did not regularly utilise any areas of habitat within the development site. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *low.* The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	This species was only recorded in close proximity of the proposed development footprint on a single occasion (see Appendix 7.4, Figure 7.3.11). The dominant habitat onsite is cutover bog this habitat is considered to provide sub-optimal foraging habitat for curlew. Significant displacement effects are not anticipated, given that the species is not dependent on the site, there are extensive areas of suitable habitat that will remain post construction and there is an abundance of suitable habitat in the wider area.	The magnitude of the effect is assessed as *low.* The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The few observations of this species occurred around the Drinagh wetlands to the east of the proposed turbines. This wetland is considered to provide more suitable habitat for foraging curlew than the cutover bog that dominants the rest of the site. This species was only recorded in close proximity of the proposed development footprint on a single occasion (see Appendix 7.4, Figure 7.3.11). Extensive areas of suitable habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant effects are not anticipated particularly given the low levels of activity recorded.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.16 collisions per year. Annual mortality of adult curlew has been calculated at 26% per annum (Evans, 1984). If 0.16 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the county population (i.e. c. 167 birds) by 0.37%. The predicted collision risk is therefore negligible in the context of the county population. No significant effects are anticipated regarding collision risk at any geographical scale.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.12 Redshank (*Breeding*)

Table 7-24 Impact Characterisation for Redshank based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Breeding redshank were recorded during both the 2018 and 2019 breeding season. Two breeding pairs were recorded within the Drinagh wetlands in 2018 while there was one breeding pair in this area in 2019. Both breeding territories were approximately one kilometre from the nearest proposed turbine. This exceeds the 800m zone of sensitivity for the species (McGuinness et.al 2015). The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no habitat loss is predicted. Significant effects with regard to direct habitat loss are not anticipated as both breeding territories were approximately one kilometre from the nearest proposed turbine. In addition, enhancement measures are proposed for the Drinagh wetlands are predicted to be beneficial for this species. Please see Section 7.11 for further details.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	This species was not recorded in close proximity of the development infrastructure and the location of both breeding territories were approximately one kilometre from the nearest proposed turbine. This exceeds the 800m zone of sensitivity for the species (McGuinness et.al 2015). The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible*	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	Significant effects with regard to displacement and barrier effect are not anticipated, given the c. 1km separation distance involved.	Impact corresponds to a ***Very Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	This species was not recorded in close proximity of the development footprint and the location of both breeding territories were approximately one kilometre from the nearest proposed turbine. This exceeds the 800m zone of sensitivity for the species (McGuinness et.al 2015). The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted. Significant effects with regard to habitat loss are not anticipated.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	This species was not recorded in flight during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.2.13 Buzzard (All Seasons)

Table 7-25 Impact Characterisation for Buzzard based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was frequently recorded within the development site during the breeding and winter seasons. No evidence of breeding activity was recorded within the development site, although there was one confirmed breeding territory and one possible breeding territory in areas of conifer plantation within 500m of the development site. Furthermore, there were three confirmed breeding territories located between one and two kilometres of the development site. Therefore, the proposed development will not result in the loss of any identified or traditional nest sites. Substantial areas of undisturbed suitable foraging habitat will remain beyond the development footprint.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	There was no evidence of breeding activity within the development site during either the 2018 or 2019 breeding seasons. Given the availability of potential nesting and foraging habitat in the wider area, no significant effects are anticipated. The favourable conservation status of this species limits the potential for ecologically significant effects. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	No Effect	No Effect
Displacement	This species was frequently recorded within the development site during the breeding and winter seasons. However, there was no evidence of breeding activity within the development site during either the 2018 or 2019 breeding seasons. Pearce Higgins (2009) describes that buzzard has been found to show significant turbine avoidance extending to at least 500m. Despite this, significant effects are not anticipated, given that extensive areas of suitable foraging habitat exists and will remain in the wider area (i.e. outside the 500m buffer zone). Particularly as onsite habitats are not considered unique to the proposed development area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 3.98 collisions per year. The favourable conservation status of this species (Green-listed BoCCI) limits the potential for ecologically significant effects to result. The loss of four birds from the local population of a Green-listed (BoCCI) species is considered of low significance.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.14 Sparrowhawk (*All Seasons*)

Table 7-26 Impact Characterisation for Sparrowhawk based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Breeding sparrowhawk were recorded during both 2018 and 2019. There were two breeding territories identified in 2018 and two in 2019. Only one of these was located within the proposed development site. A confirmed nest site with fledged chicks was located in a small area of forestry directly adjacent to the briquette factory and the N62 national road. There will not be any construction activity in this area, therefore direct impacts on this nesting area will not result from the proposed development. Significant areas of suitable nesting and foraging habitat will continue to remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low.* The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	Breeding sparrowhawk were recorded during both 2018 and 2019. There were two breeding territories identified in 2018 and two in 2019. The nest at the briquette factory has been shown to be robust to disturbance given its location adjacent to the N62 national road. Another nest was location within 500m of the proposed development. Construction adjacent to this nest could potentially cause displacement of breeding and foraging sparrowhawk. However, none of the habitats found onsite are considered to be a scarce resource locally. Therefore, displacement effects are likely to be inconsequential.	The magnitude of the effect is assessed as *low.* The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	Short-term Slight Negative Effect

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
	The widespread breeding distribution of this species limits the potential for ecologically significant effects to result. Significant displacement effects are not anticipated.		
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The proposed development area does not contain habitats that are unique to the local area. Therefore, were displacement to occur it would not result in the loss of a scarce resource for the local sparrowhawk population. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.16 collisions per year, or one collision every 6 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

7.8.2.15 Kestrel (*All Seasons*)

Table 7-27 Impact Characterisation for Kestrel based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The Proposed Development site is dominated by scrub and immature birch woodland, with large areas of suitable foraging habitat. Two confirmed kestrel breeding territories were recorded within the development site during the 2019 breeding season surveys. One of these territories occurred within the development site and within 500m of the proposed turbine locations, while the other occurred to the north of the Drinagh wetlands in the area of the proposed substation. and Significant areas of suitable nesting and foraging habitat will continue to remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant displacement effects are not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	The two identified kestrel nest sites are within 500m of the development footprint. Disturbance from construction activities could result in the partial loss of kestrel breeding habitat. However, significant areas of suitable nesting and foraging habitat will continue to remain post construction.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	No Effect	No Effect
Displacement	Raptor studies have generally found only low levels of turbine avoidance (Hötker et al. 2006; Madders & Whitfield 2006), with some species, such as kestrels, known to continue foraging activity close to turbines (Pearce Higgins et.al 2009). Significant effects are not anticipated, given that extensive areas of suitable foraging habitat exists and will remain in the wider area. Onsite habitats are not considered unique to the proposed development area.	The magnitude of the effect is assessed as *Low.* The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 1.62 collisions per year. Annual mortality of adult kestrel has been calculated at 31% per annum (Village, 1990). If 1.62 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the National breeding population (i.e. c.15,000 birds) by 0.03%. The predicted collision risk is therefore negligible in the context of the National breeding kestrel population. No significant effects are anticipated regarding collision risk at any geographical scale.	The magnitude of the effect is assessed as *Negligible.* The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.8.2.16 Snipe (*All Seasons*)

Table 7-28 Impact Characterisation for Snipe based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Snipe were regularly recorded during surveys, with observations of drumming or calling snipe during the breeding season frequently recorded. In 2018, 18 breeding territories were recorded. Of these 6 would be transected by development infrastructure. In 2019 ten breeding territories were recorded. Three of these would be transected by development infrastructure (see Appendix 7.4, Figure 7.3.18.1). The loss of breeding habitat will be minimal as the infrastructure is confined to a narrow corridor. Significant areas of suitable nesting and foraging habitat will continue to remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant habitat loss effects are not predicted. In addition, enhancement measures are proposed for the Drinagh wetlands are predicted to be beneficial for this species. Please see Section 7.11 for further details.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	Pearce Higgins et. al (2009), found that breeding snipe showed significant avoidance of turbines extending to a distance of 400m. In 2018, 18 breeding territories were recorded. Of these 13 were recorded within 400m of the turbines, while four were recorded within the Drinagh wetlands to the east of the development infrastructure. The remaining breeding territory was to the	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium*	**Short-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
	south of the Cloneen wetlands. In 2019 ten breeding territories were recorded. Five of these were within 400m of the turbines (all in Clongawny bog/west of the briquette factory). The remaining four territories were recorded within the Drinagh wetlands to the east of the proposed turbines. On a precautionary basis it is assumed that some temporary displacement may occur. However, given the extent of suitable habitat in the wider area; significant displacement during the construction phase is not anticipated.	Impact corresponds to a ***Very Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Pearce Higgins et. al (2009), found that breeding snipe showed significant avoidance of turbines extending to a distance of 400m. In 2018, 18 breeding territories were recorded. Of these 13 were recorded within 400m of the turbines. In 2019 ten breeding territories were recorded. Five of these were within 400m of the turbines (all in Clongawny bog/west of the briquette factory). On a precautionary basis it is assumed that some initial displacement may occur but given the extent of suitable habitat in the wider area; significant ongoing displacement during operation is not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	It is acknowledged that the predicted number of transits, and hence predicted rate of collision for snipe may be underestimated, as flight activity for this species is predominantly crepuscular in nature while the VP surveys are largely diurnal (Table 1.4, SNH (2017)).	The magnitude of the effect is assessed as *Negligible*.	**Long-term Imperceptible Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7.6. The collision risk has been calculated at a ratio of 0.06 collisions per year, or one collision every 17 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	

7.8.2.17 Ringed Plover (Breeding)

Table 7-29 Impact Characterisation for Ringed Plover based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Ringed plover were regularly recorded during surveys, with several occupied breeding territories identified. Within the proposed development area, there were three breeding territories identified in 2018 while there were eight breeding territories in 2019, although only five of these were within proximity of the proposed development footprint (see Appendix 7.4, Figure 7.3.19.1). Each breeding territory identified held a single breeding pair. The loss of breeding habitat will be minimal as the infrastructure, in the identified breeding areas, is confined to a narrow corridor. Significant areas of	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Medium* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
	suitable nesting and foraging habitat will continue to remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant habitat loss effects are not predicted. In addition, enhancement measures are proposed for the Drinagh wetlands are predicted to be beneficial for this species. Please see Section 7.11 for further details.		
Displacement	In total six areas where breeding occurred, were identified for ringed plover including offsite (i.e. Derrybrat and Noggus) (see Appendix 7.4, Figure 7.3.19.1). The three identified breeding areas that overlap with the development footprint will be subject to disturbance. On a precautionary basis it is assumed that some temporary displacement may occur. However, given the extent of suitable habitat in the wider area; significant displacement during the construction phase is not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The three identified breeding areas that overlap with the development footprint will be subject to disturbance (see Appendix 7.4, Figure 7.3.19.1). On a precautionary basis it is assumed that some initial displacement may occur but given the extent of suitable habitat in the wider area; significant ongoing displacement during operation is not anticipated.	The magnitude of the effect is assessed as *Medium*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Collision	This species was not recorded in flight at PCH during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.2.18 Teal (All Seasons)

Table 7-30 Impact Characterisation for Teal based on Percival (2003) & EPA (2017).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The majority of observations of this species consisted of individuals foraging, roosting/loafing and flying over the Drinagh wetlands to the east of the proposed turbines during winter months. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no habitat loss is predicted. Teal was only occasionally recorded in close proximity of the development footprint and 500m of the proposed turbine locations. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *Low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Displacement	The majority of teal were observed at the Drinagh wetlands to the east of proposed turbine locations. The dominant habitat onsite is cutover bog this habitat is considered to provide sub-optimal foraging habitat for teal. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted Significant displacement effects are not anticipated, given extensive areas of suitable habitat will remain post construction.	The magnitude of the effect is assessed as *Low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The majority of observations of this species occurred around the Drinagh wetlands to the east of the proposed turbines. Significant effects are not anticipated particularly given the low levels of activity recorded. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted. Extensive areas of suitable habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area.	The magnitude of the effect is assessed as *Low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	This species was not recorded in flight at PCH during the extensive VP survey work undertaken. While collision risk modelling can therefore not be carried out, this does not mean that the collision risk cannot be assessed, but instead it means that the collision risk, within the accuracy levels available to the assessment, is zero.	**No Effect**	**No Effect**

7.8.3 Effects on Key Ornithological Receptors during Decommissioning

7.8.3.1 All Species

Table 7-31 Impact Characterisation for Ornithological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Decommissioning Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	As above for construction phase for each species listed as a KOR.	As above for construction phase for each KOR	As above for construction phase for each KOR

7.9 Effects on Designated Areas

The Proposed Development is not located within the boundaries of any European or Nationally designated sites important for nature conservation (see Figure 3.1 of accompanying Appropriate Assessment Screening Report). There will be no direct effects on any designated site as a result of the construction, operation and decommissioning of the Proposed Development (see Section 6.8 of Chapter 6 and accompanying Natura Impact Statement).

None of the pNHAs or NHAs within the ZOI were considered as KORs in their own right for the following reasons:

- Distance/buffer from the proposed development.
- Nature of the conservation sites (e.g. terrestrial nature of habitats)

In relation to European sites, an AA Screening Assessment and Natura Impact Statement have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the proposed development in compliance with Article 6(3) of the Habitats Directive.

As per EPA draft Guidance 2017, "a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement" but should "incorporate their key findings as available and appropriate". This section provides a summary of the key assessment findings (as assessed in the AA Screening Report and NIS) with regard to Special Protection Areas. A summary of key assessment findings (as assessed in the AA Screening Report and NIS) with regard to Special Areas of Conservation is provided in Chapter 6.

The Screening for Appropriate Assessment concluded as follows:

"Following an examination, analysis and evaluation of the relevant data and information set out within this Screening Report, it cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would be likely to have a significant effect on the following sites:

- *River Shannon Callows SAC*
- *Lough Derg, North-east Shore SAC*
- *Middle Shannon Callows SPA*
- *River Little Brosna Callows SPA*
- *Lough Derg (Shannon) SPA*

As a result, an Appropriate Assessment is required, and a Natura Impact Statement shall be prepared in respect of the proposed development in order to assess whether the proposed development will adversely impact the integrity of these European Sites."

The Natura Impact Assessment concludes as follows:

> *"Following an examination, evaluation and analysis, in light of best scientific knowledge and the conservation objectives of the site, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on any European Sites, either alone or in combination with other plans or projects."*

7.10 Mitigation and Best Practice Measures

This section describes the measures that are in place to mitigate adverse negative effects associated with the Proposed Development on avian receptors. Effects on avian receptors have been addressed in two ways:

- Design of the Proposed Development.
- Management of the development phases.

7.10.1 Mitigation by Design

The project design has followed the basic principles outlined below to eliminate the potential for significant effects on avian receptors:

- The proposed development has been deliberately designed to avoid the most sensitive areas for birds within the study area. This includes the Drinagh Wetlands. (Note: the amenity pathway in this area follows the route of an existing track)
- Hard standing areas have been designed to the minimum size necessary to accommodate the turbine model that is selected.
- The proposed substation and associated grid connection will be located entirely within the development site boundary. The proposed wind farm would be connected to the national electricity grid through the existing Dallow/Portlaoise/Shannonbridge 110 kV line which traverses the north eastern part of the site. These areas have been subjected to detailed bird surveys across the two-year survey period.

7.10.2 Mitigation During Construction, Operation and Decommissioning

The following section describe the mitigation and best practise measures to be implemented during each phase of the Proposed Development.

7.10.2.1 Construction Phase Mitigation

The following measures are proposed for the construction phase:

- The removal of woody vegetation will be undertaken outside the bird breeding season which begins on the1st day of March and ends on the 31st day of August in any year.
- All woodland/scrub (c. 7.24ha) that is removed to facilitate the construction of the proposed development will be replaced with native tree species (c. 13ha). This will ensure there will be a net gain of woodland within the proposed development area.
- During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds.
- Plant and machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001) other relevant legislation.
- An Ecological Clerk of Works (ECoW) will be appointed and will operate for the duration of construction works. Duties will include:
    - Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided.

- Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site.
- Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise.
- Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.
- Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.

- A Construction and Environmental Management Plan (CEMP) has been prepared. The CEMP will be in place prior to the start of the construction phase. Best practice measures which form part of the design of the project are included in Chapter 4 of the EIAR. The CEMP is included as an Appendix to Chapter 4.

7.10.2.2 Decommissioning Phase Mitigation

The following measures are proposed for the decommissioning phase:

- During the decommissioning phase, disturbance limitation measures will be as per the construction phase.
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001).

7.11 Lapwing, Waterfowl and Wader Habitat Enhancement Plan

A potential *Moderate* effect on lapwing has been identified in the form of habitat loss. No significant effects with regard to any other KOR was identified. However, an opportunity to enhance habitat for breeding/wintering waterfowl and waders has been identified and a proposed enhancement plan is included as Appendix 7.8 of the EIAR. The plan focuses on the enhancement of supporting habitat for lapwing but its implementation will also benefit, redshank, black-headed gull, woodcock, ringed plover, whooper swan and snipe.

The plan has considered successful approaches previously implemented by Bord na Móna and BirdWatch Ireland to rehabilitate a section of cutaway bog for breeding waders (including lapwing) at Drinagh. In 2011, following rehabilitation works the number of breeding waders increased significantly: a total of ten wader pairs were recorded in the rehabilitation area in 2011 compared to two pairs in 2010, i.e. prior to any management.

It is proposed that poor-quality degraded bog, that has been colonised with birch scrub, will be rehabilitated to provide breeding habitat for waders (including lapwing). The proposed area comprises approximately 25 hectares and is located within the northern most reaches of the Drinagh wetlands (See Figure 1 in Appendix 7.8). The procedure for calculating the quantum of land which would be required to offset potential impacts is discussed in detail in Appendix 7.8.

The area selected for rehabilitation was chosen due to its proximity to the Drinagh wetlands which provide a greater diversity of invertebrate prey for foraging birds (including chicks). This can be expected to have positive implications for the breeding success of lapwing and other species (Beintema & Visser 1994).

Breeding lapwing require open land that affords unbroken all-round views (fields less than 5ha are avoided), vegetation that remains short in spring (below 8-15cm) and a mosaic of vegetation and bare ground. Management prescriptions to be implemented by the applicant to ensure suitable breeding habitat is provided include:

- The rehabilitation area will be cleared of scrub to ensure open habitat is provided. The resulting open land will comprise c. 25ha (see Chapter 6).
- The rehabilitation area will be mowed annually in late winter (i.e. mid-February) before earlier breeding birds arrive in March. Mowing will only be required in dry areas. This will ensure vegetation is short in spring. To avoid reeds encroaching in wet areas low pressure tracking machinery will be use to mowing in these areas.
- Measures to establish grassland are discussed in detail in Appendix 7.8.
- The rehabilitation area is slightly elevated above the Drinagh wetland which is located to the south and it contains drains with vertical edges. These drains will be re-profiled and in-filled to allow unfledged chicks to move between dry areas and wetland vegetation in Drinagh.
- The rehabilitation area will be rewetted by drain blocking such that the area would remain damp but will not become inundated with water.
- To the south of the rehabilitation area within the Drinagh wetlands there are large water bodies which contain islands (See Figure 1 in Appendix 7.8). Scrub has encroached in many places. For the benefit of lapwing and other species of conservation concern noted in these wetlands (e.g. black-headed gull and redshank) this scrub will be cleared to provide open breeding habitat on these islands.
- These proposed measures would be undertaken for the lifetime of the wind farm.

The proposed measures are based on previously successful management practises designed and executed by Bord na Móna and BirdWatch Ireland, which provides confidence in their likely success.

Details on the measures and strategies proposed in respect to the habitat enhancement plan can be found in Appendix 7.8.

With the successful implementation of the enhancement plan, the predicted impacts on lapwing will reduce from Moderate to Long Term Slight Effect (EPA, 2017). The implementation of the plan will also have positive effects on additional KOR species and is likely to lead to an overall biodiversity net gain.

7.12 Monitoring

7.12.1 Commencement and Pre-Construction Monitoring

It is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive), in particular sites where lapwing were recorded breeding previously. Any requirement for construction works to run into the subsequent breeding season following commencement will be subject to pre-construction bird surveys to confirm the absence of breeding birds, e.g. lapwing. If breeding activity of species of conservation concern are identified, the nest sites will be located, and no works shall be undertaken within 500m buffer in line with industry best practise. All construction works will be undertaken in compliance with the Wildlife Act.

7.12.2 Post Construction Monitoring

A detailed post-construction Bird Monitoring Programme has been prepared for the operational phase of the Proposed Development and is presented in Appendix 7.9. The programme of works will monitor parameters associated with collision, displacement/barrier effects and habituation during the lifetime of the project. Surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 and 15 of the lifetime of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009). The following individual components are proposed:

- Flight activity surveys: vantage point surveys
- Breeding Bird surveys: O'Brien & Smith/Adapted Brown & Shephard.
- Winter Distribution & Abundance Surveys: Winter Transects/Waterfowl Surveys (I-WeBS methods) (with an emphasis on wintering waterfowl).
- Targeted bird collision surveys (corpse searches) will be undertaken with training dogs. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust.

The area proposed for enhancement would be the subject of ongoing monitoring and management during the operational phase of the wind farm to ensure it is offering supporting habitat for breeding lapwing. The ongoing monitoring will take place during the breeding bird season. The monitoring will seek to identify whether lapwing are utilising the areas under active management for breeding and will be conducted by way of vantage point surveys. These surveys will be undertaken once a month March to August inclusive during monitoring years.

7.13 Residual Effects

The following species were identified as KORs and were subject to detailed impact assessment:

- Whooper Swan (Wintering)
- Golden Plover (Wintering)
- Red-necked Phalarope (Breeding)
- Hen Harrier (Wintering)
- Little Egret (All Seasons)
- Merlin (All Seasons)
- Peregrine (All Seasons)
- Lapwing (Breeding & Wintering)
- Black-headed Gull (Breeding)
- Woodcock (Breeding)
- Curlew (Non-Breeding)
- Redshank (Breeding)
- Buzzard (All Seasons)
- Sparrowhawk (All Seasons)
- Kestrel (All Seasons)
- Snipe (All Seasons)
- Ringed Plover (Breeding)
- Teal (All Seasons)

As per Percival 2003 criteria, effect significance of greater than ***Low*** was not identified for any KOR.

As per EPA 2017 criteria, effect significance of greater than ***Slight-Moderate*** was not identified for any KOR.

Taking into consideration the effect significance levels identified and the proposed best practice and mitigation; significant residual effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

7.14 Assessment of Cumulative Effects

As per SNH guidance on Assessing the Cumulative Impacts of onshore Wind Energy Developments (2012), cumulative effects arising from two or more developments may be:

- **Additive** (i.e. a multiple independent additive model)
- **Antagonistic** (i.e. the sum of impacts are less that in a multiple independent additive model)

- **Synergistic** (i.e. the cumulative impact is greater than the sum of the multiple individual effects)

7.14.1 Other Projects

Assessment material for this in-combination impact assessment was compiled on the relevant developments within the vicinity of the proposed project. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIS/EIAR documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental impacts. The projects considered in relation to the potential for in combination effects and for which all relevant data was reviewed (e.g. individual EISs/EIARs, layouts, drawings etc.) include those listed below.

7.14.2 Projects Considered in the Cumulative Impact Assessment

A review of the Planning Register for Offaly, Galway and Tipperary County Council's show that there has been a number of planning applications lodged within the vicinity of the EIAR study area. While planning applications lodged within the EIAR study area primarily relate to one-off housing or are agricultural in nature, there are a number of previous and ongoing applications for wind farm development and associated infrastructure. Further details on these applications are available below.

The projects considered in relation to the potential for cumulative impacts are provided in Section 2.7 of EIAR Chapter 2.

7.14.3 Assessment of Cumulative Effects

The following species were identified as KORs and were subject to detailed impact assessment: whooper swan, golden plover, lapwing, hen harrier, merlin, peregrine falcon, red-necked phalarope, black-headed gull, redshank, woodcock, buzzard, sparrowhawk, kestrel and snipe. Of these, lapwing was the only species where an impact greater than slight was predicted. As previously discussed, in acknowledgement of the moderate habitat loss/displacement impact identified in Section 7.9.2 a lapwing, waterfowl and wader habitat enhancement plan has been prepared (See Appendix 7.8). With the successful implementation of the enhancement plan predicted impacts on lapwing would reduce from Moderate to Slight (EPA, 2017). Cumulative impacts on lapwing are therefore not predicted.

The creation and provision of habitats is now increasingly used to offset losses caused by infrastructure and commercial development pressures (Morris *et al.*, 2006, Gibbons & Lindenmayer, 2007). The enhancement measures proposed in Section 7.9.2 that were devised for the benefit of breeding lapwing will also provide supporting habitat for other breeding and wintering water birds. The habitat created within the rehabilitation area is considered suitable for several species of breeding waders, e.g. redshank, snipe and curlew. The islands that will be cleared of scrub within Drinagh wetlands will provide suitable nesting habitat for black-headed gull and breeding waterfowl. Wintering water birds are also predicted to benefit from the enhancement measures. The rehabilitation measures would provide foraging and roosting sites for species such as wintering whooper swan, teal, mallard, lapwing, golden plover and tufted duck. Large assemblages of water birds would support foraging raptors, e.g. hen harrier, merlin and peregrine falcon. Finally, and most significantly the implementation of the proposed enhancement measures would safeguard a significant resource (Drinagh wetlands) for biodiversity for the 30-year lifespan of the proposed wind farm. Significant cumulative (direct or indirect) habitat loss are not predicted.

The proposed development was considered in the context of a potential barrier effect in combination with other wind farms in the wider landscape. It is typically considered that a barrier effect is more likely to impact large flocks of migrating water birds than other species groups such as raptors.

However, no important migratory routes for any species were identified during any of the surveys undertaken. Furthermore, the vast majority of the recorded flight activity involved short distance flights between foraging, roosting and breeding site within the study area as discussed in Section 7.5. Therefore, significant cumulative barrier effect is not anticipated.

7.14.4 Summary of Effects

Following consideration of the residual effects (post-mitigation) it is noted that the Proposed Development on its own, will not result in any significant effects on any of the identified KORs. No significant effects on receptors of International, National or County Importance were identified.

Important migratory routes for any species were not identified during any of the surveys undertaken. Therefore, significant cumulative barrier effect is not anticipated.

No potentially significant cumulative disturbance displacement, habitat loss or collision risk effects on any of the KORs has been identified with regard to the development proposal.

No residual additive, antagonistic or synergistic effects have been identified with regard to habitat loss, displacement or collision mortality for any KOR.

7.15 Conclusion

An extensive suite of bird surveys were undertaken across a full two-year survey period in compliance with recommend survey methods for onshore wind farm applications (SNH 2017). A number of key ornithological receptors were identified including a nationally important breeding population of lapwing. In light of this a habitat enhancement plan has been prepared (Appendix 7.8) which reduces the predicted impacts on lapwing from Moderate to Slight (EPA, 2017). No regular commuting/migratory flights were recorded that would constitute evidence of connectivity between the local SPAs and the proposed development area.

No significant effects are predicted on birds due to direct habitat loss or displacement during the construction, operational or decommissioning phases of the Proposed Development. The development will not have significant effects on any KOR recorded either in isolation or cumulatively with other plans and projects.

8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential impacts of the proposed wind farm development at Derrinlough and adjacent townlands, Co. Offaly on the soil and geological environment.

This report provides a baseline assessment of the environmental setting of the proposed development, as described in Chapter 4, in terms of land, soils and geology and discusses the potential likely significant effects that the construction, operation and decommissioning of the proposed development will have. Where required, appropriate mitigation measures to avoid any identified significant effects to land, soils and geology are recommended and the residual effects of the proposed development post-mitigation are assessed.

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience includes soils, subsoils and geology. We routinely complete impact assessments for land, soils and geology, hydrology and hydrogeology for a large variety of project types including wind farms and renewable energy projects.

This chapter of the EIAR was prepared by Michael Gill and Adam Keegan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm related projects across the country.

Adam Keegan is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

8.1.3 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared having regard, where relevant, to the legislation and guidance outlined in Chapter 1: Introduction and the following documents:

- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study of the site and the surrounding area was completed in advance of undertaking the walkover survey and site investigation. This involved collecting all relevant geological data for the site and surrounding area. This included consultation with the following data sources:

- Bord na Móna databases on peat depth and drainage;
- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater and Geology Databases (www.gsi.ie);
- Geological Survey of Ireland – Geological Heritage site mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway-Offaly). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition (www.epa.ie).

8.2.2 Baseline Monitoring and Site Investigations

A walkover survey, including detailed drainage mapping and baseline monitoring/sampling, was undertaken by HES between the 5th and 9th April 2019, and again between 9th and 11th September 2019. HES staff have undertaken ~60 man-hours of site work. Geotechnical ground investigations and a peat stability assessment were also undertaken by Fehily Timoney & Company (FT) during 2019. The combined geological dataset collated by HES and FT has been used in the preparation of this EIAR Chapter.

In summary, site investigations to address the land, soils and geology chapter of the EIAR included the following:

- A total of 319 no. peat probe depths/investigations points were carried out by FT and HES to determine the depth and geomorphology of the cutover peat at the proposed site;
- GPR (ground penetrating radar) peat depth geophysical surveying from 2015;
- Trial pitting by FT across the site at 69 no. locations;
- A geotechnical and peat stability assessment report by FT (Feb, 2020a);
- A peat and spoil management plan by FT (Feb, 2020b);
- A total of 41 no. gouge core sample points were undertaken by HES across the site to investigate peat and mineral soil lithology;
- Logging of subsoil exposures across the site where mineral soils and peat profiles are exposed; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

The Geotechnical and Peat Stability Assessment Report prepared by FT is included as Appendix 8.1 of this EIAR.

8.2.3 Impact Assessment Methodology

Using information from the desk study and data from the site investigations, an assessment of the importance of the soil and geological environment within the study area and proposed site is assessed using the criteria set out in Table 8.1 (NRA, 2005).

Table 8.1 Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2017) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment report are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in Table 8.2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in Table 8.3.

Table 8.2: Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 8.3: Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: - The extent or morphology of a cSAC. - Regionally important aquifers. - Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time-dependent impacts on: - The extent or morphology of a cSAC / ecologically important area. - A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). - Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time-dependent impacts on: - The extent or morphology of a cSAC / NHA / ecologically important area. - A minor hydrogeological feature.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
		Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time-dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

8.3 Existing Environment

8.3.1 Site Description and Topography

The Derrinlough Wind Farm site ("the site") which is a Bord na Móna peat bog is a combination of two bogs, Clongawny to the west and Drinagh to the east, split by the N62 which runs north-south. The site is located approximately 2km to the south of the village of Cloghan and 7km north-east of Birr in County Offaly. The total site area is approximately 2,360ha (23.6km^2).

The Bord na Móna Derrinlough Peat Briquette factory is located between the two bogs, along the N62 on the eastern side of the road. This plant processes the peat from a number of bogs in the midlands into briquettes and consists of the factory and a number of ancillary buildings. A site compound (known as Clongawny Tea Centre) relating to the currently ceased peat harvesting works exists close to the main site entrance on the western bog site (Clongawny). The vast majority of the overall site comprises drained cutover raised bog. A number of industrial railway lines intersect the site that service the adjacent bogs and the briquette factory.

The topography of the development site is relatively flat with an elevation range of between approximately 53 and 62mOD (metres above Ordnance Datum). Along the majority of the site boundaries, a ~1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within the extraction areas of the overall bogs. There are some areas of higher ground at the centre and southwest of Clongawny bog and these are covered with conifer forestry.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains also run north-south and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity.

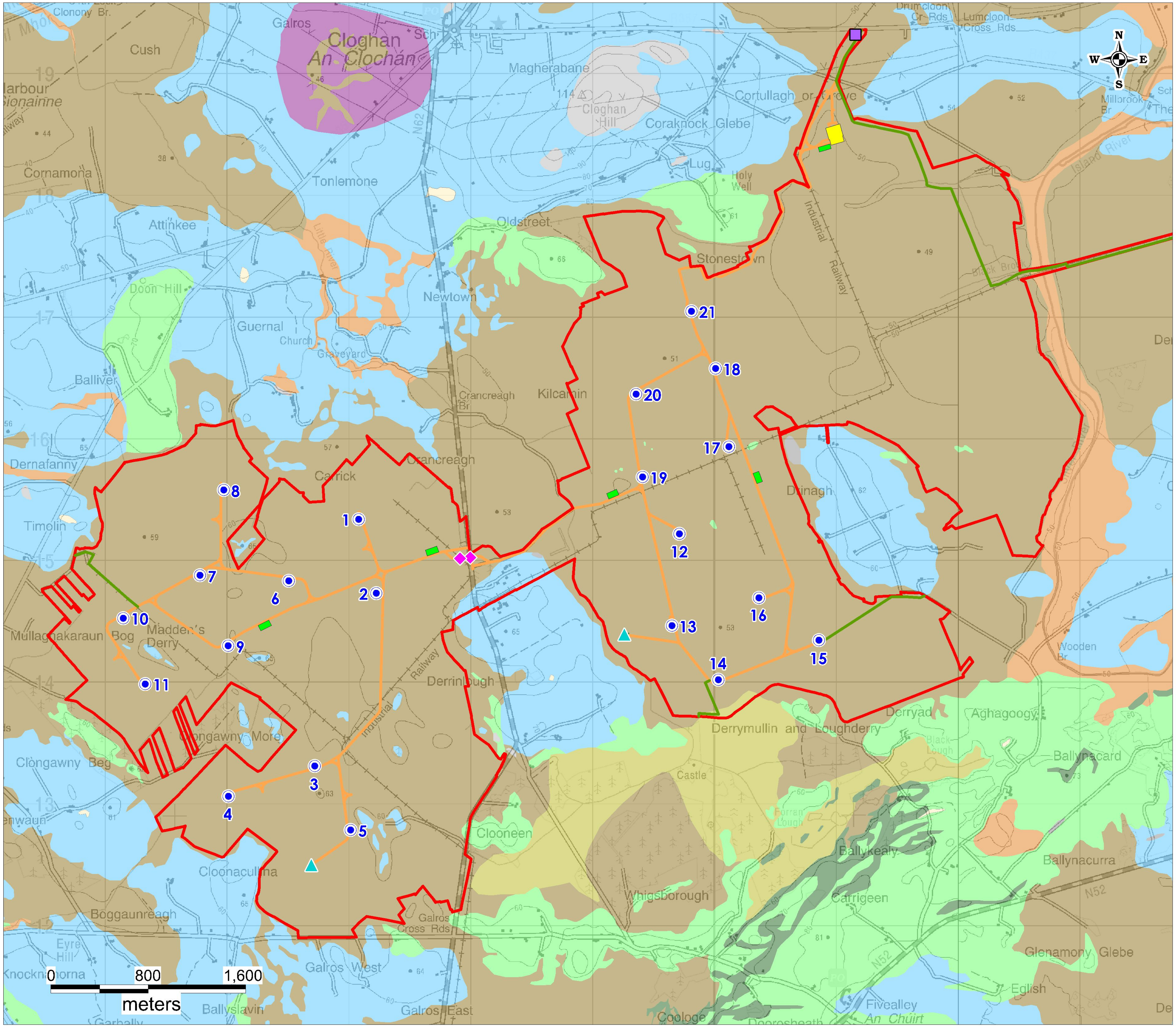
8.3.2 Peat/Soils and Subsoils

The published soils map (www.epa.ie) for the area shows that cutaway raised bog is exclusively mapped in the proposed development site. Other soil types mapped in the wider area outside of the site include Glacial Tills derived from Limestone (TLs), which are mapped predominantly north of the site, but exist as small pockets to the east, south and west. Gravels derived from Limestone (GLs) are also mapped north of the site, ~1km south of Cloghan Hill and near Doon Hill. Fen Peat is mapped south of the site, near Orran Lough, while Alluvium is mapped along the banks of the Silver River which flows along the eastern boundary of the site. A map of the local subsoil cover is attached as Figure 8.1 and again this shows the site to be entirely covered by cutover peat.

In order to investigate the peat and mineral subsoil lithology at the proposed turbine locations, a series of gouge core samples were taken at the turbine locations and also across the site at various proposed infrastructure locations. Shown on Table 8.4 below is a summary of the mineral subsoil lithology at the proposed development locations. The location of the gouge core investigation points and all peat depth data are shown on Figure 8.2.

Gouge core sampling undertaken at the proposed development locations typically encountered well-drained, black/brown, firm pseudo-fibrous or fibrous peat that was sometimes amorphous. Peat depth intervals recorded at the site (including all FT data) are shown on the histogram presented as Figure 8.3. Peat depths across the Clongawny bog area have a larger depth interval spread than across the Drinagh Bog area. The average recorded peat depth across Clongawny bog is (μ) 1.39m (with standard deviation σ = 1.12m). The average recorded peat depth across Drinagh bog is (μ) 0.7m (σ = 0.60m).

Peat depths at the proposed substation location vary between 0.3 and 1.1m, and underlying subsoil is logged as soft to firm grey sandy clay.



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Alluvium
- Eskers comprised of gravels of basic reaction
- Cut over raised peat
- Fen Peat
- Gravels derived from Limestones
- Kartsified bedrock outcrop or subcrop
- Lacustrine sediments
- Lake marl
- Bedrock outcrop or subcrop
- Till derived from limestones

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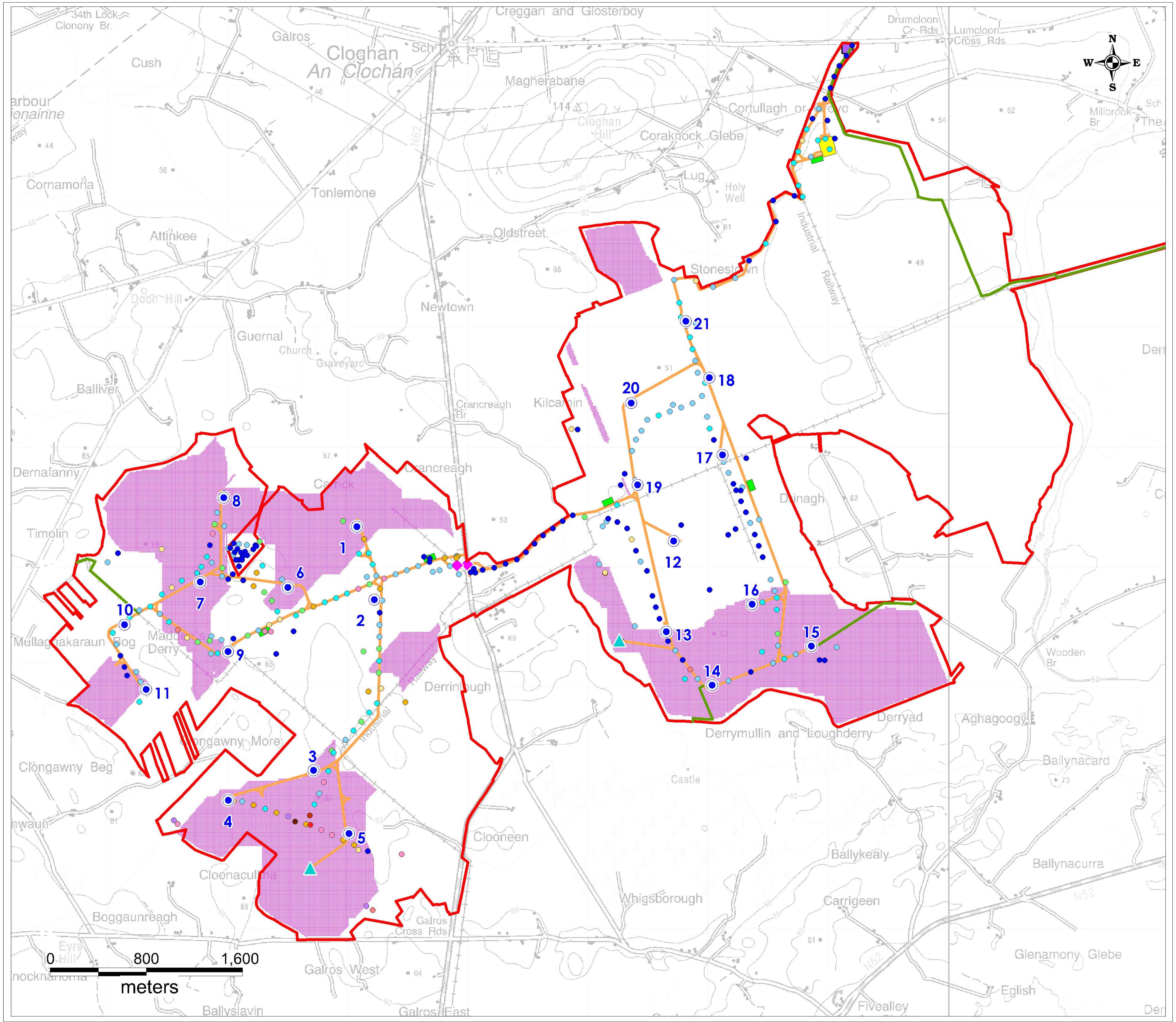
Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Local Subsoils Map	
Figure No: 8.1	
Drawing No: P1463-0-0220-A3-801-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:30,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Lidar Inferred Peat Depth Location (65,483 no.)

Peat Depth Legend

- 0 - 0.5m
- 0.5 - 1.0m
- 1 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- 3.0 - 3.5m
- 3.5 - 4.0m
- 4.0 - 4.5m
- 4.5 - 5.0m
- 5.0 - 5.5m
- 6.0 - 6.5m

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Peat Depth Map	
Figure No: 8.2	
Drawing No: P1463-0-0220-A3-802-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:30,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

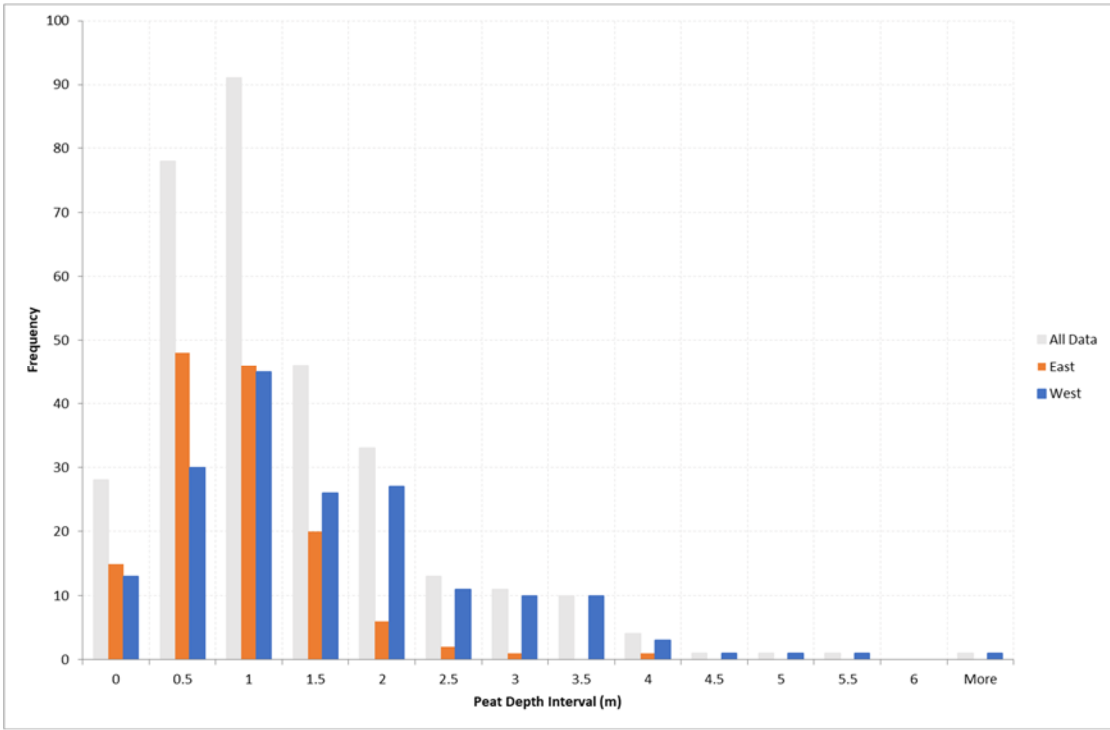
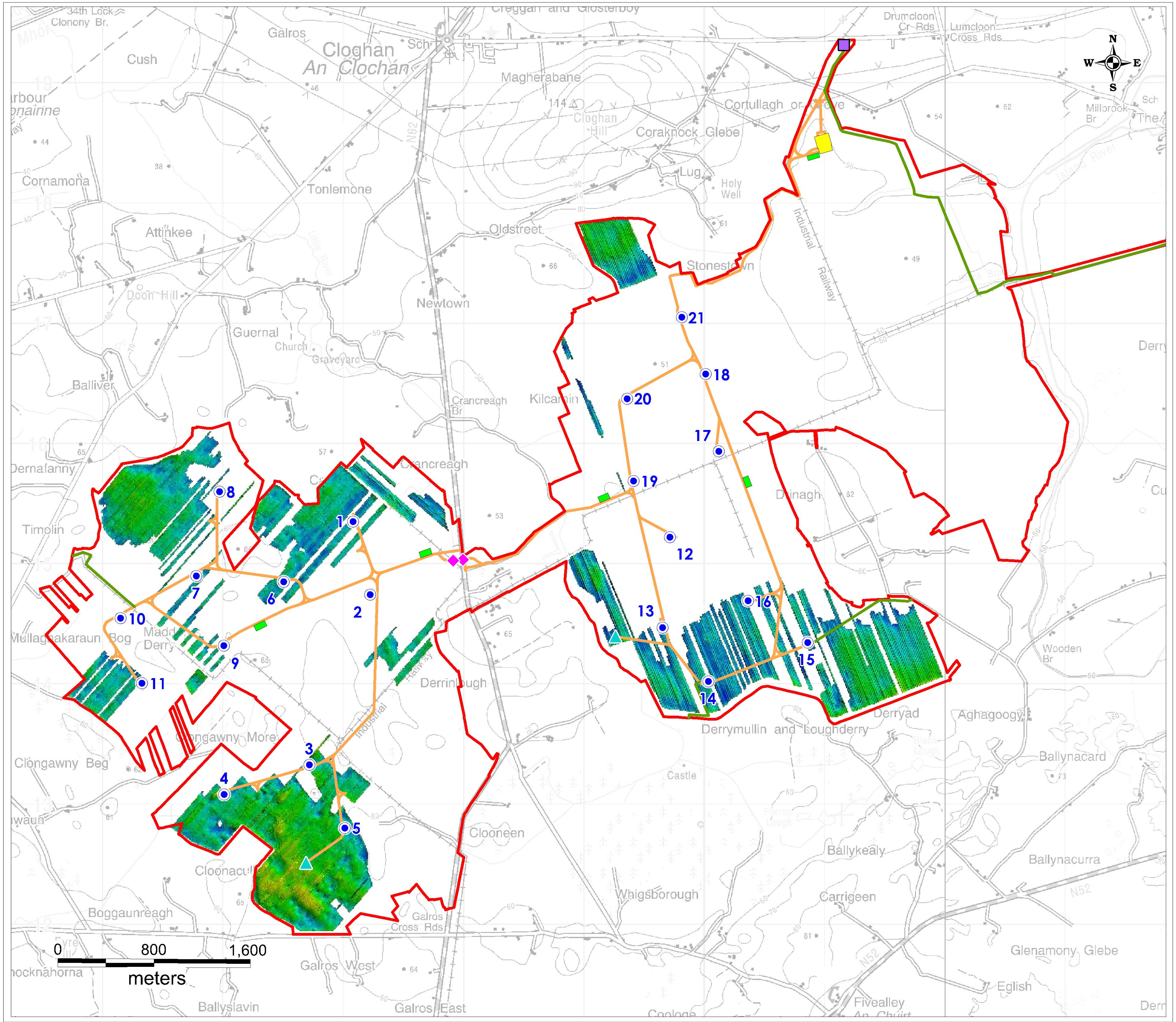


Figure 8.3: Peat depth frequency distribution plot

In addition to these hand recorded peat depths, Bord na Móna have also undertaken GPR (ground penetrating radar geophysical survey) surveys in 2015 to determine peat depths in both Clongawny and Drinagh Bogs. Grid data was extracted from these data at 5 x 5 m intervals, and a histogram of resulting data (228,219 data points) is presented as Figure 8.4. The survey areas and recorded peat depth intervals are shown on Figure 8.5. The average recorded peat depth in these areas is (μ) 1.7m (σ = 1.01m). There is a bias towards slightly deeper peat areas in these GPR survey areas as these areas were being targeted for further peat extraction, and they are also largely around the perimeter of the bogs which includes the headlands that would not have had as much peat removed historically.



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations

Peat Depth GPR Legend

7.0m
6.0m
5.0m
4.0m
3.0m
2.0m
1.0m
0.0m
-0.8m

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Peat Depth GPR survey area Map	
Figure No: 8.4	
Drawing No: P1463-0-0220-A3-804-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:30,000	Drawn By: GD
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Trial pits were also completed at each of the 21 no. proposed turbine location points. Trial Pit locations are shown on Figure 8.6.

The mineral subsoil underlying the peat at the proposed turbine locations typically comprised shell marl, lacustrine deposits and glacial tills. Where the shell marl and lacustrine deposits are present, they overlie the glacial tills. The lacustrine deposits comprised soft, grey laminated clays and silts.

A summary of average peat depths and subsoils geology (from trial pit data) for the 21 no. proposed turbine locations, the substation location, and the underground cable route are included within Table 8.4.

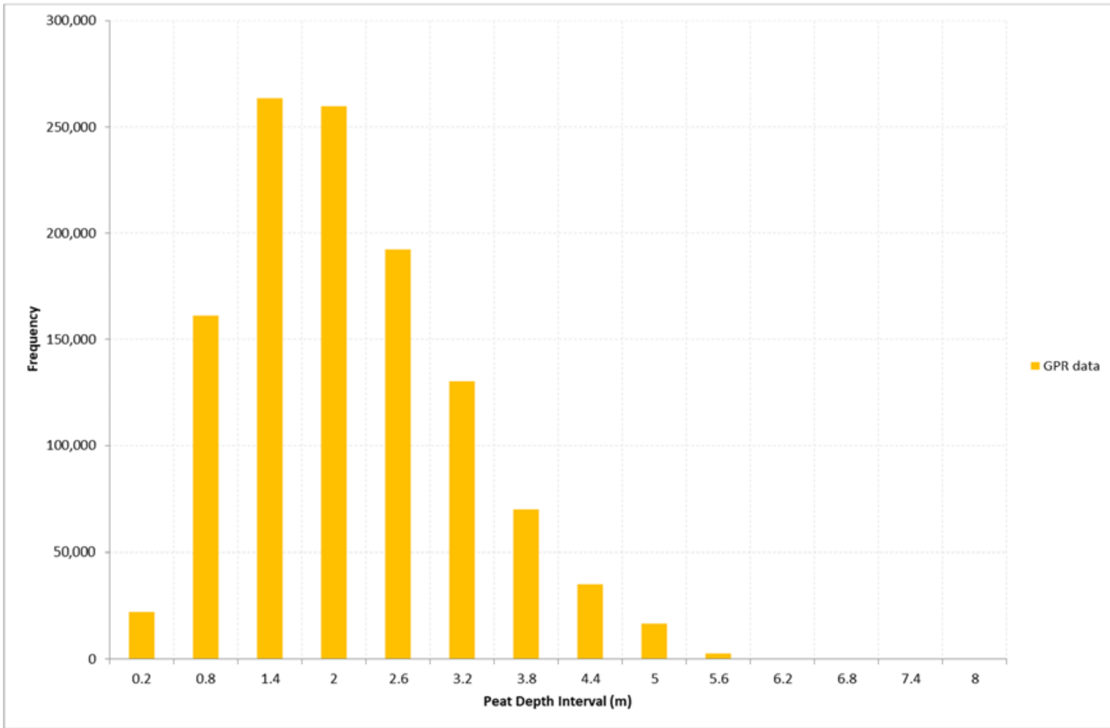
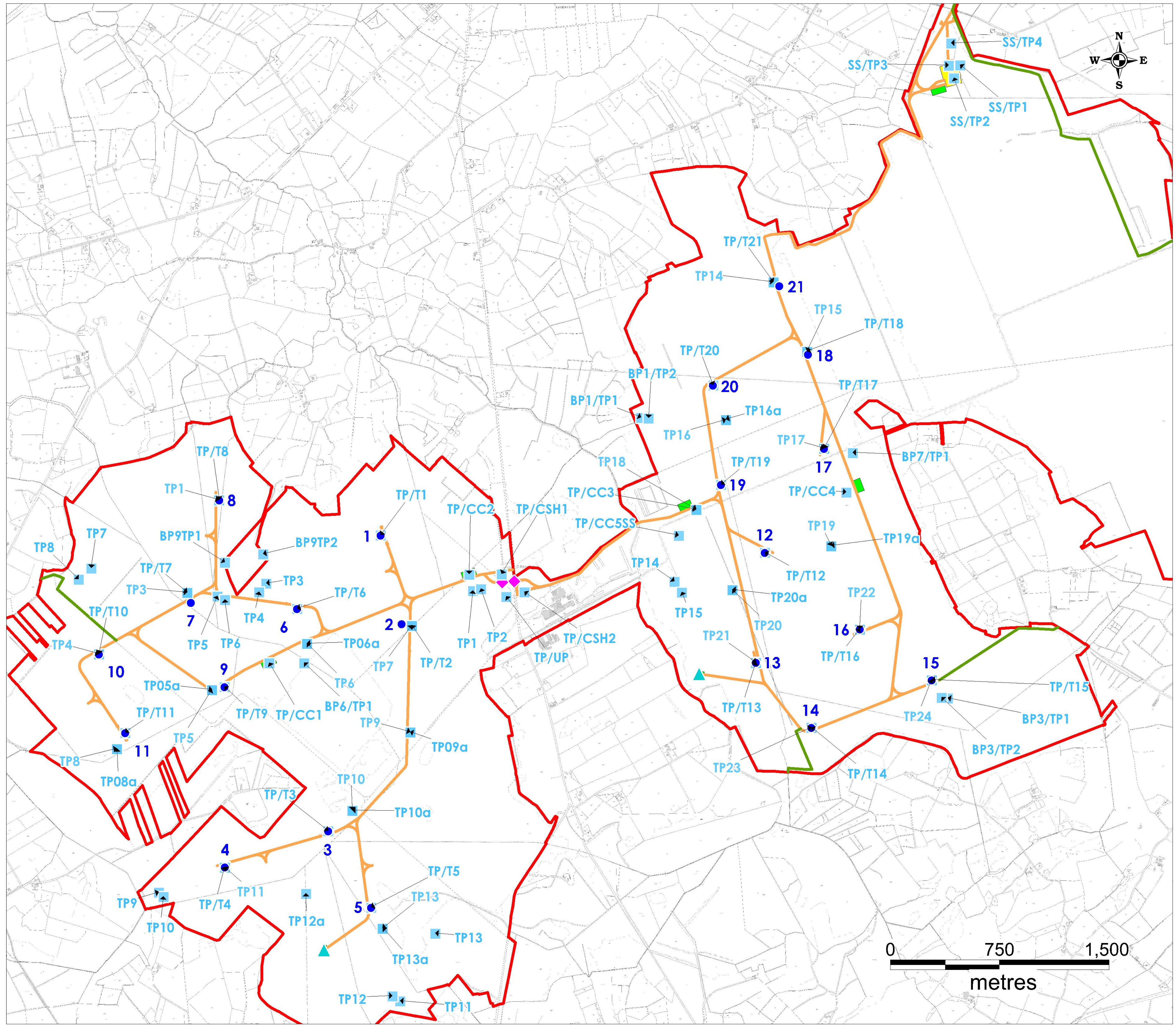


Figure 8.5: Peat depth frequency distribution plot from GPR data



Legend

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- FT Trial Pit Locations

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Trial Pit Location Map	
Figure No: 8.6	
Drawing No: P1463-0-0220-A3-806-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:25,000	Drawn By: GD
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Table 8.4: Summary of Peat Depths and Mineral Subsoil Lithology at Proposed Development Locations

Infrastructure Location	Peat Depth Range (m)	Average Peat Depth (m)	Summary of Underlying Mineral Subsoil Lithology (from FT trial pit data)
T1	0.2 – 0.5	0.35	Very soft grey very sandy CLAY
T2	0.8 – 1.4	1.1	Firm grey slightly sandy slightly gravelly CLAY with occasional subangular to sub-rounded cobbles, stiff at 2mbgl
T3	0.8 – 1.4	1.3	Soft grey very sandy SILT with occasional subangular to sub-rounded cobbles
T4	1.1 – 1.8	1.5	Very soft light grey slightly organic SILT (MARL) to 2.2mbgl, over Firm grey slightly sandy CLAY with rare subangular to sub-rounded cobbles, stiff at 2.7mbgl
T5	1.7 – 2.3	2.0	Grey very silty SAND + GRAVEL with occasional sub-rounded cobbles
T6	1.0 – 1.6	1.3	Soft to firm grey sandy gravelly CLAY with sub-rounded cobbles and boulders
T7	2.0 – 2.3	2.2	Soft grey slightly sandy SILT with occasional gravel and boulders. Firm at 2mbgl.
T8	0.7 - 1.8	1.4	Soft grey sandy CLAY with occasional subangular to sub-rounded cobbles and boulders. Damp and firm to stiff at 2.2mbgl.
T9	1.2 – 1.7	1.4	Soft light grey sandy CLAY, over Very clayey sandy GRAVEL with occasional subangular to sub-rounded cobbles
T10	1.0 – 1.5	1.3	Firm grey slightly sandy slightly gravelly SILT with occasional subangular to sub-rounded cobbles and boulders
T11	0.8 – 1.8	1.1	Soft to firm grey very sandy slightly gravelly SILT, damp, occasional sub-rounded cobbles
T12	0.3 – 0.8	0.6	Grey silty SAND with occasional sub-rounded cobbles
T13	0.2 – 0.8	0.45	Firm to stiff grey slightly sandy CLAY with occasional gravel and cobbles below 2m: some subangular to sub-rounded boulders
T14	1.2 – 1.5	1.35	Grey silty SAND with occasional cobbles and boulders
T15	0.5 – 0.7	0.6	Soft grey slightly sandy CLAY with occasional gravel and cobbles firm at 1m more frequent boulders at 2m
T16	0.5 – 0.6	0.55	Soft grey sandy SILT with frequent subangular to sub-rounded cobbles and boulders firm at 1.2m stiff at 2m

Infrastructure Location	Peat Depth Range (m)	Average Peat Depth (m)	Summary of Underlying Mineral Subsoil Lithology (from FT trial pit data)
T17	0.15 – 0.8	0.5	Firm grey slightly gravelly sandy SILT with rare subangular cobbles 1.5m - some cobbles and boulders
T18	0.3 – 0.8	0.6	Soft grey slightly sandy CLAY (damp) gravelly below 1.5m, with occasional subangular to sub-rounded cobbles
T19	0.2 – 1.2	0.9	Firm to stiff grey slightly sandy slightly gravelly CLAY with occasional sub-rounded cobbles
T20	0.8 – 1.1	0.9	Firm grey sandy SILT with occasional sub-rounded boulders. Occasional gravel and cobbles below 1.8m.
T21	1.2 – 1.6	1.4	Soft grey sandy CLAY, damp gravelly below 1.5m occasional boulders at 2.3m.
Substation	0.3 – 1.1	0.9	Soft to Firm grey slightly sandy CLAY with occasional subangular to sub-rounded cobbles
Cable Route	0.0 - 2.0	0.86	Soft to Firm grey slightly sandy CLAY

8.3.3 Bedrock Geology

Based on the GSI bedrock mapping the bedrock units underlying the proposed development site comprises Dinantian Pure Unbedded Limestone (DPUL). Below the site, Waulsortian Limestones are mapped, and these comprise massive un-bedded lime-mudstone. There are 2 no. mapped faults intersecting the site, which trend in a northwest-southeast direction.

A mapped corehole completed at the Island townland, approximately 600m east of Drinagh Bog (at ITM: 612948, 718250.3) indicated overburden deposits of 12m depth over 244.5m of Waulsortian Limestone (www.gsi.ie).

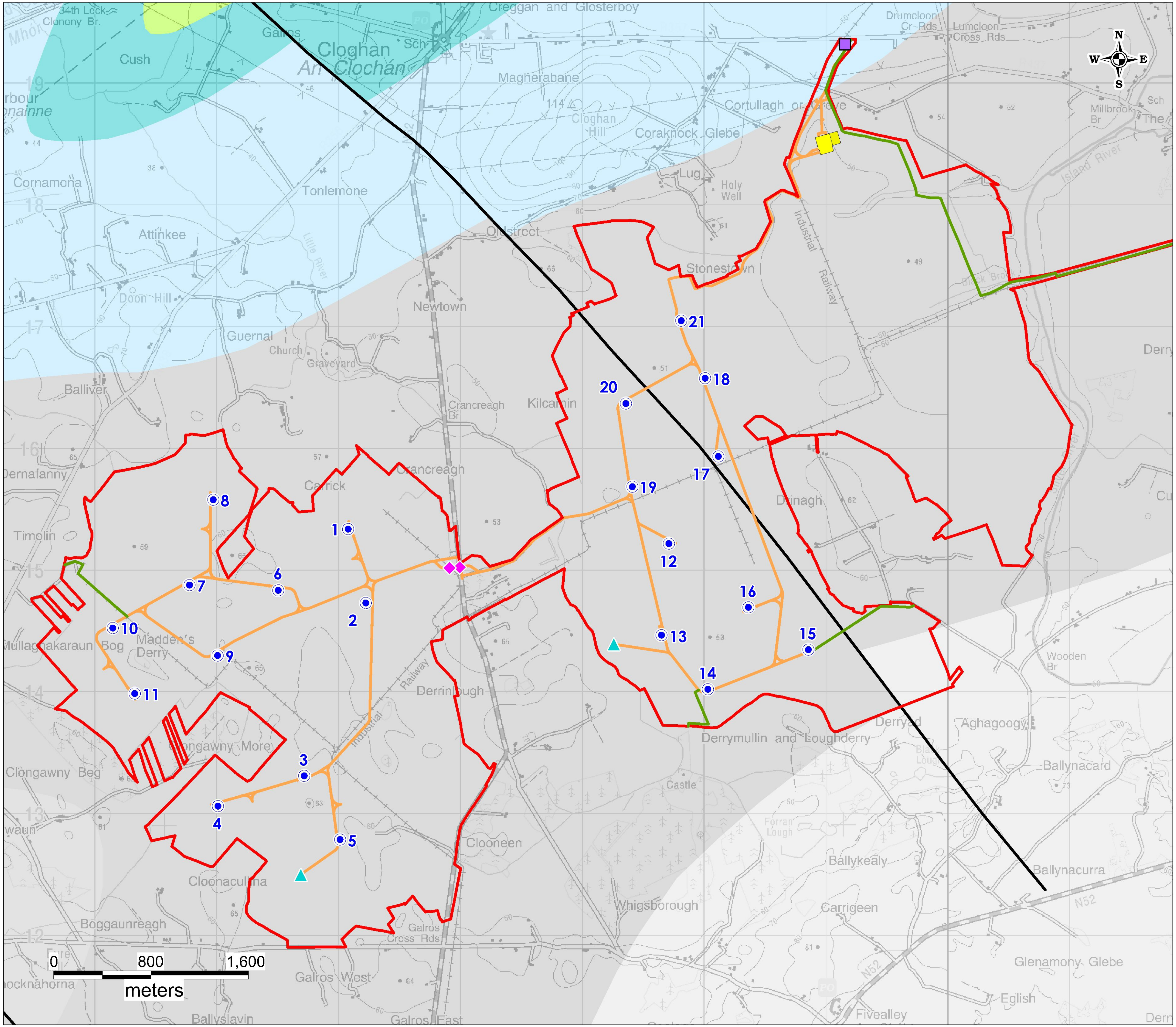
Boulders of fossiliferous pale limestone were observed at the site (especially across the Drinagh bog site). These boulders would have been deposited on top of glacial deposits towards the end of the last glacial maximum. The peat deposits accumulated around and above the boulders, and during peat extraction the boulders have been exposed at ground level. These boulders (probably derived from local underlying limestone bedrock) displayed brachiopod shells and crinoid ossicles in a pale calcium carbonate matrix. They have no real consequence for the proposed wind farm development. They are just a feature of the geology noted within the Drinagh bog.

No bedrock was encountered in any of the site investigation points. Depth to bedrock at the site is expected to be between 6-12mbgl.

A bedrock geology map of the area is attached as Figure 8.7.

8.3.4 Geological Resource Importance

The limestone bedrock underlying the site could be classified as "Medium" importance. The bedrock could be used on a "sub-economic" local scale for construction purposes. The bedrock has not been used



Legend

- EIAR Site Boundary
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- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Mapped Faults
- Dinantian (early) Sandstones, Shales and Limestones
- Dinantian Lower Impure Limestones
- Dinantian Pure Bedded Limestones
- Dinantian Pure Unbedded Limestones

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Client: Bord na Mona Powergen Ltd

Job: Derrinlough, Co. Offaly

Title: Local Bedrock Geology Map

Figure No: 8.7

Drawing No: P1463-0-0220-A3-807-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:30,000	Drawn By: GD
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in the past at the site for this purpose, likely because of the covering of peat and glacial till overburden in the area.

The glacial subsoils (i.e. sands and gravels where present) could be classified as "Medium" importance. The glacial subsoils could be used on a "sub-economic" local scale for construction purposes. There is no evidence that it was used in the past.

The overlying peat deposits at the site could be classified as "Low" importance as the peat is not designated in this area and is significantly degraded in most places at the site as a result of industrial peat production/extraction and drainage. Refer to Table 8.1 for definition of these criteria.

8.3.5 Geological Heritage Sites

There are no recorded mineral deposit sites or mining sites (current or historic) within the proposed development area. There are no geological heritage sites near the proposed development. There are 2 no. County Geological Sites near the proposed site (Drinagh and Crancreah Mushroom rocks) and 1 no. within the site boundary (Derrinlough Mushroom Rock). These are Limestone standing rocks which have been eroded near their base by acidic waters towards the end of the last Glacial Maximum. The Crancreagh Mushroom rock is situated ~600m north of the Clongawny Bog, and is ~1,150m from any proposed wind farm infrastructure. The Drinagh Mushroom Rock is situated on the southern edge of the Drinagh Bog and is ~380m from any proposed wind farm infrastructure. The Derrinlough Mushroom Rock is situated ~160meast-northeast of Derrinlough Briquette factory between the Clongawny and Drinagh bogs. It is ~60m south of an existing internal access track (between Drinagh and Clongawny bogs) that will be upgraded and used within the proposed wind farm development.

The locations of these County Geological Heritage sites are shown on Figure 8.8 relative to the proposed site layout.

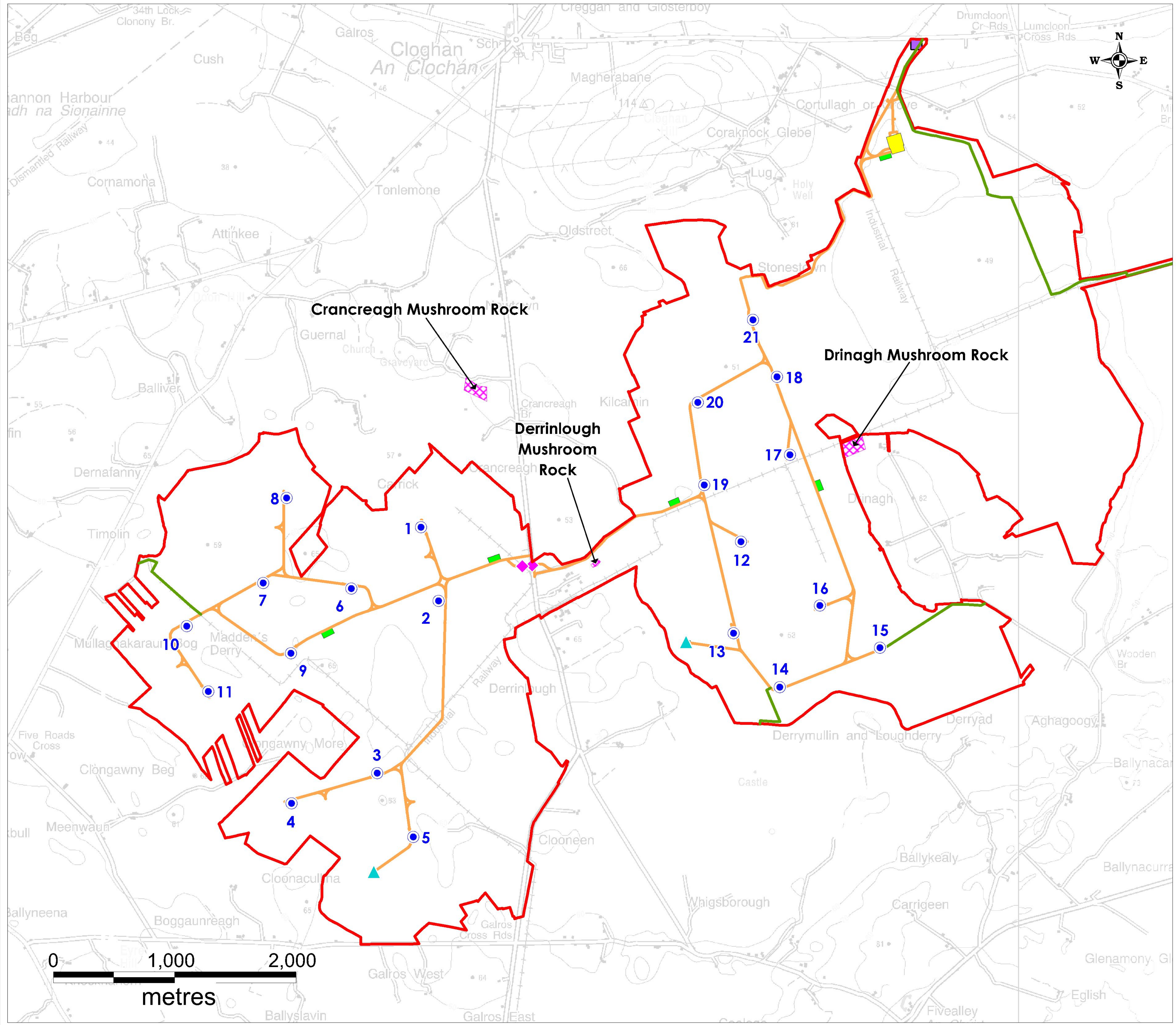
8.3.6 Peat Stability Assessment

A Geotechnical and Peat Stability Assessment Report (FT, 2020a) is attached in Appendix 8.1. Summary data and conclusions from that report are provided below.

The hand vane results indicate undrained shear strengths in the range 20 to 120kPa, with an average value of about 65kPa. The strengths recorded would be typical of well-drained peat as is present on the Derrinlough site.

Peat strength at sites of known peat failures (assuming undrained (short-term stability) loading failure) are generally very low, for example, the undrained shear strength at the Derrybrien failure (AGEC, 2004) as derived from essentially back-analysis, though some testing was carried out, was estimated at 2.5kPa. The recorded undrained strengths at the Clongawny/Drinagh site are significantly greater than the lower bound values for Derrybrien indicating that there is no close correlation to the peat conditions at the Derrybrien site and that there is significantly less likelihood of failure on the Clongawny/Drinagh site.

The minimum required Factor of Safety (FoS) is 1.3 based on BS6031:1981: Code of Practice for Earthworks (BSI, 2009). The assigned probability of instability associated with a given FoS value is described in Table 8.5 over.



Legend

- EIAR Site Boundary
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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Location of County Geological Heritage Sites Map	
Figure No: 8.8	
Drawing No: P1463-0-0220-A3-808-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:30,000	Drawn By: GD
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Table 8.5: Probability Scale for Factor of Safety.

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	<1.0	Very Likely

8.3.6.1 Peat Stability Assessment Results

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site.

The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

The drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

As mentioned above, the Geotechnical and Peat Stability Assessment Report (FT, 2019a) is attached in Appendix 8.1.

8.3.6.1.1 *Undrained Analysis*

Undrained analysis results are presented in Table 8.6. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

Table 8.6: Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	607027	715375	68.77	22.92
T2	607206	714769	16.38	9.55
T3	606666	713348	24.56	14.33
T4	605958	713100	9.56	6.14
T5	606961	712824	14.95	10.42
T6	606452	714870	11.32	6.96
T7	605724	714916	14.95	10.42
T8	605919	715618	19.10	12.28
T9	605954	714337	20.23	12.73
T10	605094	714562	11.47	6.88
T11	605273	714023	6.17	3.97
T12	609661	715257	42.98	19.10
T13	609600	714503	21.50	9.56
T14	609982	714058	11.47	6.88
T15	610807	714384	24.58	10.12
T16	610313	714732	57.31	21.49
T17	610068	715972	14.35	6.38
T18	609958	716616	10.52	4.67
T19	609360	715724	28.65	15.63
T20	609307	716406	31.26	16.37
T21	609761	717087	7.42	4.57
Substation	610966	718547	31.26	16.37
Temporary Construction Compound 1	606260	714498	10.42	8.00

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Temporary Construction Compound 2	607630	715110	26.45	14.95
Temporary Construction Compound 3	609113	715577	16.37	11.09
Temporary Construction Compound 4	610305	715713	7.65	4.59
Temporary Construction Compound 5	610858	718421	31.26	16.37
Met Mast 1	606638	712525	9.82	7.64
Met Mast 2	609210	714421	31.26	16.37

8.3.6.1.2 Drained Analysis

Drained analysis results are presented in Table 8.7. As outlined above, the drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Table 8.7: Factor of Safety Results (drained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	607027	715375	45.85	33.09
T2	607171	714769	10.92	13.79
T3	606666	713348	16.37	20.68
T4	605958	713100	6.37	8.86
T5	606961	712824	9.97	15.04
T6	606452	714870	7.54	10.05
T7	605724	714916	9.97	15.04
T8	605919	715618	12.73	17.73
T9	605954	714337	13.48	18.38
T10	605094	714562	7.65	9.93

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T11	605273	714023	4.12	5.72
T12	609661	715257	28.65	27.58
T13	609600	714503	14.34	13.79
T14	609982	714058	7.65	9.93
T15	610807	714384	16.38	14.60
T16	610313	714732	38.20	31.02
T17	610068	715972	9.57	9.20
T18	609958	716616	7.01	6.73
T19	609360	715724	19.10	22.56
T20	609307	716406	20.84	23.64
T21	609761	717087	4.95	6.59
Substation	610966	718547	20.84	23.64
Temporary Construction Compound 1	606260	714498	6.95	11.54
Temporary Construction Compound 2	607630	715110	17.63	21.58
Temporary Construction Compound 3	609113	715577	10.92	16.01
Temporary Construction Compound 4	610305	715713	5.10	6.62
Temporary Construction Compound 5	610858	718421	20.84	23.64
Met Mast 1	606638	712525	6.55	11.03
Met Mast 2	609210	714421	20.84	23.64

The findings of the peat stability assessment showed that the site has an acceptable margin of safety and is suitable for the proposed wind farm development. The findings include recommendations and control measures (Section 12 of Appendix 8.1 of this EIAR) for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

An analysis of peat stability was carried out at the turbine locations, substation compound, construction compounds and met masts for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

An undrained analysis was carried out, which applies in the short-term during construction. For the undrained condition, the calculated FoS for load conditions (1) & (2)[1] for the locations analysed, show that all locations generally have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis would be considered the most critical condition for the peat slopes.

The calculated FoS for load condition (1) is in excess of 1.30 for each of the locations (579 no. locations) analysed with a range of FoS of 1.62 to in excess of 10, indicating a low risk of peat instability.

The calculated FoS for load condition (2) is in excess of 1.30 for each of the locations (579 no. locations) except at 2 no. locations where FoS's of 1.21 and 1.26 were calculated. It should be noted that the locations where the marginally low FoS's were calculated, the slope angles were based on contour survey plans for site which give approximate values. Based on site data recorded during the walkover, it is likely that the slope angles derived from the contour survey plans overestimated the slope angle at these locations. The 2 no. marginally low FoS's are located alongside the proposed access road between turbines T12 and T13. The proposed works at these locations entails the construction of a floated section of access road i.e. no excavation works are proposed at these locations. Peat instability at these locations is not envisaged to be an issue.

The calculated FoS for load condition (2) for the remaining 577 no. locations were in excess of 1.30, indicating a low risk of peat instability.

The peat stability risk assessment at each infrastructure location (as listed above) identified a number of mitigation/control measures to reduce the potential risk of peat failure. Sections of access roads to the nearest infrastructure element should be subject to the same mitigation/control measures that apply to the nearest infrastructure element.

In summary, the findings of the peat assessment showed that the proposed Derrinlough wind farm site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

8.4 Characteristics of the Proposed Development

The proposed development will typically involve removal of peat and subsoils for access roads, internal access road networks, internal cable network, hardstanding emplacement, turbine foundations, substation, crane hardstands, construction compounds, and met mast installation. The construction grade granular fill and the higher quality, surfacing granular fill and sand will be sourced from local, authorised quarries. The locations of the existing quarries and typical proposed routes to site chosen for

[1] *For the stability analysis two load conditions were examined, namely*

Condition (1):	*no surcharge loading*
Condition (2):	*surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.*

the purposes of assessment throughout this EIAR are shown in Figure 4.23. These and/or other authorised quarries will be used as sources of stone during the construction of the Proposed Development proposed development.

Estimated volumes of peat to be removed are shown in Table 8.8 below. It is estimated that up to 484,600m^3 of sand and gravel will be imported for proposed construction works.

In terms of peat handling and long-term storage of excavated peat, Bord na Móna has considerable experience in this area, both during peat production operations and during the rehabilitation processes associated with its cutaway bogs. This experience has shown that the most environmentally sensitive and stable way of handling and moving of excavated peat is its placement across the site and at locations as close as possible to the extraction areas. Placement of excavated peat and spoil within 1m high and 5m wide corridor on both sides of the proposed access roads is proposed, and additional peat material will be used at turbine locations for landscaping. The overall peat and spoil storage volumes are shown in Table 8.9. These are taken from the Peat and Spoil management Plan prepared by FT (FT. 2020b).

Proposed construction methodologies for each element of infrastructure is summarised in Table 8.10.

Table 8.8: Estimated Peat, Mineral Soil and Bedrock Excavation Volumes

Infrastructure Element (1)	Typical Dimensions	Peat Volume (m^3) (2)	Spoil (non-peat) Volume (m^3) (2)	Comments
21 no. Turbines and Hardstands	22m diameter excavation footprint for turbine foundation with hardstand area	152,535	57,700	Hardstanding area and foundation footprint
Access Roads including entrances	Assumed 6m wide road surface	57,150	29,465	Excludes proposed floating sections of access road where no excavation of peat will take place
Substation	17,564m^2 footprint	18,963	6,326	Hardstanding area and foundation footprint
2 no. Meteorological Masts	10 x 10m foundation footprint and 600m^2 hardstanding area	3,490	780	Hardstanding area and foundation footprint. Met Mast 1 likely a piled foundation
5 no. Temporary Construction Compounds and 2 no. Construction Phase Security Hut Platforms	Hardstanding areas – 5,000m^2	37,800	8,570	Hardstanding areas
2 no. Underpasses	Precast concrete box culverts	1,440	4,200	May be piled structures however excavation works will be required
Proposed Amenity Links	3m wide footpath	0	0	Floated construction hence no excavation works
Cable route and grid connection		7,345		Includes the internal network cabling works
N52/N62 Junction			6,920	
Sub-total		**278,723m^3**	**113,961m^3**	
Total Peat and Spoil volume		**392,684m^3**		

Note (1) The location of the infrastructure elements on-site are shown on Planning Drawings.
Note (2) A factor of 20% (bulking factor of 15% and contingency factor of 5%) has been applied to the excavated peat & spoil volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

Table 8.9: Summary of Peat and Spoil Placement Areas on Site

Location	Peat & Spoil Volume (m^3)	Comment
Peat and spoil placement alongside infrastructure elements	352,000	1m in height and 14m wide corridor on both sides of proposed infrastructure elements on site. For example, 7m wide corridor on both sides of proposed access roads, see Section 7.4 of the report for further details and Figure 7-1. The placement of peat and spoil alongside infrastructure elements also includes around hardstanding areas, either side of cable trenches, etc.
Landscaping (1)	42,000	It is estimated that approximately 2,000m^3 of peat will be required for landscaping purposes at each of the 21 no. turbine locations
Total =	394,000m^3	

Table 8.10: Summary of Proposed Infrastructure construction methods

Location	Foundation/Construction Method
21 no. wind turbines	Turbine foundations indicated to be piled but may have a small number that have gravity foundations.
Access roads	Floating access roads and excavate and replace roads (road types A, B, and C) are the proposed road construction types proposed for the site which given the ground conditions and type of terrain present are deemed appropriate. The total length of new proposed access road to be constructed on-site is 29.3km (see Peat and Spoil Management Plan, Appendix 4.2).
Crane hardstands	The crane hardstands will be constructed using the founded technique (i.e. non-floated technique). Crane hardstands are generally constructed using compacted Class 1/6F material or granular fill in accordance with turbine manufacturer requirements on a suitable sub-formation to achieve the required bearing resistance. The hardstands will be designed for the most critical loading combinations from the crane. The hardstands will require to be founded on material underlying the peat deposits. The typical make-up of the hardstands may include up to 1200mm of granular stone fill with possibly a layer of geotextile and/or geogrid.
Substation foundations and platforms	The substation platforms will be constructed using the founded technique (i.e. non-floated technique). The substation foundations may comprise strip/raft foundations under the main footprint of the building with possibly a basement/pit for cable connections. Substation platforms are generally constructed using compacted Class 1/6F material or granular fill in accordance with Eirgrid/ESB network requirements on a suitable sub-formation to achieve the required bearing resistance. The substation platforms will require to be founded on material underlying the peat deposits. Typical founding depth for substation platform likely to be 0.5 to 2.0m.

Temporary Construction Compounds	The temporary construction compound platforms will be constructed using the founded technique (i.e. non-floated technique). The platforms are generally constructed using compacted Class 1/6F material or granular fill in accordance with turbine manufacturer requirements on a suitable sub-formation to achieve the required bearing resistance. The platforms will require to be founded on material underlying the peat deposits. Typical founding depth for temporary construction compound platforms will require excavations from 1m to 3.5m bgl.
Met Masts	The met mast foundations will likely comprise gravity type foundation and a piled foundation. Based on the ground conditions present at proposed met mast 1, it is envisaged that the foundation will require a piled foundation. Given the thickness of peat and lacustrine soils present at this location a gravity type foundation is not likely to be a suitable solution. This will be determined following confirmatory site investigation works prior to the construction of the proposed development. Based on the ground conditions present at proposed met mast 2, it is envisaged that the gravity type foundation will require to be founded on till. The peat and lacustrine soils are not likely to be suitable founding stratums for the met mast foundation. At the underside of the met mast foundation, a layer of structural upfill (class 6N/6P) or granular fill in accordance with met mast supplier requirements will likely be required. This will be determined following confirmatory site investigation works prior to the construction of the proposed development.
Permanent Underpasses	Two new permanent underpasses are proposed as part of the proposed development. The first underpass will traverse beneath the N62, immediately north of Derrinlough Briquette Factory. This underpass will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used during the operational phase for wind farm maintenance. A second underpass is proposed in Clongawny bog beneath an existing Bord na Móna railway line. This underpass will also be used for amenity purposes and for wind farm maintenance during the operational phase. The underpasses will take the form of precast concrete box culverts and will be founded on a competent stratum at depth. Given the ground conditions present across the site, the culvert foundations may need to be piled. This will be determined following confirmatory site investigation works prior to the construction of the proposed development. At the underside of the culvert foundations, a layer of structural up-fill (class 6N/6P) in accordance with Transport Infrastructure Ireland (TII) requirements will be required.

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do Nothing Scenario

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

Localised 3rd party turbary peat cutting along the margins of the site will also continue.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely effects of the proposed development and mitigation measures that will be put in place during the construction phase to eliminate or reduce them are outlined below.

8.5.2.1 Peat and Subsoil Excavation

Excavation of peat and subsoil will be required for construction of works for the installation of access roads (floating and excavated roads, i.e. road type A, road type B and road type C (FT, 2020b)), gravity foundations for turbine bases, crane hardstands, met masts, substation, underpasses, internal cable network and turbine delivery route accommodation works. This will result in a permanent removal and relocation of in-situ peat and subsoil at most excavation locations. Estimated volumes of peat and subsoils to be relocated are summarised above. There is no loss of peat or subsoil, it will just be relocated within the site.

Pathway: Extraction/excavation.

Receptor: Peat and subsoil.

Pre-Mitigation Potential Impact: Negative, slight/moderate, direct, high probability, permanent effect on peat and subsoil due to relocation within the site.

Proposed Mitigation Measures by Design:

- Placement of turbines and associated infrastructure in areas with shallower peat where possible;
- Use of floating roads, where appropriate, to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation and temporary compounds and access roads;
- The proposed development has been designed to avoid sensitive habitats within the application area;
- A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design;

- Excavated peat will only be moved short distances from the point of excavation and will be used locally for landscaping; and,
- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.

Residual Effect Assessment: The granular soil at the site can be classified as of "Medium" importance and the peat deposits at the site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall site area is extensive while the proposed development footprint is approximately 1.45% of the overall site area. The impact is the disturbance and relocation of c 392,684 m3 of soil and subsoil during construction. The design measures incorporated into the project as described above in particular the avoidance of deeper peat areas combined with the 'Medium' and 'low' importance of the deposits means that the residual effect is considered - Negative, slight, direct, high probability, permanent effect on peat and subsoils due to disturbance and relocation within the site.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.2.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of peat, subsoils and pollution of the underlying aquifer) on the geological and water environment.

Pathway: Peat and subsoil and underlying bedrock pore space.

Receptor: Peat and subsoil, bedrock.

Pre-Mitigation Potential Impact: Negative, slight, direct, short-term, medium probability effect on peat, subsoils and bedrock.

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- Fuels stored on-site will be minimised. All storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical control building (at the substation) will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (which is contained in Appendix 4.3).

Residual Effect Assessment: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect is considered to be - Negative, imperceptible, direct, short-term, low probability effect on peat and subsoils and bedrock.

Significance of Effects: No significant effects on peat, subsoils and bedrock are anticipated.

8.5.2.3 Erosion of Exposed Subsoils and Peat During Construction of Infrastructure

There is a high likelihood of erosion of peat and spoil during its excavation and during landscaping works. The main impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in Chapter 9.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat and subsoil.

Pre-Mitigation Potential Impact: Negative, slight, direct, short-term, high probability effect on peat and subsoils by erosion and wind action.

Proposed Mitigation Measures:

- Peat removed from turbine locations and access roads will be used for landscaping close to the extraction area;
- Where possible, the upper vegetative layer (where still present) will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat storage areas;
- Re-seeding and spreading/planting will also be carried out in these areas; and,
- A full Peat and Spoil Management Plan for the development is shown as Appendix 4.2.

Residual Effect Assessment: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this all excavation works will be completed in accordance with a detailed Peat and Spoil Management Plan, material will be moved the least possible distance, and reseeding and planting will be completed to bind landscaped peat and spoil together. Following implementation of these measures the residual effected is considered - Negative, slight, direct, short-term, medium probability effect on peat and subsoils by erosion and wind action.

Significance of Effects: No significant effects on soils, subsoils or bedrock are anticipated.

8.5.2.4 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on the proposed wind farm development and the surrounding environment. The potential significant effects of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of infrastructure;
- Drainage disruption by blockage of drainage pathway by relocated peat and spoil;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates; and,
- Degradation of the peat environment by relocation of peat and spoil.

Pathway: Vehicle movement and excavations.

Receptor: Peat and subsoils.

Pre-Mitigation Potential Impact: Negative, significant, direct, low probability permanent effect on peat and subsoils. The findings of the peat stability assessment showed that the proposed Derrinlough wind farm site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

Proposed Mitigation Measures:

The following general control measures incorporated into the construction phase of the project will assist in the management of the risks for this site:

- Appointment of experienced and competent contractors;
- The site should be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Set up, maintain and report findings from monitoring systems (as outlined in the Geotechnical and Peat Stability Assessment);
- Ensure construction method statements are developed and agreed before commencement of construction and are followed by the contractor; and,
- Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.

Please refer to Appendix 8.1 for proposed turbine specific and road section design proposals.

Residual Effect Assessment: A detailed Geotechnical and Peat Stability Assessment has been completed for the development proposal. The findings of that assessment have demonstrated that there is a low risk of peat failure (at the site) as a result of the proposed development. With the implementation of the control measures outlined above the residual effect is considered - Negative, imperceptible, direct, low probability, permanent effect on peat and subsoils.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.2.5 Piling Works

As a worst-case design scenario turbine and infrastructure locations may require piled foundations. For the piled turbine foundations, a typical piling type and configuration could be up to 50 no. 300mm square concrete driven piles. A similar type pile and configuration was used for the turbine foundations on the Mount Lucas wind farm. A similar piling system and array would be used under other infrastructure components (e.g. substation), but with a reduced pile frequency/spacing.

Pathway: piling works.

Receptor: peat/soils and subsoils.

Pre-Mitigation Potential Impact: Negative, slight, direct, permanent low probability impact on subsoils by piling works.

Proposed Mitigation Measures:

Other than surface level and minor excavation works, any piling works will not produce significant volumes of spoil as the proposed piling system are driven piles (these will displace soil/subsoil within the ground.

No mitigation measures are proposed or required for soils and geology environment.

Residual Effect Assessment: The effects of piling works on soils and geology have been assessed. Pile install works would only result in small volumes of spoil, and minimal displacement of in-situ peat and subsoils. This small displacement would not alter ground levels, nor change the local geological environment in any significant way. As such the residual effects are considered - negative, direct, imperceptible, permanent, low probability impact on peat and subsoils by piling works.

Significance of Effects No significant effects on soils and subsoils are anticipated.

8.5.2.6 Potential Impacts on County Geological Sites

There are 2 no. County Geological Sites (CGS) near the proposed development site and 1 no. CGS within the site boundary. These mushroom rocks were chemically weathered by acidic waters towards the end of the Last Glacial Maximum and consist of Limestone standing rocks which narrow towards their base due to this weathering action. The Crancreagh Mushroom rock is situated ~600m north of the Clongawny Bog, and is ~1,150m from any proposed wind farm infrastructure. The Drinagh Mushroom Rock is situated on the southern edge of the Drinagh Bog and is ~380m from any proposed wind farm infrastructure. The Derrinlough Mushroom Rock is situated ~160m east-northeast of Derrinlough Briquette factory between the Clongawny and Drinagh bogs. It is ~60m south of an existing internal access track (between Drinagh and Clongawny bogs) that will be upgraded and used within the proposed wind farm development.

No effects from the development will occur at Crancreagh Mushroom Rock and Drinagh Mushroom Rock as there will be no construction or operational works near either of these locations.

Pathway: Damage by vehicular/machinery movement.

Receptor: Mushroom Rock (CGS).

Pre-Mitigation Potential Impact: Negative, significant, indirect, medium probability impact on Derrinlough Mushroom Rock by damage or relocation by vehicular/machinery movements.

Proposed Mitigation Measures:

No mitigation measures are proposed for the Crancreagh CGS as there will be no construction or operational works near this site.

Mitigation measures for the Derrinlough Mushroom Rock include advising all vehicle and construction plant operators of the location of geological sites and instruct them to avoid those areas. No works will be completed within 30m of the Derrinlough Mushroom Rock. In addition, the geological heritage sites will be cordoned off with appropriate fencing to avoid accidental vehicular movement within these areas. The mitigation measures for the Mushroom Rock sites will be incorporated into the CEMP and access roads will be kept a minimum distance of 30m from the rocks.

Residual Effect Assessment: Crancreagh Mushroom Rock and Drinagh Mushroom Rock will not be affected by the proposed development due their remote locations from any intended wind farm works. Avoidance mitigation is outlined above for Derrinlough Mushroom Rocks. With the implementation of these avoidance measures the residual effects on Derrinlough Mushroom Rock are considered -

Negative, imperceptible, indirect, unlikely effect on County Geological Sites due to damage by vehicular/machinery movement.

Significance of Effects No significant effects on County Geological Sites are anticipated as a result of the proposed development.

8.5.2.7 Proposed Substation

As presented in Table 8.8 above the estimated volume of peat and spoil to be excavated at the proposed substation is 25,289 m^3 (18,963m^3 of peat and of 6,326m^3 of spoil). The exact location of the substation has been selected based on detailed geotechnical investigations and peat stability risk assessments. Material excavated at the substation location will be used for landscaping and the remainder will be permanently stored in low linear sections.

Pathway: Extraction/excavation of peat and soil/subsoils (spoil).

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Impact: Negative, slight/moderate, direct, high probability, permanent effect on peat and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section 8.5.2.1.

Mitigation measures in respect of potential piling works are outlined at Section 8.5.2.5. The residual effect of all piling works is assessed in Section 8.5.2.5.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.2 above and measures dealing with soil erosion are dealt with in Section 8.5.2.3. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.3.2, and the residual effects of soil erosion are assessed in Section 8.5.2.3.

Residual Effect Assessment: The granular soil at the substation site can be classified as of "Medium" importance and the peat deposits at the site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall application site area is extensive (~2,360 Ha) while the proposed substation development footprint is small (~1.76a Ha), or ~0.07% of the overall site area. The impact is the disturbance and relocation of c 25,289 m^3 (note this is already included in the 392,684 m^3 assessed in Section 8.5.2.1) of peat and spoil during the construction of the substation and the residual effect of this is considered - Negative, slight, direct, high probability, permanent effect on peat and subsoils due to disturbance and relocation within the site.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.2.8 Proposed Permanent Underpasses

Two permanent underpasses are proposed as part of the development. The first underpass will traverse beneath the N62, immediately north of Derrinlough Briquette Factory. This underpass will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used during the operational phase for wind farm maintenance. A second underpass is proposed in Clongawny bog beneath an existing Bord na Móna railway line. This underpass will also be used for amenity purposes and for wind farm maintenance during the operational phase.

The underpasses will take the form of precast concrete box culverts and will be founded on a competent stratum at depth. As a worst-case, the precast concrete boxes may need to be underpinned by piling.

Pathway: Extraction/excavation of peat and spoil and potential piling works

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Impact: Negative, slight/moderate, direct, high probability, permanent effect on peat and subsoil due to excavation and relocation within the site.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section 8.5.2.1.

Mitigation measures in respect of potential piling works are outlined at Section 8.5.2.5. The residual effect of all piling works is assessed in Section 8.5.2.5.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.2 above and measures dealing with soil erosion are dealt with in Section 8.5.2.3. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.3.2, and the residual effects of soil erosion are assessed in Section 8.5.2.3.

Residual Effect Assessment: The granular soil at the substation site can be classified as of "Medium" importance and the peat deposits at the site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The impact is the disturbance and relocation of c 5,640 m^3 of soil and subsoil during the construction of the underpass and the residual effect of this is considered - Negative, slight, direct, high probability, permanent effect on peat and subsoils due to excavation and relocation within the site.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.2.9 Proposed Amenity Links

A total of approximately 18km of amenity pathways (including walkways and cycleways, and a carpark) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. These pathways will have a gravel/crushed stone finish surface.

In addition, approximately 6.5km of dedicated amenity pathways are proposed to provide access points/links into and out of the site as follows:

- Internal link to R437 allowing further access to Drinagh and Derrybrat and to facilitate potential future connection to Lough Boora Discovery Park.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link from the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

The proposed construction methodology for the amenity pathways is by floating road construction, with no requirement for additional excavation or spoil generation. Pathways will be created on the existing ground surface by adding crushed stone.

Pathway: Extraction/excavation of peat and soil/subsoils (spoil).

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Impact: Negative, slight, direct, high probability, permanent effect on peat and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section 8.5.2.1.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.2 above and measures dealing with soil erosion are dealt with in Section 8.5.2.3. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.3.2, and the residual effects of soil erosion are assessed in Section 8.5.2.3.

Residual Effect Assessment: It is proposed to place amenity pathways on top of existing ground. Ground disturbance and peat and spoil relocation during these works will be minimal. As such the residual effects of these works are considered - Negative, imperceptible, direct, high probability, permanent effect on peat and subsoils by covering with 3m wide pathway.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.2.10 Proposed Turbine Delivery Route Junction Works

A new temporary arrangement will be required at Kennedy's Cross, located in the townland of Ballindown, (junction of the N52 and N62 National Secondary Roads), comprising construction of a new road across third party lands, to facilitate the delivery of turbine components and other abnormal loads. The proposed new road will measure approximately 160 metres in length and have a 6-metre running width.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Soils and subsoils.

Pre-Mitigation Potential Impact: Negative, slight/moderate, direct, high probability, permanent effect on soil and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section 8.5.2.1.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.2 above and measures dealing with soil erosion are dealt with in Section 8.5.2.3. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.3.2, and the residual effects of soil erosion are assessed in Section 8.5.2.3.

Residual Effect Assessment: The proposed works footprint is small (960m^2), and there will be minimal disturbance to the local geology. As such the residual effects are considered as - Negative, direct, slight, high probability, permanent effect on local subsoils.

Significance of Effects: No significant effects on soils and subsoils are anticipated.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

Very few potential direct impacts are envisaged during the operational phase of the Proposed Development. These may include:

- Some construction vehicles or plant may be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil; and,
- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater.
- In relation to indirect impacts a small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries.

None of these potential impacts are considered to be significant, as they are of such small scale and also of an intermittent nature.

Mitigation measures for soils and geology during the operational phase include the use of aggregate from authorised quarries for use in road and hardstand maintenance. Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on ground/peat and subsoils and groundwater or surface water quality. The substation transformer will be in a concrete bunded capable of holding 110% of the stored oil volume. Turbine transformers are located within the turbines, so any leaks would be contained within the turbine. These mitigation measures are considered sufficient to eliminate potential risks to ground/peat/soils and subsoils, and groundwater and surface water quality.

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas. This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant.

Some of the impacts will be avoided by leaving elements of the proposed development in place where appropriate. The substation will be retained by EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the soils and geology environment are envisaged during the decommissioning stage of the proposed development.

8.5.5 Cumulative Effects

Due to the localised nature of the proposed construction works which will be kept within the proposed development site boundary, there is no potential for significant cumulative effects in-combination with other local developments on the land, soils and geology environment. The only way the wind farm proposal can have in combination effects with other off site projects and plans is via the drainage and off site surface water network, and this hydrological pathway is assessed in Chapter 9. The construction of the grid connection works will only require relatively localised excavation works within the site boundary and therefore will not contribute to any significant cumulative effects.

8.5.6 Post Construction Monitoring

None required.

9. HYDROLOGY AND HYDROGEOLOGY

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential significant effects of the proposed wind farm development on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed wind farm development and associated works;
- Identify likely significant effects of the proposed development on surface water and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and
- Assess cumulative effects of the proposed development and other local developments.

9.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include upland hydrology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill and Adam Keegan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Adam Keegan is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.6 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in Table 9.1 below.

Table 9.1: Summary of Water Environment Related Scoping Responses

Consultee	Description	Addressed in Section
Geological Survey of Ireland (GSI)	• Assessment of Geohazards required, including peat stability, and groundwater flooding. • GSI have identified 3 local County Geological Sites, Crancreagh Mushroom Rock; Derrinlough Mushroom Rock; and, Drinagh Mushroom Rock. • Assessment of groundwater characteristics/resources and groundwater protection required. • Assessment of mineral resources and aggregates required.	Refer to Chapter 8: Land, Soils and Geology (Appendix 8.1) for a Geotechnical and Peat Stability Assessment. Flooding is addressed in Section 0. Groundwater assessment addressed at Section 9.3.8, Section 9.3.9, Section 9.3.10, Section 9.3.15, Section 9.5.3.2, Section 9.5.3.8, and Section 9.5.3.9. Refer to Chapter 8: Land, Soils and Geology for assessment of aggregate resources.
Department of Culture Heritage and Gaeltacht	• Where archaeological material is to be preserved in-situ, empirical measurements into the future hydrology of the site will be required, e.g. by mean of the use of dip wells (piezometers).	This issue related to Archaeology, but the type of potential monitoring is hydrological.
Department of Agriculture, Food and the Marine	• A response was received but mainly related to felling works.	As felling works does not form a part of this proposal no response is provided.

9.1.4 Relevant Legislation

This chapter of the EIAR is prepared in accordance with the requirements of of the Environmental Impact Assessment legislation outlined in Chapter 1: Introduction

The requirements of the following legislation are also complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;

- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU (“**WFD**”). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);
- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the “Drinking Water Directive”) and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018)

9.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR is carried out in accordance with guidance oytlined in Chapter 1: Introduction the guidance contained in the following:

- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Scottish Natural Heritage (2010): Good Practice During Wind Farm Construction;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006).

9.2 Methodology

9.2.1 Desk Study

A desk study of the proposed development site, third party turbary lands and surrounding area was completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation of the following:

- Bord na Móna databases on peat depth and drainage;
- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway-Offaly). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland (2003) – Banagher Groundwater Body Initial Characterization Report, and Clara GWB Initial Characterization Report;
- OPW Indicative Flood Maps (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

9.2.2 Baseline Monitoring and Site Investigations

A hydrological walkover survey, including detailed drainage mapping and baseline monitoring/sampling, was undertaken by HES between the 5th and 9th April 2019, and again between 9th and 11th September 2019. HES staff have undertaken ~60-man hours of site work. Geotechnical ground investigations and a peat stability assessment were also undertaken by Fehily Timoney & Company (FT) during 2019. The combined geological and hydrogeological dataset collated by HES and FT has been used in the preparation of this EIAR Chapter.

In summary, all site investigations to address the Hydrology and Hydrogeology chapter of the EIAR included the following:

- Walkover surveys and hydrological mapping of the site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- A total of 319 peat probes were undertaken by FT & HES in 2019 to determine the thickness and geomorphology of the blanket peat overlying the site;
- A Geotechnical and Peat Stability Assessment was undertaken by FT (Dec 2019a);
- Trial pitting by FT across the site at 69 no. locations;
- A total of 41 no. gouge core sample points were undertaken by HES across the site to investigate peat and mineral soil lithology;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) and surface water flow measurements were taken to determine the origin and nature of surface water flows surrounding the site;
- A flood risk assessment for the proposed development has been undertaken by HES; and,
- A total of 20 no. surface water samples were taken to determine the baseline water quality of the primary surface waters originating from the proposed development site.

9.2.3 Impact Assessment Methodology

The guideline criteria (EPA, August 2017) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 9.2 are used to assess the potential effect that the proposed development may have on them.

Table 9.2 Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

9.3 Receiving Environment

9.3.1 Site Description and Topography

The Derrinlough Wind Farm site ("the site") which is a Bord na Móna peat bog is a combination of two bogs, Clongawny to the west and Drinagh to the east, split by the N62 which runs north-south. The site is located approximately 2km to the south of the village of Cloghan and 7km northeast of Birr in County Offaly. The total site area is approximately 2,360 ha (~23.67km^2).

The Bord na Móna Derrinlough Peat Briquette Factory is located between the two bogs, along the N62 on the eastern side of the road. This plant processes the peat from a number of bogs in the midlands into briquettes and consists of the factory and a number of ancillary buildings. A site compound (known as Clongawny Tea Centre) relating to the currently ceased peat harvesting works exists close to the main site entrance on the western bog site (Clongawny). The majority of the overall site comprises heavily drained cutover raised bog. A number of active industrial rail lines intersect Clongawny and

Drinagh bogs and these railways service the adjacent bogs and the Bord na Móna Derrinlough Peat Briquette Factory.

The topography of the development site is relatively flat with an elevation range of between approximately 53 and 62mOD (metres above Ordnance Datum). Along the majority of the site boundaries, a ~1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within the extraction areas of the overall bogs. There are some areas of higher ground at the centre and southwest of Clongawny bogs and these are covered with conifer forestry.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run north-south also, and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity.

A site location map is included as Figure 1.1.

9.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall recorded at the Banagher rainfall station, located ~4.5km west of the site are presented in Table 9.3.

Table 9.3 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Edenderry		200,400		216,000		37		1928		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
80	59	65	54	60	62	58	84	75	85	79	82	842

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Birr, approximately 10km south of the site. The long-term average PE for this station is 445mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 422mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

Effective rainfall (ER) = AAR – AE

= 842 mm/yr – 422mm/yr

ER = 420mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 18mm/year average annual recharge is given for basin peat in this area (recharge coefficient of ~4%). This means that the hydrology of the site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the site are estimated to be 17mm/yr and 403mm/yr respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the Derrinlough Wind Farm site are presented in Table 9.4

Table 9.4 Drinagh Return Period Rainfall depths (mm)

	Return Period (Years)			
Storm Duration	1	5	30	100
5 mins	3.8	6.6	13.9	17.1
15 mins	6.2	10.9	19.5	28.0
30 mins	7.8	12.3	22.9	32.0
1 hour	10	16.2	26.8	36.5
6 hours	18.6	27.2	40.4	51.5
12 hours	23.6	33.3	47.3	58.9
24 hours	30	40.6	55.5	67.3
2 days	37.1	48.6	63.9	75.8

9.3.3 Regional Hydrology

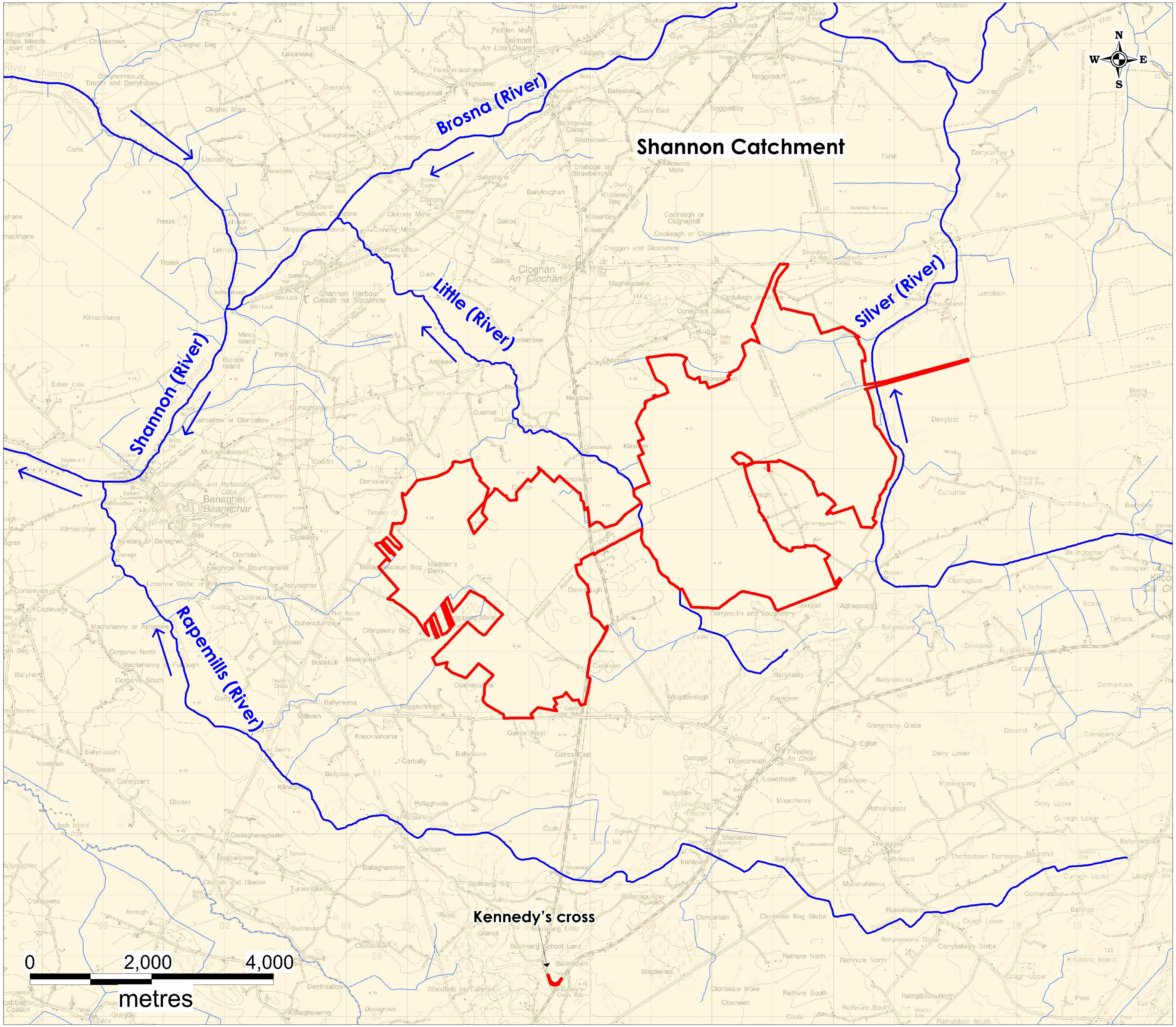
Regionally the proposed development site is located in the River Shannon surface water catchment (IE25_01) within Hydrometric Area 25 of the Shannon International River Basin District. A regional hydrology map is shown as Figure 9.1.

On a more local scale, the majority of the site is located in the Brosna river sub-catchment (Brosna_SC_080). The Little River flows in a northwesterly direction through the centre of the site and crosses the N62 ~1.5km north of the Derrinlough Briquette factory. The Little river discharges to the Brosna river at the confluence in the townland of Moytown Demense, ~5.5km northwest of the site. The Brosna then flows west, where it meets the River Shannon near Shannon Harbour.

The eastern side of the Drinagh bog is mapped within the Brosna_SC_070 sub-catchment. The Silver River flows north through this catchment, along the eastern boundary of the site. It flows north before joining the Brosna river ~3km southeast of Ferbane.

The western edge of the site, within the Clongawny bog, is drained by the Shannon lower sub-catchment (Shannon [Lower]_SC_040). A number of small tributaries flow west/southwest before joining the Rapemills river, which drains the sub-catchment. The Rapemills river then flows north for ~5.5km before entering the Shannon river just west of Banagher.

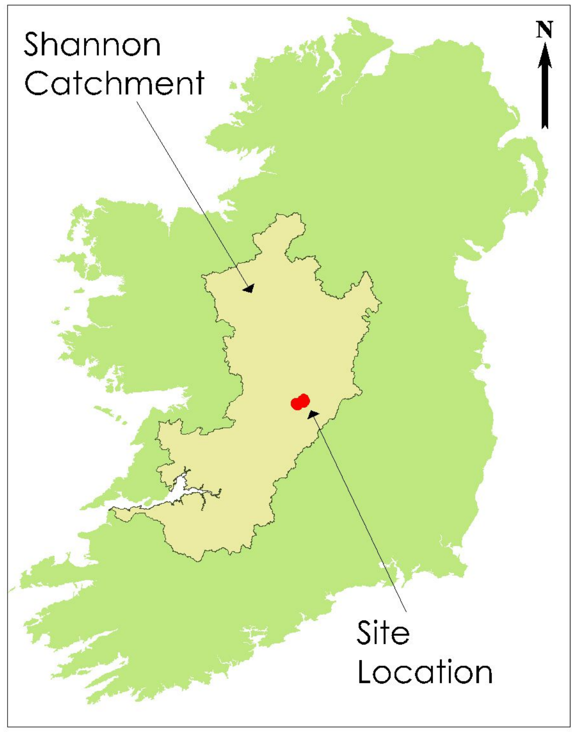
A local hydrology map is shown as Figure 9.2.



Legend

- EIAR Site Boundary
- Rivers
- Rivers / Streams
- Flow direction

Key Plan



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Client: Bord na Mona Powergen Ltd

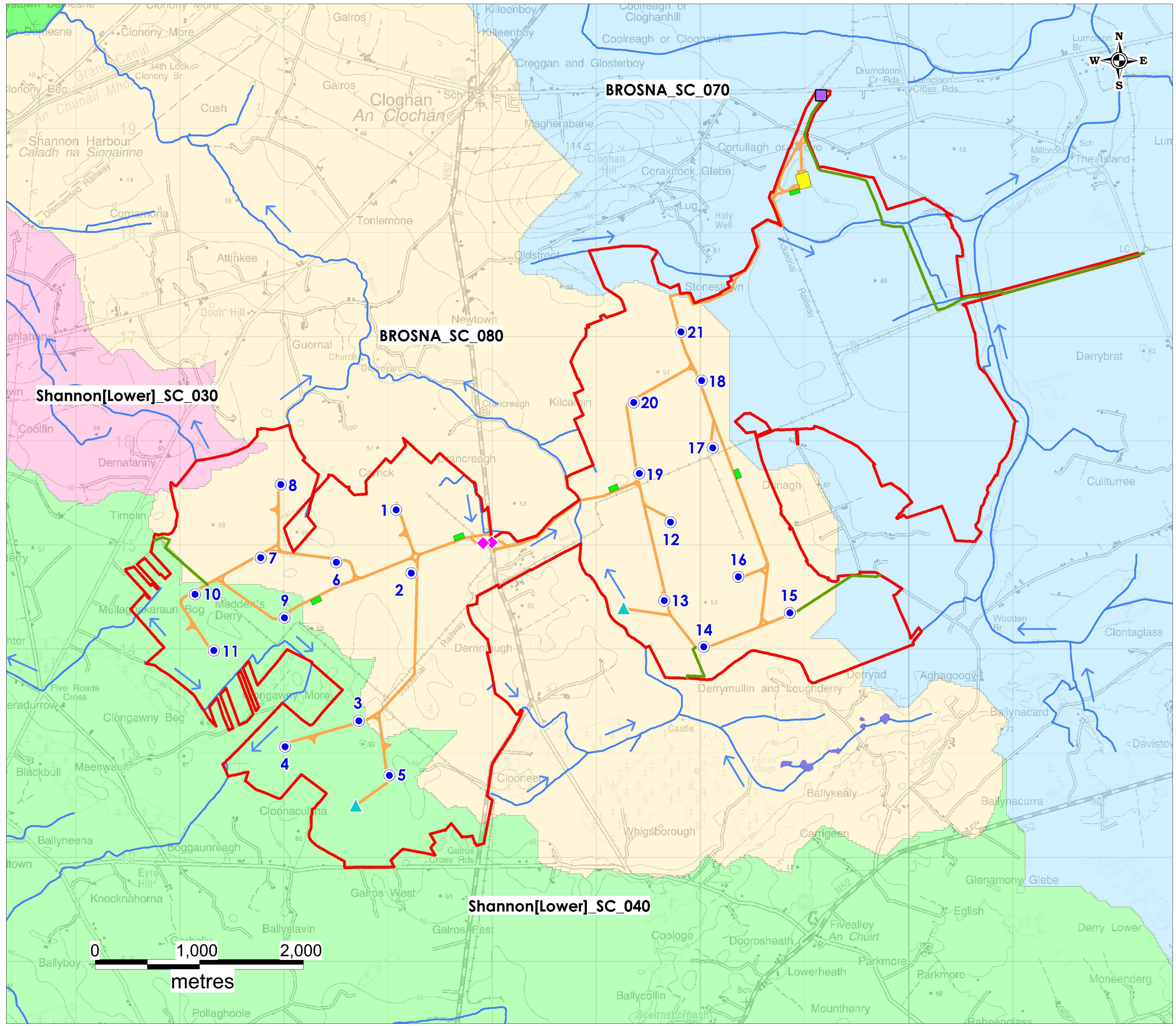
Job: Derrinlough WF, Co. Offaly

Title: Regional Hydrology Map

Figure No: 9.1

Drawing No: P1463-0-0220-A3-901-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:60,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Rivers
- Flow Direction

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Title: Local Hydrology Map

Figure No: 9.2

Drawing No: P1463-0-0220-A3-902-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

9.3.4 Site Drainage

In general, the overall site area comprising the two bogs is relatively flat. The topography ranges from ~53 – 62 mOD, with gentle slopes in some locations.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run north-south also, and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity.

An existing site drainage map is shown within Figure 9.3.

There are 3 no. pumping stations across the two bogs (P15/006, P15/007, and P15/008). These are identified on the site drainage map (Figure 9.3). Max discharge from the pumping stations are designed to be below greenfield runoff rates and are rated for removal of rainfall events equivalent to 15mm in 1 hour (approx. -5yr return period).

Surface water draining/pumped from the site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers (i.e. Little River and Silver river). A flow diagram of the existing drainage system is shown in Figure 9.4 below.

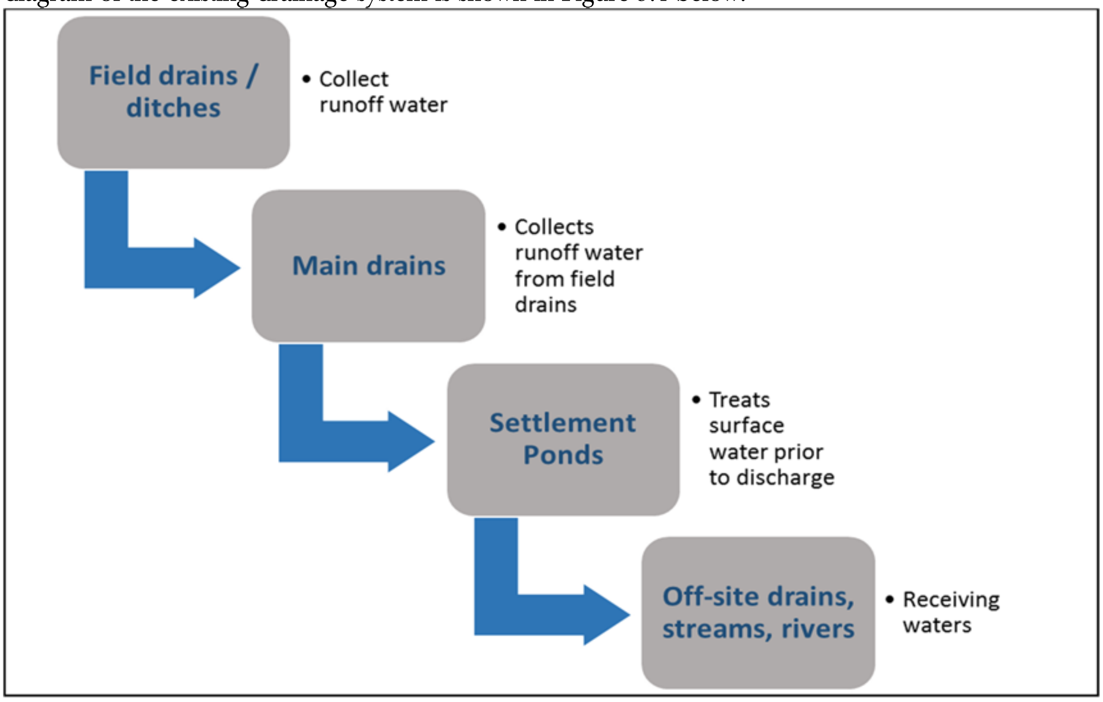
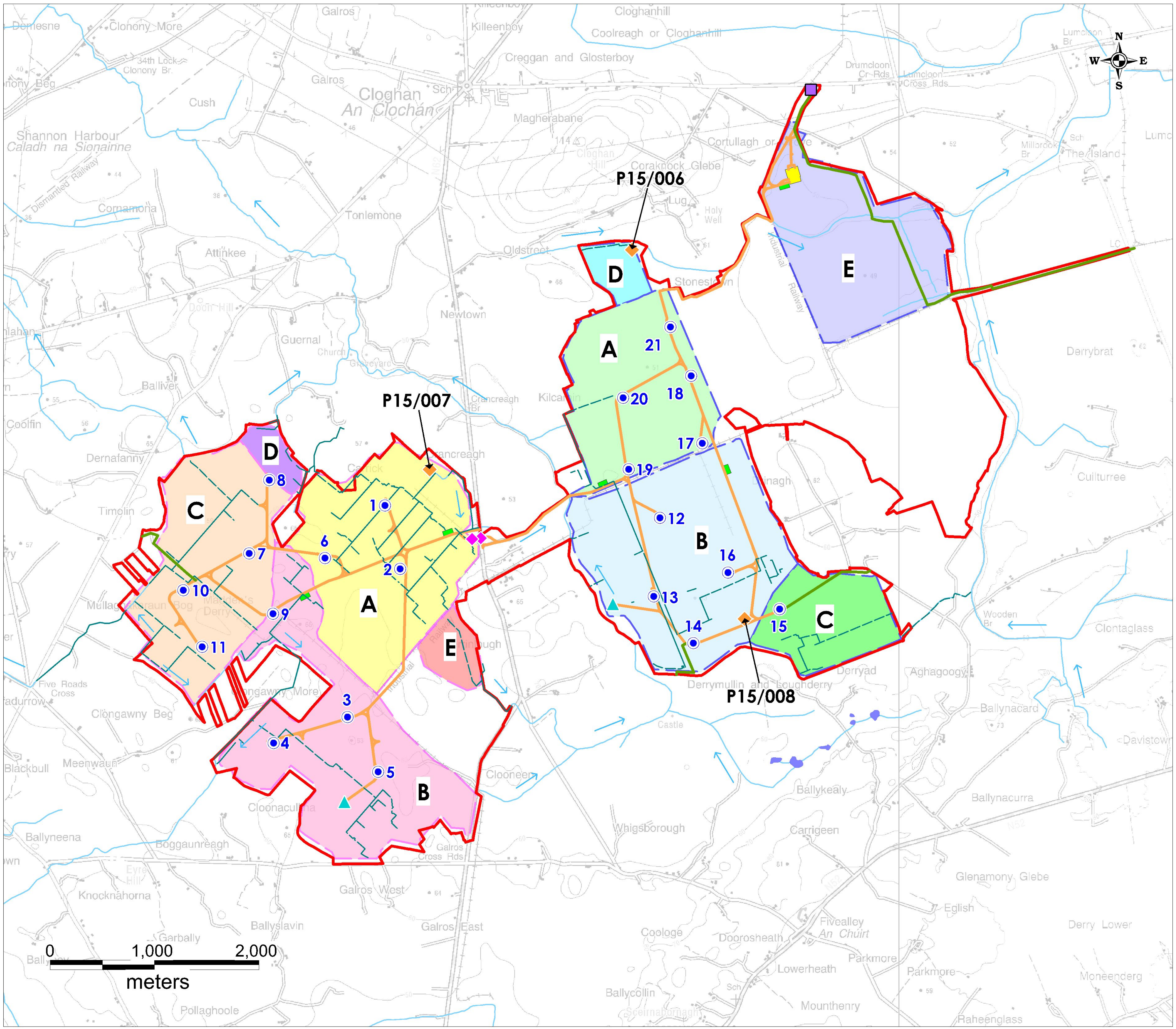


Figure 9.4: Process Flow Diagram for Existing Drainage System



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Pump Stations
- Piped drains
- Open drains
- Rivers/Streams
- River Flow Direction
- Lakes
- A-E Clongaway Bog Subcatchments
- A-E Drinagh Bog Subcatchments

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: SiteDrainage Map	
Figure No: 9.3	
Drawing No: P1463-0-0220-A3-903-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

9.3.5 Baseline assessment of site runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the proposed development site.

The rainfall depths used in this water balance, are long term averages, are not used in the design of the sustainable drainage system for the wind farm.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 9.5). It represents, therefore, the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the site pre-wind farm development. The surface water runoff co-efficient for the site is estimated to be 96% based on the predominant peat coverage (refer to Section 9.3.2).

The highest long-term average monthly rainfall recorded at Banagher over 30 years occurred in the month of December, at 82mm. The average monthly evapotranspiration for the synoptic station at Birr over the same period in December was 2.7mm. The water balance presented in Table 9.6 indicates that a conservative estimate of surface water runoff for the site during the highest rainfall month is 2,008,454m^3/month or 64,798m^3/day for the proposed development site.

Table 9.5: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.082
Average December Potential Evapotranspiration (PE)	-0.007
(AE = PE x 0.95)	-0.0067
Effective Rainfall December (ER = R - AE)	0.0887
Recharge (4% of ER)	0.0035
Runoff (96% of ER)	0.0851

Table 9.6: Baseline Runoff for the Site

Study Area	Approx. Area (ha)	Baseline Runoff per Wettest month (m^3)	Baseline Runoff per day (m^3) in wettest month
Development Site	2,360	2,008,454	64,789

9.3.6 Flood Risk Assessment

This section presents an overview of the flood risk assessment undertaken for the proposed development. The full flood risk assessment report for the proposed Derrinlough Wind Farm is provided as Appendix 9.1.

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie) and historical mapping (i.e. 6" and 25" base maps) were consulted.

No recurring flood incidents within the site boundary were identified from OPW's indicative river and coastal flood map - Refer to Plate 9.1.

Identifiable map text on local available historical 6" or 25" mapping for the study area do not identify any lands that are "liable to flood".

Much of the site is mapped as "Benefiting Lands". Benefiting lands are defined as a dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945, as amended) and indicating areas of land subject to flooding or poor drainage.

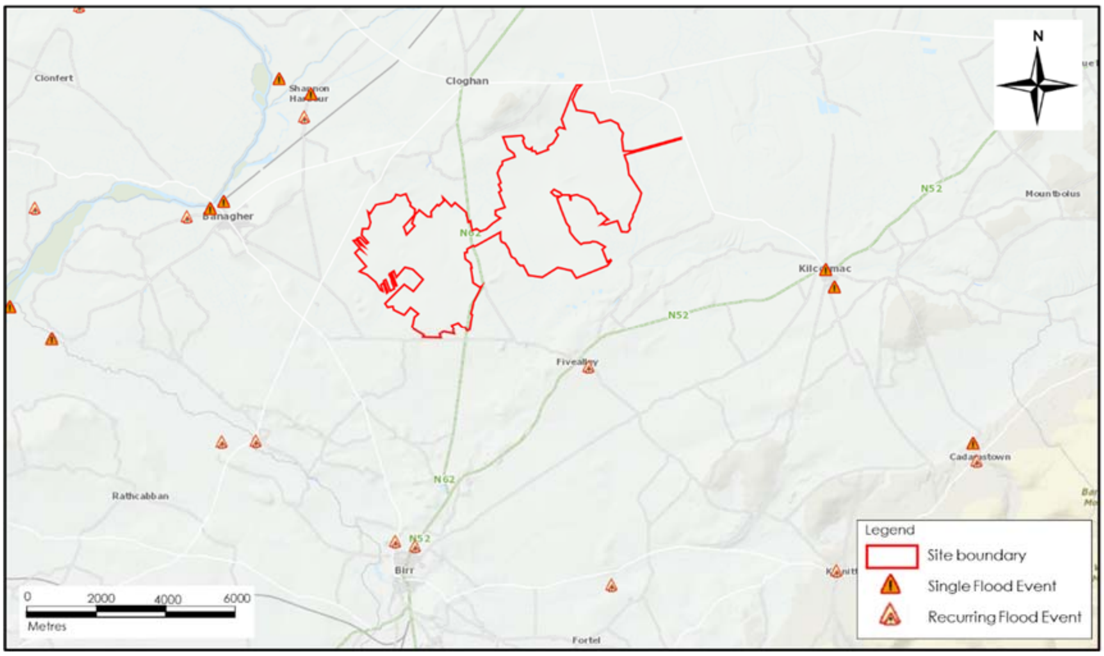


Plate 9.1: OPW's indicative river and coastal flood map.

The PFRA mapping (www.cfram.ie) shows the extents of the indicative 1 in 100-year flood zone which relates to fluvial (i.e. river) flood events (refer to Plate 9.2 below). The vast majority of the proposed development site is located outside of the 1 in 100-year flood zone (Flood Zone A) with the exception of a section on the north-eastern corner of the site and along the eastern and middle boundary of the proposed site. All proposed turbine locations and the access roads are outside of the fluvial indicative 1 in 100-year fluvial flood zone.

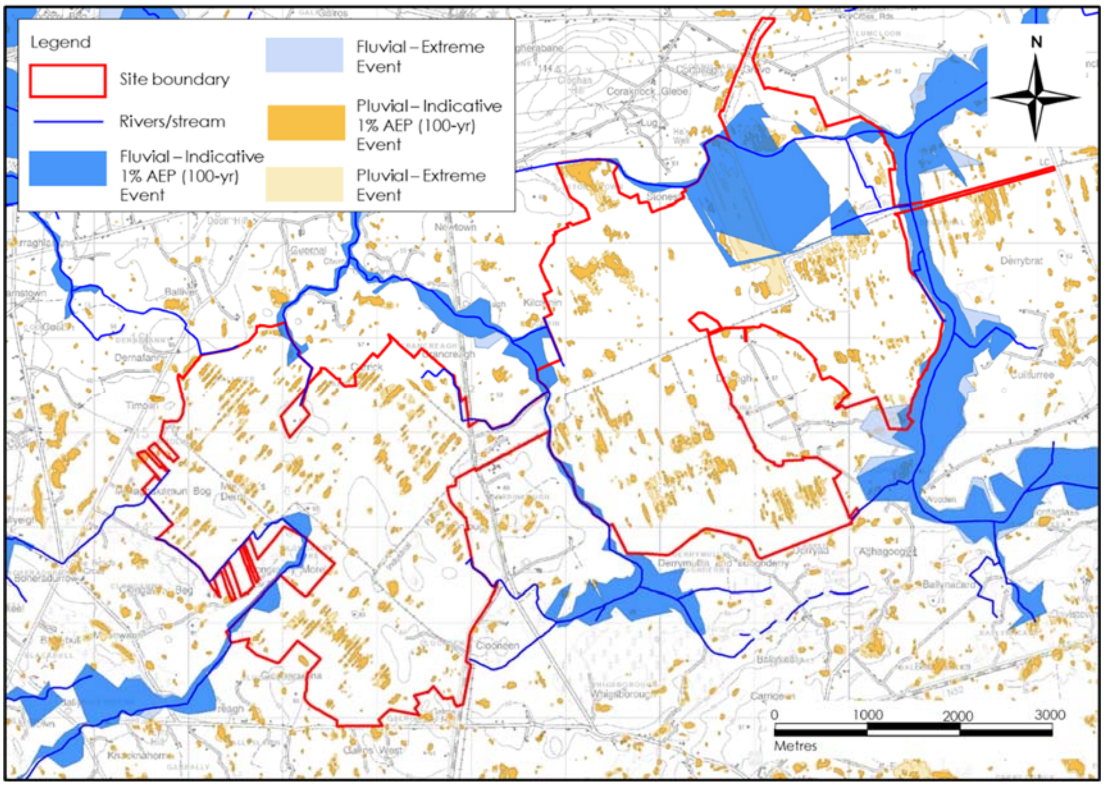


Plate 9.2: Local PFRA flood zone mapping

Also shown on the PFRA mapping is the indicative extent of pluvial flooding (i.e. flooding from rainfall ponding). As seen from Plate 9.2, pluvial flooding appears to occur along the main drainage channels within the site and this is as a result of surface water runoff backing up in the drainage routes when the capacity of the outfalls are exceeded.

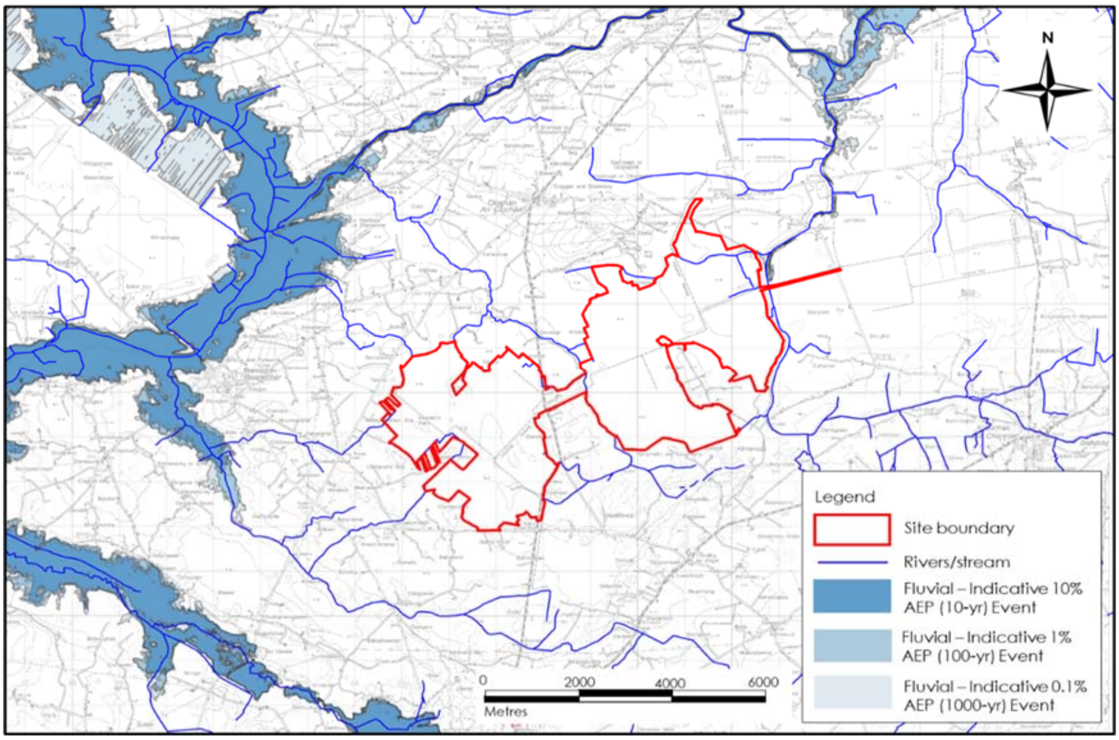


Plate 9.3: Local CFRAM flood zone mapping.

Where complete, the CFRAM OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. The proposed development site is not identified on the CFRAM flooding fluvial extent mapping, dated February 2015 as being located in either Flood Zone A or B. Therefore, according to CFRAMs the proposed development is located in Zone C, where the probability of flooding is low. This suggests that the site is suitable for the proposed development in terms of flood risk. The fluvial flood zones areas indicated on the CFRAM mapping are shown on Plate 9.3 above.

9.3.7 Surface Water Quality

Biological Q-rating data for EPA monitoring points on the Silver, Little and Rapemills rivers are shown in Table 9.7 below. Most recent data available (2004 to present) show that the Q-rating for the rivers range from 'Poor' to 'High' in the vicinity of the proposed development site.

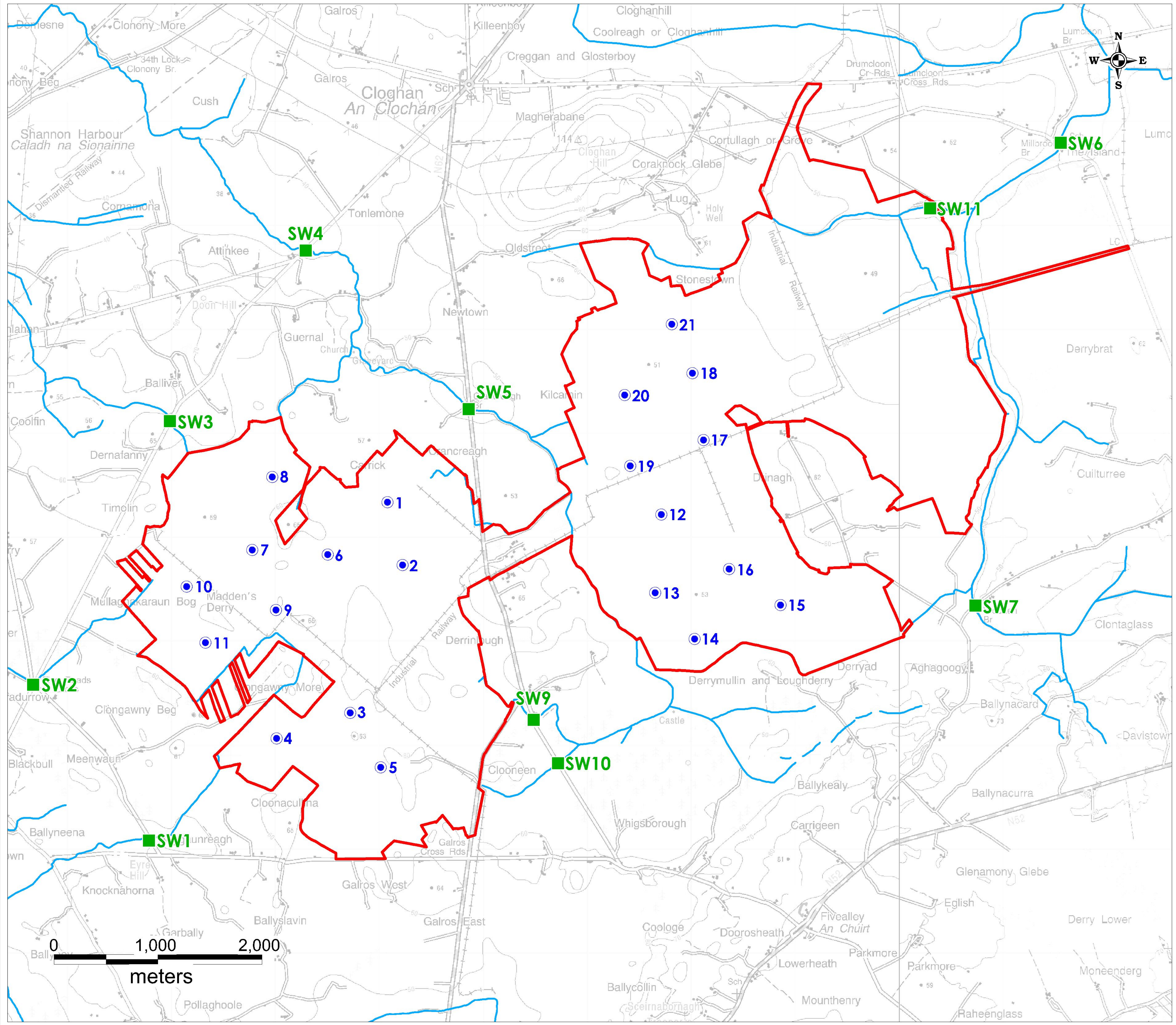
Table 9.7:EPA Water Quality Monitoring Q-Rating Values

Waterbody	Station ID	Easting	Northing	EPA Q-Rating Status
Silver River	RS25S020500	612676	714379	Q4 (Good)
Silver River	RS25S020600	613488	718807	Q4 (Good)
Little River	RS25L010100	607879	716251	Q2-3 (Poor)
Little River	RS25L010200	606245	717799	Q4-5 (High)
Little River	RS25L010400	604145	719835	Q4-5 (High)
Rapemills River	RS25R010300	604767	710225	Q3-4 (Moderate)

Field hydrochemistry measurements of electrical conductivity (µS/cm), pH (pH units), dissolved oxygen (mg/l) and temperature (°C) were taken within surface watercourses downstream of the proposed development (refer to Figure 9.5 for locations). The results are listed (along with estimated flows) in Table 9.8 and Table 9.9. The monitoring locations were typically small streams/rivers which drain towards the larger Shannon river to the north/northwest of the site.

Electrical conductivity (EC) values at the monitoring location ranged between 435 and 697µS/cm. This indicates that a considerable quantity of groundwater is mixing with the surface water runoff from the surface of Clongawny/Drinagh bogs. The source of the groundwater is most likely to be from the mineral subsoils that underlie the peat in this area. The mineral subsoils are likely to have become more exposed in places as a result of peat cutting and installation of drainage channels that extend below the peat layer and into the mineral soil.

The pH values were generally slightly basic, ranging between 7.46 and 8.27. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat. However, the pH is likely higher due to the high temperatures and dry weather which preceded the monitoring.



Legend
EIAR Site Boundary
Proposed Turbine Location
Surface Water Sampling Locations
Rivers/Streams

Note:
Please note there is no sampling point 8.

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Surface Water Sampling Location Map	
Figure No: 9.5	
Drawing No: P1463-0-0220-A3-905-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

Table 9.8: Field Parameters - Summary of Surface Water Chemistry Measurements (03/04/2019)

Location ID	Easting	Northing	Temp °C	DO (mg/l)	EC (µS/cm)	pH	Flow (L/s)
SW1	604732	712118	7.4	10.58	624	7.9	200
SW2	603617	713616	7.4	8.96	449.9	7.75	20
SW3	604934	716153	8.7	10.59	527	7.46	-
SW4	606240	717795	8.5	11.75	679	8.19	240
SW5	607806	716268	9.6	8.61	645	7.97	400
SW6	613504	718833	7.3	11.2	653	8.08	1800
SW7	612682	714379	7.5	11.46	678	8.14	450
SW9	608433	713279	7.5	9.53	611	7.68	20
SW10	608669	712861	7.5	11.17	697	8.05	20
SW11	612248	718202	7.3	11.05	554	8.05	120

Table 9.9: Field Parameters - Summary of Surface Water Chemistry Measurements (09/04/2019)

Location ID	Easting	Northing	Temp °C	DO (mg/l)	EC (µS/cm)	pH	Flow (l/s)
SW1	604732	712118	12.2	9.44	596	7.92	150
SW2	603617	713616	11.1	8.39	435.5	8.04	20
SW3	604934	716153	10.4	10.99	537	7.53	10
SW4	606240	717795	11.0	11.6	661	8.27	200
SW5	607806	716268	10.7	9.52	630	7.79	400
SW6	613504	718833	10.2	11.03	638	8.05	1500
SW7	612682	714379	10.3	11.27	653	7.99	500
SW9	608433	713279	11.2	8.57	609	7.63	25
SW10	608669	712861	11.5	10.12	678	8.07	20
SW11	612248	718202	10.3	10.63	546	7.95	100

Surface water samples were also taken at these points for laboratory analysis. Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 9.10 and Table 9.11 below. In addition, the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009) (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) are shown in Table 9.12. Original laboratory reports are attached as Appendix 9.2.

Table 9.10: Analytical Results of HES Surface Water Samples (03/04/2019)

Parameter	EQS	Sample ID									
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW9	SW10	SW11
Total Suspended Solids (mg/L)	≤25(+)	<5	<5	<5	<5	<5	6	<5	<5	<5	12
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.39	0.53	0.02	0.03	0.14	0.04	0.02	0.25	0.03	0.03
Nitrite NO_2 (mg/L)		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen (mg/L)	-	14.5	<5.0	12.8	14.3	20.2	20.8	31.8	12.9	17.6	20.4
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	20.6	21.3	35.3	29	30	21.6	21.3	30.3	37.5	21.1
BOD	≤ 1.3 to ≤ 1.5(*)	<2	<2	<2	<2	2	<2	<2	<2	<2	<2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9.11: Analytical Results of HES Surface Water Samples (09/04/2019)

Parameter	EQS	Sample ID									
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW9	SW10	SW11
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5	<5	<5	<5	<5	6	<5	<5
Ammonia (mg/L)	-≤0.065 to ≤ 0.04(*)	0.38	0.33	0.03	0.13	0.14	0.03	0.04	0.21	0.04	0.04
Nitrite NO_2 (mg/L)		0.12	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	-≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen (mg/L)	-	0.12	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	22	22.3	37.9	35.5	30.1	22.4	22.1	33	39.6	22.2
BOD	≤ 1.3 to ≤ 1.5(*)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Total suspended solids ranged between <5 and 6mg/l. All results were therefore below the limits for both Salmonid and Cyprinid waters.

Ammonia N ranged between 0.02 and 0.53 mg/l, which is generally above the limits for both Salmonid waters and Cyprinid waters. SW1, SW2, SW5 and SW9 were above the limits during both sampling events, while SW4 was elevated on 09th April 2019. The remaining samples were at or below 0.04 mg/l. The presence of elevated ammonia is likely due to natural decomposition of peat.

BOD was less than 2mg/l in all samples, which is below the limits for both Salmonid and Cyprinid waters.

Nitrite ranged between <0.002 and 0.061mg/l and results were typically low which is what would be expected in a peatland environment. In comparison to the Water Framework Directive (2000/60/EC) limits for Salmonid and Cyprinid waters, there were four and one exceedances, respectively.

Nitrate ranged between <5.0 and 31.8 mg/l and results were typically between 10-20 mg/l which is what would be expected in a peatland environment.

In comparison to S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) , 9 of 20 results for ammonia N exceeded both the "Good Status" and "High Status" threshold values.

In relation to ortho-phosphate, all samples were at least within the "High Status" with values of <0.02.

*Table 9.12: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Orthophosphate	High status ≤0.025 (mean)
	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)

* S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

9.3.8 Hydrogeology

The Waulsortian limestones which are mapped to underlie the proposed development site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). The limestone bedrock in the area of the proposed development is covered by a substantial thickness of lacustrine and glacial deposits which in turn is overlain by cutaway/cutover peat. The glacial deposits will likely provide the dominant potential pathway for groundwater movement in the proposed development site especially where permeable tills or sands and gravels are present under peat and lacustrine deposits.

Groundwater vulnerability is mapped by the GSI as medium. Groundwater recharge is classified as low with a recharge coefficient of 4% mapped at the site.

Due to the presence of the overlying peat (which results in minimal recharge) and the bulk low permeability of the underlying lacustrine deposits, groundwater movement through the glacial deposits will be relatively slow unless higher permeability sands and gravels are present. Recharge is likely to be limited to the perimeter of the development site where the peat is thin or absent (the presence of peat will prevent rapid recharge to underlying regional groundwater systems). Based on topography and regional surface water drainage flows groundwater flow direction towards the east of the site is likely to be towards the Silver River, while the east of Clongawny bog and west of Drinagh bog likely drains towards the Little River, while the west of Clongawny bog likely drains towards the Rapemills River. A low groundwater gradient is expected.

There is a shallow water table in the peat layer across the site. This is perched and largely isolated from the underlying regional groundwater system (which occurs in underlying till and bedrock).

9.3.9 Groundwater Vulnerability

The vulnerability rating of the bedrock aquifer underlying site is classified as “Moderate” and this is consistent with the presence of basin peat underlain by a substantial depth of lacustrine SILT/CLAY and glacial deposits.

This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies, such as drains and streams, are more vulnerable than groundwater at this site.

9.3.10 Groundwater Hydrochemistry

There is no groundwater quality data for the proposed wind farm site and groundwater sampling would generally not be undertaken for this type of development, as groundwater quality impacts would not be anticipated given the low potential for groundwater dispersion and movement within the aquifer as outlined in the preceding section.

Based on data from GSI on the Clara GWB, groundwaters in this area are typically very hard with a calcium-bicarbonate signature. Hardness generally ranges from 380 – 450 mg/l as $CaCO_3$, with high electrical conductivities (650 – 800 μ S/cm).

9.3.11 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2018 - 2021) objectives, which have been integrated into the design of the proposed wind farm development, include the following:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration and maintain a ‘high’ status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2021;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that surface waters, regardless of whether they have ‘Poor’ or ‘High’ status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

Strict mitigation measures (refer to Section 9.5.3 and 9.5.4) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

9.3.12 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for download from (www.wfdireland.ie)

The Clara GWB (IE_SE_G_116) underlies most of the development site. This GWB is assigned ‘Good Status’, which is defined based on the quantitative status and chemical status of the GWB. The Banagher GWB (IE_SH_G_040) underlies the extreme west of the site and is also assigned ‘Good Status’.

9.3.13 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in which development is proposed (or immediately upstream of) are shown in Table 9.13 below.

The eastern section of the site is drained by the Silver River (IE_SH_25S020700) which achieved 'moderate' status under the WFD 2013-2018. The centre of the site is drained by the River Little (Cloghan) (IE_SH_25L010400) which achieved 'good' status. Both of these rivers flow generally north and discharge to the River Brosna (IE_SH_25B091200) which also achieved 'moderate' status. The Rapemills River which flows west of the site, in a northerly direction towards Banagher has not been assigned a status under the WFD.

Table 9.13: Summary WFD Information for Surface Water Bodies

SWB Code	Water Body	General Physico-Chemical Status	Fish status	Overall Status
IE_SH_25L010400	Little (Cloghan)	Good	Moderate	Moderate
IE_SH_25S020700	Silver	Pass	Moderate	Moderate
IE_SH_25B091200	Brosna	Pass	N/A	Good

9.3.14 Designated Sites and Habitats

Within the Republic of Ireland designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs), candidate Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). Designated sites within the same surface water catchments as the proposed development site are listed below:

- Lough Coura pNHA (Site Code: 000909), directly south of proposed development site boundary;
- All Saints bog and esker SAC (Site Code: 000566) exists ~3.1km southwest of the proposed development site;
- All Saints bog SPA (Site Code: 004103) exists ~3.1km southwest of the proposed development site;
- Ridge Road, SW of Rapemills SAC (Site Code: 000919), 3.4km south-west of proposed development site;
- River Shannon Callows SAC (Site Code: 000216) exists ~2.3km northwest of the proposed development site this area is also listed as the Middle Shannon NHA; and,
- River Little Brosna Callows SPA (Site Code: 004086) is located ~5km southwest of the proposed site, as well as the River Little Brosna Callows NHA (Site Code: 000564), the SPA boundary also encompasses the area of the All Saints bog and esker.

The proposed development site is indirectly connected via surface water (hydrologically) to the River Shannon Callows SAC/Middle Shannon SPA, through the tributaries of the Shannon which flow north/northwest from the site (Silver, Little and Rapemills Rivers). There is no direct hydrological (surface water) connection to the All Saints bog and esker SAC as a hydraulic boundary exists between the proposed site and the SAC (i.e. the barrier is the River Rapemills). There is no direct hydrological connection to the Ridge Road SW of Rapemills SAC as a hydraulic boundary exists between the proposed site and the SAC (i.e. the barrier is the River Rapemills). There is also no direct hydrological connection to River Little Brosna Callows SPA / River Little Brosna Callows NHA as a hydraulic boundary exists between the proposed site and the SAC (River Rapemills). A summary of potential hydrological pathways (surface water connections) and hydrogeological pathways (groundwater connections) is included below as Table 9.14.

Designated sites in proximity to the proposed development site are listed below and shown on Figure 9.6. Other sites, outside of those listed above are considered to be remote from the proposed development, and as such due to physical and hydrological/hydrogeological separation cannot be affected (from a water perspective) by the proposed development. An impact assessment of these remaining listed sites is completed below at Section 9.5.3.8.

Table 9.14: Relative distances and connectivity to designated sites

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
Lough Coura pNHA	<1 km, and 320m from T14	No direct connection. Indirect connections exist via surface water (tributaries to Little River).	Groundwater connectivity will be limited due to; 1) significant separation exists to infrastructure development locations; 2) baseline conditions between pNHA and development locations is highly modified already (by drainage and forestry, and presence of N62 roads, and associated drainage); 3) differences in elevation, and 4) shallow depth of proposed works; 5) Groundwater flow is also likely to be towards the northwest in line with local surface water drainage systems; and, 6) the presence of the Little River to the east acting as a hydraulic boundary.
All Saints bog and Esker SAC / All Saints Bog SPA	~3.1km as crow flies	No direct connection. Indirect connections exist via surface water flows (tributaries to Rapemills river, and Rapemills river).	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate rivers acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.
Ridge Road, SW of Rapemills SAC	~3.43km at nearest point	No direct connection. Indirect connections exist via surface water flows (tributaries to Rapemills river, and Rapemills river).	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate river acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.
River Shannon Callows SAC / Middle Shannon Callows SPA	~2.3km to west along river channel	No direct connection.	Likely, but significant distance between the proposed development site and SAC/SPA, as well as presence

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
	~7.65km to northwest along river channel	Indirect connections exist via surface water (Little River, Island River, Brosna River, and tributaries to Rapemills river, and Rapemills river).	of several local streams and major rivers (groundwater likely to discharge to Little river, Island River, and Brosna River before reaching the River Shannon).
River Little Brosna Callows SPA / River Little Brosna Callows NHA	~5.5km to southwest as crow flies	No direct connection. No indirect connections exist via surface water.	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate rivers acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.

9.3.15 Water Resources

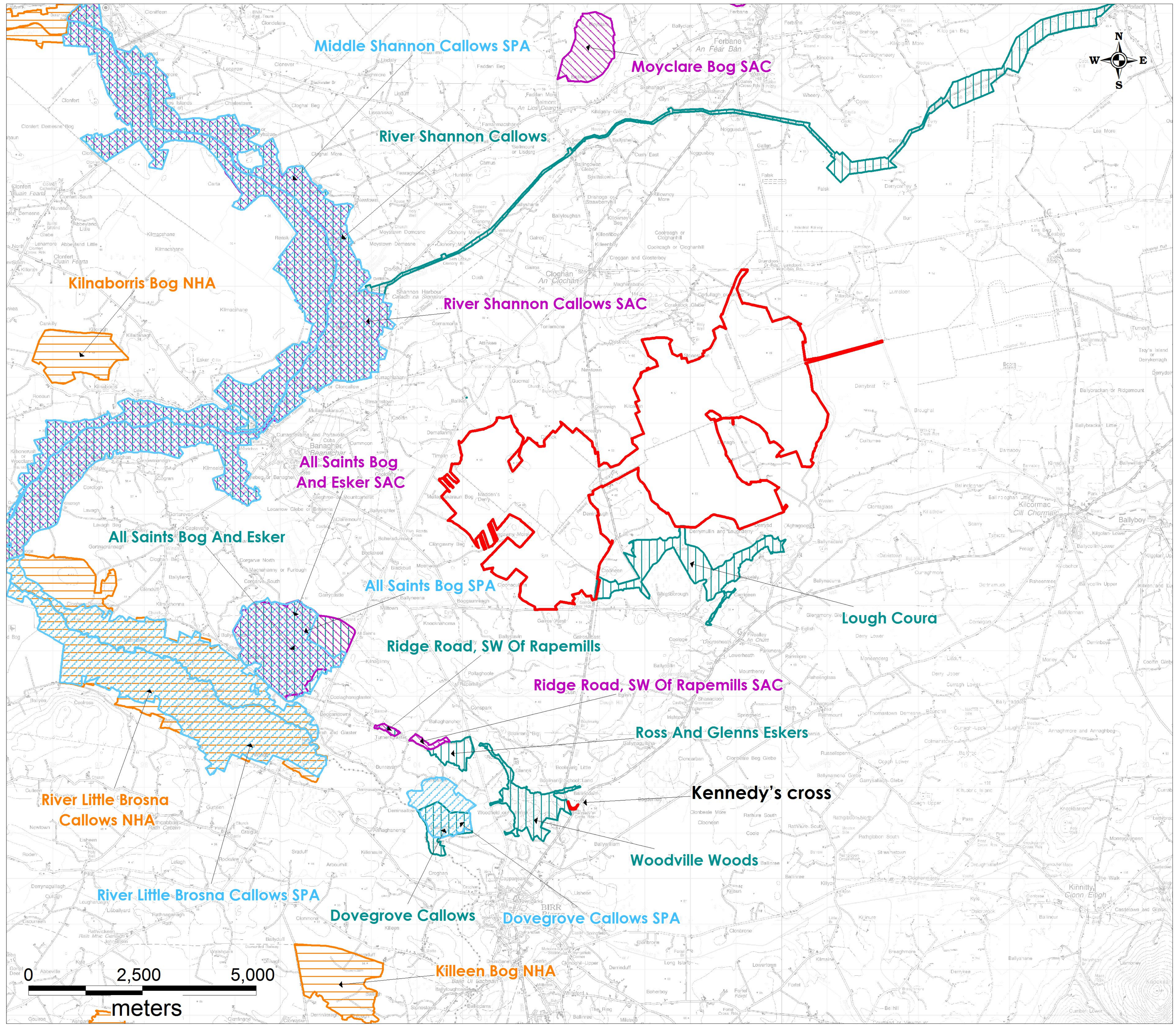
There is 1 no. mapped PWS (Banagher Public Water Supply Scheme) within 3 km of the site. The Banagher PWS is located west of the site, approximately 2 km southeast of Banagher. The mapped source protection zone for this GWS does not fall within the proposed development site boundary.

A search of private well locations (wells with location accuracy of 1–50m were only sought) was undertaken using the GSI well database (www.gsi.ie). 2 no. wells with an accuracy of 1–50m were mapped in the area of the proposed development site, which were mapped as belonging to Bord na Móna and Erin Peat, and are assumed to be water sources used in the production and manufacturing of the peat products. All the wells mapped in the area surrounding the site are mapped only to an accuracy of 1km and therefore assessing potential impacts on these wells cannot be undertaken in any reliable manner.

To overcome the poor accuracy problem of other GSI mapped wells (>50m accuracy) it is conservatively assumed (for the purpose of assessment only) that every private dwelling in the area (shown on Figure 9.7) has a well supply and this impact assessment approach is described further below. (Please note wells may or may not exist at each property, but our conservative rationale here is that it is better to assume a well may exist at each downgradient property and assess the potential impacts from the proposed development on such assumed wells, rather than make no assessment and find out later that groundwater wells do actually exist).

9.3.16 Receptor Sensitivity

Due to the nature of wind farm developments, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages, potential piling works, and construction of the proposed underpasses. These potential significant effects are assessed in Sections 9.5.3 and 9.5.4. Some of these are common potential impacts on all construction sites (such as road works and industrial sites).



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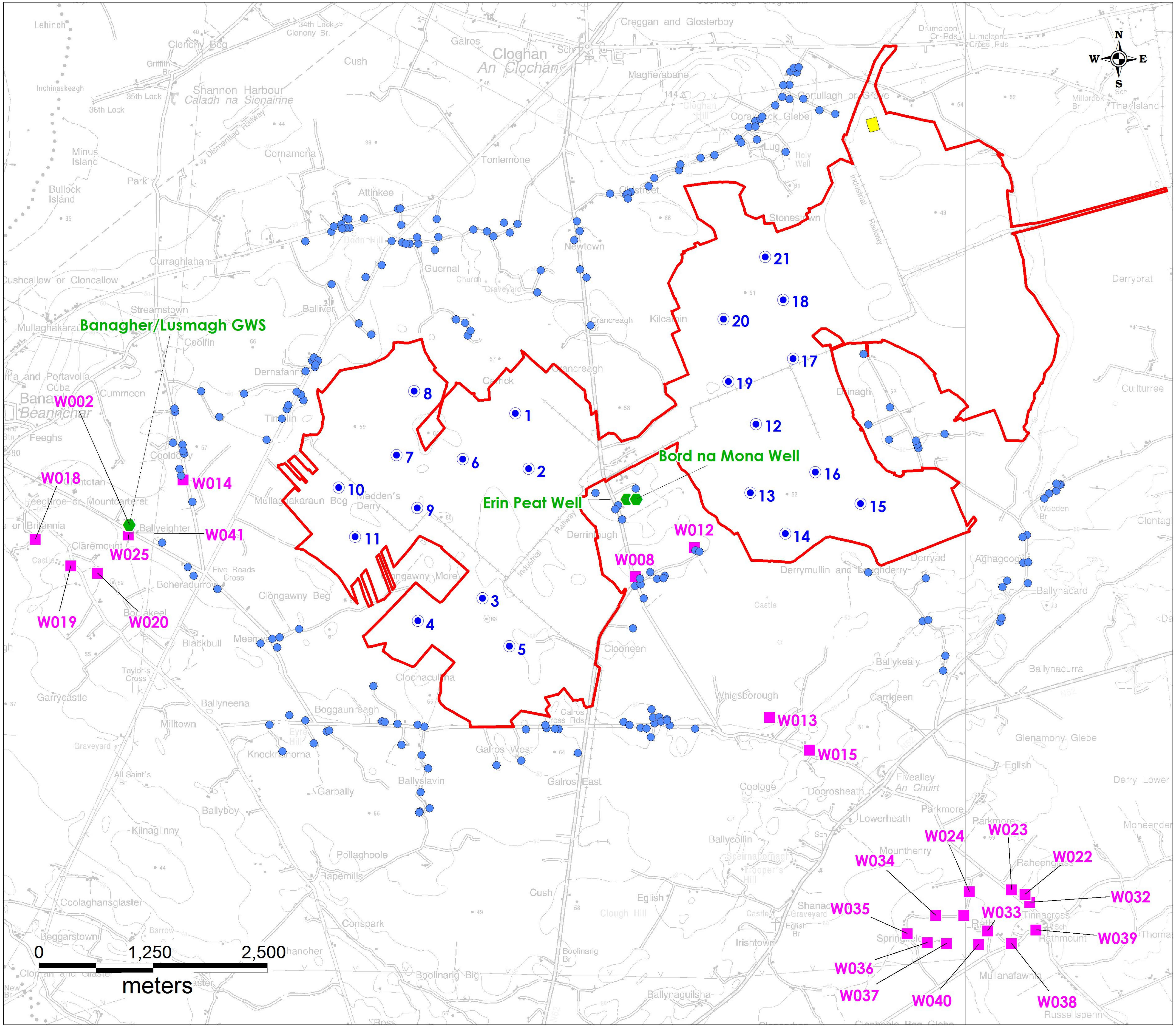
Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Designated Sites Map	
Figure No: 9.6	
Drawing No: P1463-0-0220-A3-906-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:80,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Substation
- Private Dwelling Locations
- GSi Mapped Wells
- Well Locations

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Client: Bord na Mona Powergen Ltd

Job: Derrinlough, Co. Offaly

Title: Local Well Locations Map

Figure No: 9.7

Drawing No: P1463-0-0220-A3-907-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:40,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

All potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below (Sections 9.5.3 and 9.5.4) to deal with these potential impacts.

Based on criteria set out in Table 9.2 above, the Locally Important Aquifer can be classed as Sensitive to pollution. The majority of the site, however, is covered in cutover peat which in turn is underlain by silt dominated glacial deposits and these layers act as a protective cover to the underlying bedrock aquifer. The glacial deposits are not mapped as an aquifer, but they are likely to be used locally as a water supply and therefore they can also be classed as Sensitive to pollution. However, due to the presence of the peat and silt/clay layers (which have low permeability and act as a barrier to infiltration), any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing drainage regime (refer to Section 9.5.4.1) thereby avoiding changes to flow volumes leaving the site via the existing outfalls.

9.4 Characteristics of the Proposed Development

The development comprises 21 no. wind turbines, 2 no. anemometry masts, new and upgraded site access roads, 2 no. permanent underpasses, a substation and associated connection to the national grid, temporary construction compounds. A full description of the proposed development is included in Chapter 4 of this EIAR.

9.4.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the proposed development. The first method involves ‘keeping clean water clean’ by avoiding disturbance to existing drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing drainage network. There will be no direct discharges to the existing drains.

During the construction phase, all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Plate 9.4 below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in Appendix 4.5 of the EIAR.

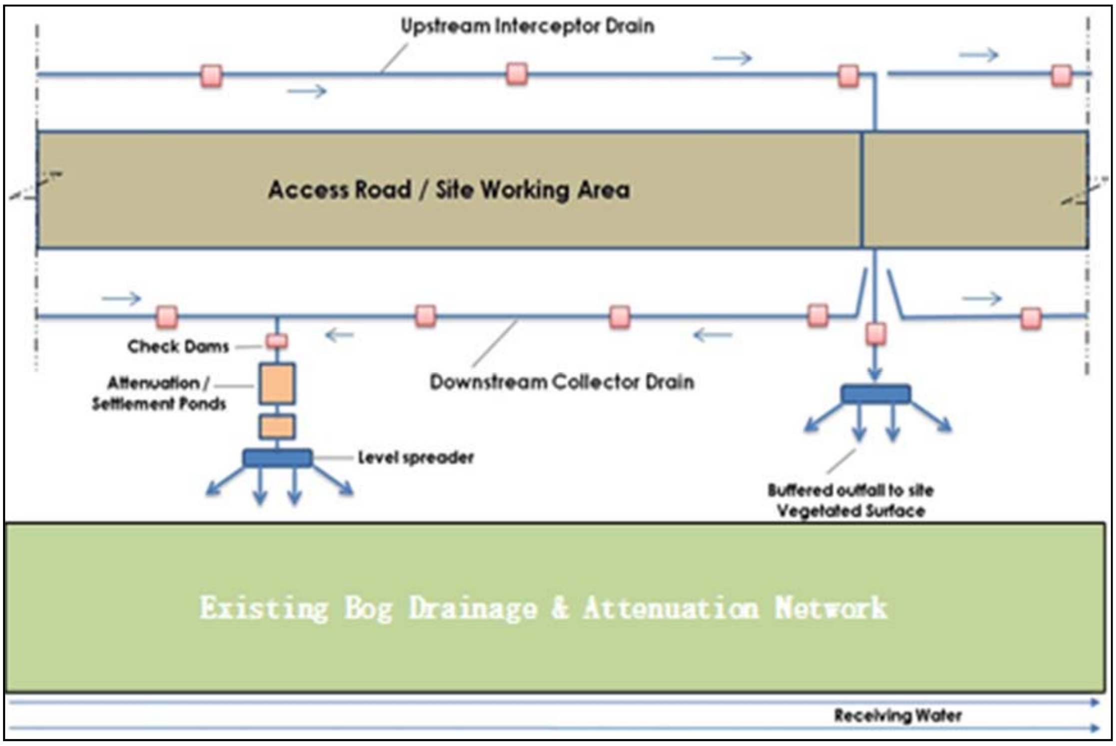


Plate 9.4: Schematic of Proposed Site Drainage Management

9.4.2 Development Interaction with the Existing Bog Drainage Network

The proposed wind farm drainage will not significantly alter the existing drainage regime at the site. Moreover, the proposed drainage system will be fully integrated into the existing bog drainage systems.

Existing field drains and main drains will be routed under/around access tracks using culverts as required.

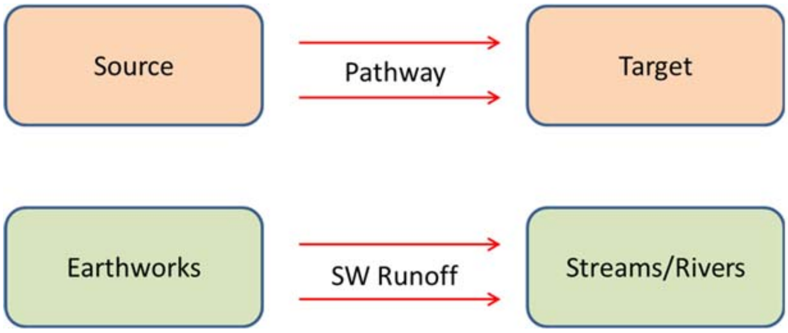
Runoff from access tracks, turbine bases, and developed areas (construction compounds, sub-stations, met masts) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing peat field drains. From there this water will flow towards the relevant bog site boundaries in existing field drains and main drains, and then be treated further in the existing main (bog) settlement ponds prior to discharge from the proposed development site.

One of the proposed ecological aspects of the drainage design is to re-wet the site in small areas, where possible, to create wet areas as such wetland features which are good for overall site biodiversity. Ponding would occur in these areas to a very shallow depth, and only intermittently following heavy rainfall. No large open bodies of water are proposed, and where intermittent ponding occurs this will be broken up into small areas using peat berms.

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed wind farm development.



As outlined previously, where potential impacts are identified, the classification of impacts in the assessment follows the descriptors set out in the Glossary of effects (EPA, 2017) as outlined in Chapter 1 of this EIAR.

The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5.3 and 9.5.4), we have presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (Table 9.15). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all wind farm construction and operation and decommissioning activities.

Table 9.15: Impact Assessment Process Steps

Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which potential impacts are generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by (engineering) design.
Step 6	Post-Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

9.5.2 Do -Nothing Scenario

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The hydrology of the site would remain as it is described in the baseline characterisation. The rail lines that supply peat to Derrinlough Briquette Factory from other bogs adjacent to the proposed wind farm, will continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases in the Boora Bog Group, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

9.5.3 Construction Phase - Likely Significant Effects and Mitigation Measures

9.5.3.1 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road construction, turbine base/hardstanding construction, construction compound construction, met mast construction, underpass construction, substation construction, cable route excavations, amenity paths construction (also refer to Section 9.5.3.10), turbine delivery route accommodation works, grid connection works (under and overground), entrance locations and amenity car park will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. Potential sources of sediment-laden water include:

- Drainage and seepage water resulting from excavations;
- Stockpiled excavated material providing a point source of exposed sediment; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream of the site could be significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers and associated dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, medium probability effect.

Proposed Mitigation by Avoidance:

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains). All of the key proposed development areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively. The proposed buffer zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and associated release of sediment;
- Avoid excavations within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid 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.

In addition, and as outlined above the wind farm drainage system will link into the existing bog drainage system, and discharge from each of the bog sites via existing large settlement ponds, which are some distance from the proposed development footprint. As such, there is significant distance for wind farm related surface water to travel before it actually reaches the edge of the bogs and joins any receiving waters outside of the overall bog boundaries (Clongawny and Drinagh bogs).

Proposed Mitigation by Design:

Presented below are temporary and long-term drainage control measures that will be utilised during the construction phase of the wind farm. As stated above there is an existing drainage network at the site which comprises field drains, main drains and perimeter settlement ponds. The measures outlined below will be used in conjunction with the existing drainage network to ensure protection of all rivers and streams downstream of the proposed development site.

Source controls:

- Interceptor drains, vee-drains, diversion drains.
- Small working areas, covering temporary stockpiles, weathering off of side-cast peat/spoil, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls:

- Interceptor drains, vee-drains, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriates systems.

Treatment systems:

- 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.

There is an extensive network of drains already existing at the site, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The key elements being the upgrading and improvements to water treatment elements, such as in-line controls and treatment systems, including silt traps and settlement ponds.

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 where possible. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Temporary silt traps will be placed in the existing drains downstream of construction works, 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 directly into the existing drain network but discharged locally at each turbine location through field drains, main drains, and existing settlement ponds;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across the bog surface and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site;
- Velocity and silt control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works; and,

- Existing culverts will be lengthened where necessary to facilitate access road widening.

Water Treatment Train

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 will apply for all of the construction phase.

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 the existing drainage network 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.

Silt Bags:

Silt bags will be used where small to medium volumes of water need to be pumped from excavations (e.g. the proposed underpass locations). As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

Pre-emptive Site Drainage Management:

The works programme for the construction stage of the development will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy 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/weekly basis, as required, to allow site staff to direct proposed and planned construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Éireann 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;
- MeteoAlarm: 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 Éireann 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 Éireann 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 planned works to be safely executed (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Earthworks should be suspended if forecasting suggests any 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 earthworks being suspended the following control measures should be completed:

- Secure all open peat/spoil 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.

Management of Runoff from Peat and Subsoil Storage Areas:

It is proposed that excavated peat will be used for landscaping close to its original extraction point. During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas as required. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Timing of Site Construction Works:

Construction of the site 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 operational for all subsequent construction works.

Proposed Drainage and Water Quality Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works and will be included in the CEMP. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing (visual, supplemented with pH, electrical conductivity, temperature, dissolved oxygen and turbidity monitoring), sampling and laboratory analysis of a range of parameters[1] with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based).

Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, low probability effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

[1] *example suite: pH (field measured), Electrical Conductivity (field measured), temperature (field measured), Dissolved Oxygen (field measured), Turbidity (NTU) (sonde measured), Flow (m/s), Total Suspended Solids (mg/l), Ammonia, Nitrite (NO_2) (mg/l), Ortho-Phosphate (P) (mg/l), Nitrate (NO_3) (mg/l), Phosphorus (unfiltered) (mg/l), Chloride (mg/l), and BOD (mg/l).*

9.5.3.2 Potential Impacts on Groundwater Levels during Excavation Works

No borrow pits are proposed at the site, so no associated dewatering works are proposed. Smaller scale temporary dewatering may occur at some excavations (i.e. turbine bases, cable trenches (underpass is dealt with separately below), and these have the potential to affect local groundwater levels. However, temporary reductions in groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat and subsoil geology, which comprises moderate to low permeability lacustrine and glacial deposits.

The installation of turbine bases in the underlying glacial deposits is also likely to require some temporary dewatering arrangements, where deeper excavations occur. However, due to the dominance of moderate to low permeability glacial till subsoils and lacustrine deposits below the bogs the impacts on groundwater levels will be localized to the excavation and only for a temporary basis during the construction work. Water level impacts are unlikely to be significant beyond 50m from any excavation.

Pathway: Groundwater flow paths.

Receptor: Groundwater levels.

Pre-Mitigation Potential Impact: Slight, indirect, temporary, low probability effects on local groundwater levels.

Proposed Mitigation Measures by Design:

- There are large separation distances between proposed works and local houses, and associated water wells. The closest houses are at least 750m from proposed turbine bases.
- Similarly, main streams and rivers are at least 200-500m away from any turbine bases, and at these potential effects will be imperceptible; and,
- The proposed underground cable trench is designed to be shallow and will only be approximately 1.2m in depth. At this depth it will only potentially interact with shallow perched water within the peat profile. No interaction with deeper regional groundwater will occur. Therefore, re no impacts on the local groundwater table or flows are anticipated from this element of the development.

Residual Effects: Due to large separation distances between proposed development works and water wells and local stream and rivers, and the relatively shallow nature of the proposed works, and also the prevailing geology of the proposed development site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local groundwater levels.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels are anticipated.

9.5.3.3 Excavation Dewatering and Potential Impacts on Surface Water Quality

Groundwater seepages will likely occur in turbine base, substation and construction compound excavations, and these will create additional volumes of water to be treated by the runoff management system. In some areas, groundwater inflows may be more significant where lenses of sand and gravel are intercepted within the glacial till deposits.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are not anticipated in this respect.

The main potential significant effects are as a result of turbidity and suspended solids on downstream surface water receptors. Poor water quality in downstream stream and rivers has the potential to affect aquatic habitats and species (e.g. fish and invertebrates).

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, low probability effects to surface water quality.

Proposed Mitigation by Design:

Management of excavation seepages 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;
- If required, pumping of excavation inflows will prevent build-up of groundwater in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface;
- 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 the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.

Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local surface water quality and associated aquatic habitats.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

9.5.3.4 Underpass Dewatering and Potential Effects on Surface Water Quality and Groundwater Levels

Temporary dewatering may occur at the proposed underpass locations, and these have the potential to impact on local groundwater levels by drawdown. Drawdown in water levels can affect baseflow to rivers and streams, and water levels in local groundwater wells. Excavation depths will be in the order of ~3 to ~6.5m. Two underpasses are proposed, and these will require a limited works area and the duration of the installation works will be short (i.e. 4 to 8 weeks). The locations of the proposed underpasses are remote from surrounding houses, so potential impacts on groundwater wells is limited by large separation distances. Any temporary dewatering will be treated and discharged to local surface water so there will be temporary net loss in water volume reaching local streams and rivers. In addition, potential groundwater level effects via drawdown are limited due the local hydrogeological regime which comprises moderate to low permeability lacustrine and glacial deposits. It is likely that permanent drainage at the underpass locations will be by gravity to a local outfall.

In addition, during construction groundwater seepages will likely occur into the underpass construction areas and this will create additional volumes of water to be treated by the runoff management system.

During construction stage, groundwater inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are anticipated in this respect.

The recorded geology at the underpass locations (from trial pit TP/UP) include ~1.1m of peat over firm grey slightly gravelly SILT. A moderate groundwater inflow was recorded at 3.3mbgl. Slight to the east of the N62 (at trial pit TP/CSH2) peat depth was recorded at 0.3m, with firm grey gravelly clay forming the subsoil. No significant groundwater inflows were recorded at this location.

The installation of permanent underpasses in the underlying glacial deposits will require permanent dewatering/gravity drainage arrangements. However, due to the dominance of moderate to low permeability peats, glacial till subsoils and lacustrine deposits below at the underpass locations the impacts on groundwater levels due to these excavations will be localized to the underpass areas. Dewatering impacts will not extend far enough to impact on local sensitive receptors. Water level drawdown impacts are unlikely to be significant beyond 50m from the permanent underpass excavations.

Pathway: Groundwater levels, and flow to local surface water.

Receptor: Down-gradient surface water bodies, and groundwater levels.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, low probability effects to surface water quality. Imperceptible, direct, slight, long term, high probability effect on local groundwater levels.

Proposed Mitigation Measures for Water Quality Protection:

Management of excavation seepages 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;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface;
- The pumped water volumes will be discharged via silt bags and settlement tanks/ponds to adjacent to excavation areas, or via specialist treatment systems such as a "Siltbuster" unit;
- There will be no direct discharge to the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.

Residual Effects: Due to large separation distances between proposed underpass development works and local groundwater wells, and the relatively shallow nature of the proposed works, and also the prevailing geology of the proposed development site the potential for water level drawdown impacts from the two underpass construction locations at receptor locations is considered negligible. In addition, controls for water treatment prior to release to surface water will be implemented to ensure surface water quality will be maintained. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local surface water quality. Imperceptible, direct, temporary, low probability effects on local groundwater levels.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality or groundwater levels are anticipated.

9.5.3.5 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. In addition, the accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbons have a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Impact: Negative, indirect, slight, short term, medium probability effect to local groundwater quality. Indirect, negative, significant, short term, low probability effect to surface water quality.

Proposed Mitigation Measures:

- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- 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 or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry 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;
- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

Residual Effect: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, low probability effect on groundwater and surface water.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated.

9.5.3.6 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Impacts on surface water quality could affect fish stocks and aquatic habitats.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality.

Pre-mitigation Effect: Negative, significant, indirect, temporary, low probability effect to surface water quality. Negative, slight, indirect, temporary, low probability effect to local groundwater.

Proposed Mitigation Measures:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site compounds, 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 from the site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the site, nor discharged to the site.

Residual Effect: During the construction phase no water or wastewater will be sourced on the site, nor discharged to the site, therefore no residual effects are anticipated.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated.

9.5.3.7 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, with artificial variations not in excess of $\pm$ 0.5 of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic species and habitats. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to introduction of high pH alkaline waters into the system. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

Pathway: Site drainage network.

Receptor: Surface water and peat water hydrochemistry.

Pre-Mitigation Potential Impact: Negative, moderate, indirect, short term, medium probability effect to surface water.

Proposed Mitigation Measures:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;

- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compounds. These temporary lined wash-out pits will be removed from the site at the end of the construction phase;
- Will use weather forecasting to plan dry days for pouring concrete; and,
- Will ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Effect: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, low probability impact.

Significance of Effects: For the reasons outlined above, no significant effects on surface water quality are anticipated.

9.5.3.8 Potential Impacts on Hydrologically Connected Designated Sites

The proposed development site is not located within any designated conservation site. As stated in Section 9.3.14 above, the proposed development site is located in the River Shannon regional catchment. Local designated sites, other than those listed in Table 9.14 are considered to be remote from the proposed development, and as such due to physical and hydrological and hydrogeological separation will not be affected by the proposed development. Local designated sites listed in Table 9.14 are assessed below with respect to hydrological connectivity and potential for significant hydrological and hydrogeological effects.

Pathway: Surface water flowpaths, and groundwater levels.

Receptor: Down-gradient water quality and groundwater levels at designated sites.

Impact Assessment – Lough Coura pNHA

Lough Coura pNHA is located to the south of the proposed development site, and it abuts the development site boundary along the southeast of Clongawny bog over ~450m, and again along the southern boundary of Drinagh bog over a distance of ~110m.

The baseline conditions of the land between the pNHA and development locations is highly modified already by drainage and forestry planting and associated drainage.

For the Clongawny bog area, the presence of the N62 road, the bog railway and their associated drainage provide a significant separation from that bog to the pNHA. Also, the nearest turbine is some 970m from the pNHA boundary (mitigation by design). There is a section of high ground between that turbine (T5) and the pNHA area. The proposed works at T5 are relatively shallow in nature and groundwater flow below Clongawny bog is likely, due to local topography and local drainage patterns, to be to the west and northwest away from Lough Coura pNHA

For the Drinagh bog area, the presence of existing bog drainage and drainage associated with local tributaries to the Little River also provide existing hydraulic boundaries to the pNHA. The nearest turbine is some 320m from the pNHA boundary (mitigation by design). The proposed works at T14 are relatively shallow in nature and groundwater flow below Drinagh bog is likely, due to local topography and local drainage patterns, to be to the west and northwest away from Lough Coura pNHA and towards the Little River.

For these various scientific (physical and hydrological) reasons, the potential for hydrological drawdown effects to occur at the pNHA as a result of the proposed wind farm development are negligible.

Impact Assessment – All Saints bog and Esker SAC / All Saints Bog SPA

There are surface water connections between the proposed development site and All Saints bog and Esker SAC / All Saints Bog SPA. These pathways could transfer poor quality surface water that may affect the designated sites. However, detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. In addition, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5. Implementation of the mitigation measures will ensure protection of water quality in receiving waters.

There is also a significant separation distance between the proposed development site and All Saints bog and esker SAC (~3.7km to proposed T4 and T11, the two nearest turbines). Ground elevation at T4 and T11 are ~52mOD and ~54mOD respectively. Ground elevations at All Saints bog and esker SAC range between 35-42mOD. Excavation depths at the development site are in the order of ~3 to 6.5m and piling depths may be in the order of ~8 to 12m. The intermittent nature of the turbine locations (they are not continuous, but are separated by large tracks of open bog) and the large separation distance between the development site and All Saints bog and Esker SAC, and the presence of the intermediate hydraulic boundary (the Rapemills River), allows us to conclude using the physical and scientific data that there will be no significant hydrological or water quality impacts on All Saints bog and Esker SAC / All Saints bog SPA from the proposed wind farm development.

Impact Assessment – Ridge Road, SW of Rapemills SAC

There are no surface water connections between the proposed development site and Ridge Road, SW of Rapemills SAC.

There is also a significant separation distance between the proposed development site and Ridge Road, SW of Rapemills SAC (~4.13km to proposed T4, the nearest turbine). Ground elevation at T4 and T5 are ~53mOD and ~54mOD respectively. Ground elevations at Ridge Road, SW of Rapemills SAC range between 50-55mOD. Excavation depths at the development site are in the order of ~3 to 6.5m and piling depths may be in the order of ~8 to 12m. The intermittent nature of the turbine locations (they are not continuous, but are separated by large tracks of open bog) and the large separation distance between the development site and Ridge Road, SW of Rapemills SAC, and the presence of the intermediate hydraulic boundary (the Rapemills River), allows us to conclude using the physical and scientific data that there will be no significant hydrogeological or water quality impacts on Ridge Road, SW of Rapemills SAC from the proposed wind farm development.

Impact Assessment - River Shannon Callows SAC and Middle Shannon SPA

There are surface water connections between the proposed development site and River Shannon Callows SAC and Middle Shannon SPA. These pathways could transfer poor quality surface water that may affect the designated sites. However, detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5. Implementation of the mitigation measures will ensure protection of water quality in receiving waters.

Groundwater from below the development site may also discharge as baseflow to the Little River, the Rapemills River (or its tributaries) and Brosna River before entering the River Shannon Callows SAC and Middle Shannon SPA. Groundwater quality and quantity will not be affected by the proposed development as outlined in Section 9.5.3.2, Section 9.5.3.5, Section 9.5.3.7, and Section 9.5.3.9.

Using these physical characteristics and by implementation of proven mitigation measures, we can conclude that there will be no significant hydrological or water quality impacts on River Shannon Callows SAC and Middle Shannon SPA from the proposed wind farm development.

Impact Assessment – River Little Brosna Callows SPA / River Little Brosna Callows NHA

There are no surface water connections between the proposed development site and the River Little Brosna Callows SPA / River Little Brosna Callows NHA, and therefore there is no likelihood of any significant effects arising in the absence of a hydrological link.

There is also a significant separation distance between the proposed development site and River Little Brosna Callows SPA / River Little Brosna Callows NHA (~5.5km as the crow flies). The Rapemills River forms an intermediate hydraulic boundary between the wind farm development and River Little Brosna Callows SPA / River Little Brosna Callows NHA sites. It is not physically possible, due to hydrological separation, for groundwater to flow below the Rapemills River and reach the River Little Brosna. Using these physical and topographical (i.e. scientific) data we can conclude that there will be no likely significant hydrological or water quality impacts on River Little Brosna Callows SPA / River Little Brosna Callows NHA from the proposed development.

Pre-Mitigation Potential Impact: No significant hydrological or hydrogeological effects on designated sites listed in Table 9.14 have been identified.

Residual Effects: For the reasons outlined above we consider there will be no residual effects on all designated sites listed in Table 9.14.

Significance of Effects: For the reasons outlined above, no significant impacts on any designated sites are anticipated.

9.5.3.9 Potential Effects on Local Groundwater Well Supplies

As stated in Section 9.3.8 above, the groundwater flow in the mineral soil deposits (silts, sands and gravels) beneath the peat at the proposed development site is expected to discharge into the Silver River, Rapemills River and the Little River. The most western edge of the site, within the Clongawny bog, likely discharges into the Rapemills river located to the west/southwest of the site. Groundwater flow within the centre of the site, near the N62, will flow towards the Little River, while groundwater flow towards the west of the site, within the Drinagh bog, will discharge towards the Silver River.

Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the proposed development footprint are identified and an impact assessment for these actual and potential well locations is undertaken.

As shown on Figure 9.7, there are a number of dwellings situated along the N62, along the R435 and other minor roads surrounding the Clongawny bog, as well as dwellings along the R437 and other minor roads surrounding the Drinagh bog.

The dwellings surrounding the Clongawny bog are downgradient of the Rapemills River and smaller tributaries, and it is expected that the majority of groundwater flow discharges to these waterbodies, as well as to the larger drainage ditches around the bog.

The Silver River flows along much of the eastern side of the Drinagh bog, and so acts as a hydraulic boundary for groundwater flow. The majority of the dwellings in this area are situated east of this boundary and therefore no impacts on groundwater flow are expected. The Little River flows along the western edge of the Drinagh bog parallel to the N62 and also acts as a hydraulic boundary and groundwater flow from the western edge of the Drinagh bog, the area of the site situated near the N62 and potentially the eastern edge of the Clongawny bog is also expected to discharge to the Little River.

The wind farm is designed so that it at least 750m from surrounding dwelling houses.

The closest proposed infrastructure up-gradient of the dwellings within the setback distance is shown in Table 9.16 below.

Table 9.16: Potential Private Wells Down-gradient of the Development Footprint

Development Footprint Location	Sub-catchment	Distance from Closest Private Dwelling (m)	Assessment
T10	Rapemills	916	Down-gradient, but large separation distance.
T2	Little	750	Across-gradient, but large separation distance.
T3	Little	750	Down-gradient, but large separation distance.
T20	Little	1,395	Down-gradient, but large separation distance.
Substation	Island River/Brosna	340	Down-gradient

Note:
1. Distance from closest turbine, compound, or substation (i.e. excavation/earthworks location). Access roads and the cable trench nor amenity path are not considered a potential risk due to the shallow nature of those works. The distances listed above are from the nearest wind farm infrastructure within the same surface water catchment as the dwelling.
2. Each dwelling is assumed to have an on-site private water well as outlined above (this is for assessment purposes only, wells may or may not actually exist).

The closest proposed infrastructure to these dwellings is the substation which has a setback distance of approximately 340m. Due to the shallow nature of the excavation works associated with the substation, no impacts on groundwater levels or local wells are anticipated.

There are 3 no. proposed turbines potentially upgradient of a private dwelling (well locations assumed but not confirmed). The closest upgradient turbine is over 750m away. Due to the nature of the foundation excavations and the use of cement, the potential impacts on closet down-gradient dwelling (and potential well) is assessed below.

Pathway: Groundwater flowpaths.

Receptor: Groundwater Supplies.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, long term, low probability effect.

Impact Assessment

The risk to any potential well source down-gradient of a turbine location from potential contaminant release (i.e. sediment, hydrocarbons, and cement-based compounds) within any excavation at this separation distance is negligible (i.e. 750m). Due to the relatively low bulk permeability of mineral soils beneath the peat (i.e. predominately silts and clays with some interbedded gravels), the low recharge characteristics (due to the overlying peat) and the low groundwater gradients (flat topography), groundwater travel times are expected to be slow. The relatively low permeability and the diffuse nature of groundwater flow in the mineral soils would mean that a pollutant would take months/years to travel this distance as demonstrated below by means of the Darcy mean velocity equation:

$$q = k.i$$

$$v = q/ ne$$

$$T = L / v$$

where:

q = specific discharge (m/day)

k = permeability m/day (a value of 20m/day for moderate to low permeability subsoils is used).

ne = porosity (a value of 0.025 is used for silts/clays).

i =slope of the water table in the subsoil can be estimated from on topography (a value of 0.005 is used down-gradient of the turbine (60mOD -55mOD)/1000m = 0.005).

v = Darcy velocity (m/day).

L = Distance (metres).

T = Time of travel (days)

Based on a groundwater flow velocity of 20m/day (2.3×10^{-4} m/s, conservative worst-case estimate), the time of travel (ToT) for a potential pollutant to flow from the development location to the closest dwelling house (i.e. 750m) would be in the order of 5 years. During this time any discharge would be assimilated and attenuated by natural groundwater flow and diluted by rainfall recharge. Also, any entrained sediment would be filtered within the low permeability subsoils. Therefore, the risk posed to potential well sources at this distance from potential spills and leaks from excavations is negligible.

In addition, there are proposed mitigation measures (outlined above) that will minimise and prevent potential groundwater contamination from hydrocarbons and other chemicals (refer to Sections 9.5.3.5, 9.5.3.6, and 9.5.3.7).

Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider the residual effects to be - negative, imperceptible, indirect, long term, low probability effect in terms of quality or quantity.

Significance of Effects: For the reasons outlined above, no significant impacts on potential groundwater supplies are anticipated.

9.5.3.10 Potential Impacts of the Proposed Amenity Links

A total of approximately 18km of amenity pathways (including walkways and cycleways, and carpark) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. The roads will be re-purposed following construction to form the amenity pathways, in addition to being used for maintenance access during operation. The amenity pathways will have a gravel/crushed stone finish surface. Figure 4.30 outlines the final configuration of the internal roads with the cycleway included in the layout plan.

In addition, approximately 6.5 km of dedicated amenity pathways are proposed to provide access points/links into and out of the site as follows:

- Internal link to R437 allowing further access to Drinagh and Derrybrat to facilitate potential future connection to Lough Boora Parklands.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link to the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

In addition to the amenity pathway, a new public car park will be provided for recreational use during the operational stage. The car park will be located adjacent to the proposed access off the R357, immediately north of the proposed substation.

The amenity access points off the R357 and L7009 are discussed in Section 4.4.1. Only these access points will be available to public during the operational phase. As outlined in Section 4.3.3, amenity connectivity between Clongawny and Drinagh Bogs will be via an underpass beneath the N62 only.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Surface water quality and groundwater quality.

Pre-Mitigation Potential Impact: Negative, slight, indirect, low probability, short-term effect on surface water quality and groundwater quality.

Proposed Mitigation Measures:

Detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5.

Residual Effect: For the reasons outlined in the impact assessment above, we consider the residual effects to be - Negative, imperceptible, indirect, low probability, short-term effect on surface water and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water and groundwater quality are anticipated.

9.5.3.11 Potential Effects of the Proposed Haul Route Junction Works

A new temporary arrangement will be required at Kennedy's Cross, located in the townland of Ballindown, (junction of the N52 and N62 National Secondary Roads), comprising construction of a new road across third party lands, to facilitate the delivery of turbine components and other abnormal loads. The proposed new road will measure approximately 160 metres in length and have a 6-metre running width.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Surface water quality and groundwater quality.

Pre-Mitigation Potential Impact: Negative, slight, indirect, low probability, temporary effect on surface water quality and groundwater quality.

Proposed Mitigation Measures:

Detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5.

Residual Effect: Based on the implementation of proven mitigation, as outlined above, we consider the residual impacts to be - Negative, imperceptible, indirect, low probability, temporary effect on surface water and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water and groundwater quality are anticipated.

9.5.4 Operational Phase - Likely Significant Effects and Mitigation Measures

9.5.4.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the proposed access roads and hardstands are impermeable. The assessed footprint comprises turbine bases and hardstandings, access roads, amenity links, site entrances, substation and temporary construction compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The emplacement of the proposed permanent development footprint, as described in Chapter 4 of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 1,213 m^3/month (Table 9.17). This represents a potential increase of approximately 0.06 % in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions (Table 9.6). This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 34.2ha, representing 1.45% of the total study area of ~2,360 ha.

Table 9.17: Baseline Site Runoff V Development Runoff

Development Type	Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 96% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions (m^3)
Wind Farm	2,008,454	64,789	342,000	30,318	29,106	1,213	39	0.06%

The additional volume is low due to the fact that the runoff potential from the site is naturally high (96%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the proposed development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Pathway: Site drainage network.

Receptor: Surface waters and dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, permanent, moderate probability effect on all downstream surface water bodies.

Proposed Mitigation by Design:

As the part of the proposed wind farm drainage design, it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing drainage network. The new proposed drainage measures will then create significant additional attenuation to what is already present. The operational phase drainage system will be installed and constructed in conjunction with the existing bog drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed into downstream field drains;
- Collectors drains will be used to gather runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling;
- On sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/roadside drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of access road sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to existing drains;
- Settlement ponds will be designed in consideration of the greenfield runoff rate, existing bog settlement ponds will also buffer discharges from the two bog (Clongawny and Drinagh); and,
- Finally, all surface water runoff from the development will have to pass through the settlement ponds at the existing bog outfall locations.

Post-Mitigation Impact Assessment

As stated in Section 9.3.4 above there are existing surface water control measures at the bog which comprise high level bog surface drains, low level main drains and settlement ponds. All these existing drainage measures offer some surface water attenuation during rainfall events. However, as the part of the proposed wind farm drainage (which is outlined further in Section 9.4.1 and Section 9.4.2 above), it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing drainage network. The new proposed drainage measures will then in effect create significant additional attenuation to what is already present at the site. The net effect of this will be a reduction in the overall runoff coefficient of the bog as demonstrated by the use of the Rational Method in Table 9.18 below. Based on a conservative reduction in the runoff coefficient from 0.96 to 0.85 for the overall site, there would a potential 11.4% reduction in runoff volumes from the site. This assessment demonstrates that there will be no risk of exacerbated flooding down-gradient of the site as a result of the proposed wind farm development. The proposed development will in effect retain water within the bog for longer periods.

Table 9.18: Surface Water Runoff Assessment for Proposed Wind Farm Drainage

Site Area	C (1)	Area (m^2)	Rc (2)	100-Year 6hr Rainfall Depth (m)	Runoff Volume (m^3)	Total Site Runoff Volume (m^3)
Without Wind Farm Drainage Control						
Undeveloped Area	2.78	23,258,000	0.96	0.0515	1,149,876	1,167,489
Development Footprint	2.78	342,000	1.00	0.0515	17,613	
With Wind Farm Drainage Control						
Undeveloped Area	2.78	23,258,000	0.85	0.0515	1,018,119	1,034,851
Development Footprint	2.78	342,000	0.95	0.0515	16,732	
Estimated Potential Reduction in Site Runoff Volumes (%)						11.4%

Notes: 1 – Constant, 2- Runoff Coefficient

Residual Effect: With the implementation of the proposed wind farm drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect are - Negative, imperceptible, indirect, long-term, moderate probability effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, no significant effects on downstream flood risk is anticipated.

9.5.4.2 Runoff Resulting in Suspended Solids Entrainment in Surface Waters

During the operational phase, the potential for silt-laden runoff is much reduced compared to the construction phase. In addition, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of site entrances, internal roads, hardstand areas and amenity pathways. These works would be of a very minor scale and would be very infrequent. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated against.

During such maintenance works there is a small risk associated with release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers and associated dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, temporary, low probability effect.

Proposed Mitigation Measures:

Mitigation measures for sediment control are the same as those outlined in Section 9.5.3.1.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined in Section 9.5.3.5.

Residual Effects: With the implementation of the proposed wind farm drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect are - Negative, imperceptible, indirect, temporary, low probability effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

9.5.4.3 Potential Effects on Local Groundwater Well Supplies from Operation of Abstraction Well at Proposed Substation

It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies* (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. A pump house is not currently envisaged as an in-well pump will direct water to a water tank within the roof space of the control building (subject to final design). Bottled water will be supplied for drinking, if required. The proposed abstraction volume from the well will be small, as there will only be intermittent use of welfare facilities at the substation. For the purpose of our assessment we have assumed a worst-case abstraction of $1m^3$/week.

As presented in Table 9.16 above, the closest dwelling to the proposed substation location is ~340m. Based on this separation distance, and the very low abstraction rate proposed from the substation groundwater well, and also based on the type of underlying geology (limestone bedrock aquifer, (*c.f.* Section 9.3.8),

Pathway: Groundwater volume and water level drawdown.

Receptor: Local groundwater supplies.

Pre-Mitigation Potential Impact: Neutral, imperceptible, indirect, long-term, low probability effect on local groundwater volumes and water levels.

No mitigation is proposed, as the proposed abstraction is such a small volume.

Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology), we consider the residual effects to be none.

Significance of Effects: For the reasons outlined above, no significant impacts on local groundwater supplies from operation of the proposed substation well are anticipated.

9.5.4.4 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts (i.e. contamination) on public and private water supplies and potential flooding. There are no mapped public or group water scheme groundwater protection zones in the area of the proposed wind farm site. The Banagher PWS abstraction is located west of the site, approximately 2 km southeast of Banagher. The mapped source protection zone for this GWS does not fall within the proposed development site boundary. Notwithstanding this, the proposed site design and mitigation measures ensures that the potential for impacts on the groundwater environment are not significant

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. The Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water within the existing site. On-site drainage control measures will ensure no downstream increase in flood risk.

9.5.5 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas.

This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".

Some of the impacts will be avoided by leaving elements of the proposed development in place where appropriate. The substation will be retained by EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment are envisaged during the decommissioning stage of the proposed development.

9.5.6 Assessment of Cumulative Effects

A cumulative impact assessment was undertaken regarding other wind farm developments and non-wind farm developments located within a 20km radius and inside the River Shannon catchment. The wind farm developments assessed are listed in Table 9.19 below and are shown on Figure 9.8. Non-wind farm developments that have been assessed are listed in Section 2.5.

In terms of the potential impacts of developments on downstream surface water bodies (e.g. Sliver River, Rapemills River, Little River, Little Brosna River and River Shannon), the biggest risk is during the construction phase of the Proposed Development as this is the phase when earthworks and excavations will be undertaken at the sites. However, within 20km of the proposed site inside the River Shannon catchment, a high majority (54%) of the other windfarm developments are operational, therefore construction phase impacts with the proposed Derrinlough WF are not anticipated. It is also anticipated that the Cloghan wind farm will be built in advance of the proposed Derrinlough wind farm, and therefore the relative construction periods will not overlap. However, a worst-case scenario would be that the Cloghan wind farm and Derrinlough WF are constructed at the same time, and this is assessed below.

In terms of operational phase hydrological effects, the total number of turbines that could potentially be operating within a 20km radius of the site inside the River Shannon catchment is 43 no. (which includes 21 no. from the proposed Derrinlough WF). The total catchment area of the River Shannon within a 20km radius of the proposed site is ~1,384km^2 and therefore this equates to 1 turbine for approximately every ~32km^2 which would not be considered high density. Therefore, effects on catchment hydrology and water quality are not be expected.

The construction of the wind farm grid connection works will only require relatively localised excavation works within the site boundary and therefore will not contribute to any significant cumulative effects on the water environment.

Implementation of the proposed drainage mitigation during the construction phase (Section 9.5.3) will ensure there will be no cumulative significant adverse impacts on the water environment from the proposed development and other wind farm developments (including a concurrent construction of Cloghan wind farm) and non-wind farm developments within the River Shannon catchment. Non-wind projects also include exempted development such as OPW arterial and drainage maintenance works.

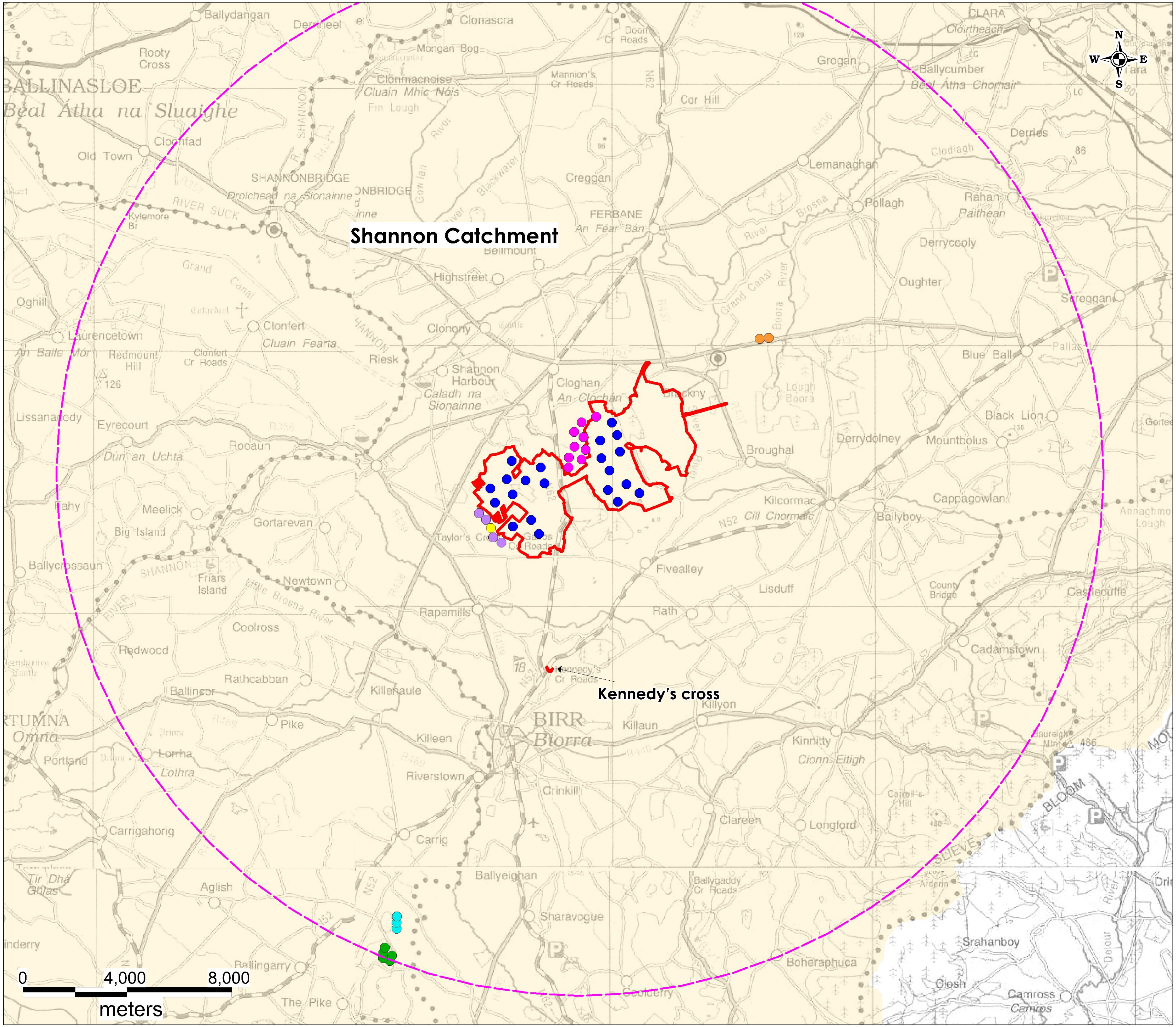
In terms of cumulative hydrological effects arising from elements of the Proposed Development no significant effects on water quality or flood flows are expected as they are all contained within the site and therefore will be within the wind farm drainage catchment where all construction water will be attenuated and treated as described above (Sections 9.5.3 and 9.5.4).

Table 9.19: Other Wind Farm Developments in the River Shannon catchment within a 20km radius of the site

Catchment Area	Wind Farm Name	Status	Potential No. of Turbines in Catchment
River Shannon	Skehanagh WF	5 no. Existing	5
	Carrig WF	3 no. Existing	3
	Meenwaun WF	4 no. Existing	4
	Meenwaun WF	1 no. Permitted	1
	Cloghan WF	9 no. Permitted	9
Potential Total			**22**

9.5.7 Post Consent Monitoring

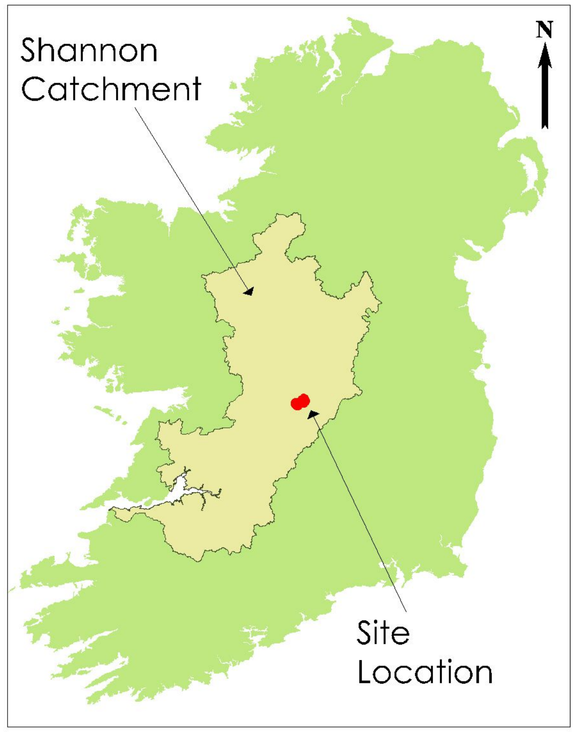
None required.



Legend

- EIAR Site Boundary
- Derrinlough WF (Proposed)
- Carrig WF (Existing)
- Cloghan WF (Permitted)
- Leabeg WF (Existing)
- Meenwaun WF (Existing)
- Meenwaun WF (Permitted)
- Skehanagh WF (Existing)
- 20km radius from the site

Key Plan



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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough WF, Co. Offaly	
Title: Cumulative Assessment Map	
Figure No: 9.8	
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Scale: 1:100,000	Drawn By: GD
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10. AIR AND CLIMATE

10.1 Air Quality

10.1.1 Introduction

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the construction, operation and decommissioning of the proposed development.

The proposed development site is sited on the Clongawny and Drinagh Bogs approximately 2km south of the village of Cloghan in County Offaly. The townlands in which the proposed development is located, including the proposed 110kV substation and grid connection route, are listed in Table 1-1 in Chapter 1 of this EIAR.

The land uses and types within the proposed development site are a mixture of bare cutover and cutaway peat, re-vegetation of bare peat, commercial forestry, telecommunications (a 30m Mast) and wind measurement (a single 100m anemometry mast on Clongawny Bog). There are also several Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to Derrinlough Briquette Factory which is located in the most western part of Drinagh bog.

The surrounding land uses, and types comprise a mixture of forestry, agricultural land, a mosaic of active peat extraction, cutover and cutaway peatland, amenity (e.g. Lough Boora Parklands) and wind energy. The operational Meenwaun Wind Farm is located adjacent to the southwestern boundary of the proposed development site.

Due to the non-industrial nature of the proposed development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR. Although the site is located close to the peat-powered West Offaly Power Station at Shannonbridge, it is expected that air quality in the existing environment locally is good. The West Offaly Power Station is operated by the ESB under IPC Licence No. P0611-02 issued by the Environmental Protection Agency (EPA); therefore, all emissions from this site are strictly controlled and monitored. This power station is scheduled to close in 2020.

The production of energy from wind turbines has no direct emissions as is expected from fossil fuel-based power stations. Harnessing more energy by means of wind farms will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. Some minor short term or temporary indirect emissions associated with the construction of the wind farm include vehicular and dust emissions. Emissions from the construction, operation and decommissioning phases of the project are addressed in Section 10.1.5.

10.1.1.1 Relevant Guidance

The air quality and climate section of this EIAR is carried out in accordance with the 'EIA Directive' as amended by Directive 2014/52/EU and having regard, where relevant, to guidance listed in Section 1.8.1 of Chapter 1: Introduction.

10.1.1.2 Statement of Authority

This chapter of the EIAR was completed by Eoin McCarthy and Michael Watson. Eoin is a Senior Environmental Scientist with McCarthy O'Sullivan Ltd. with over 8 years of experience in private consultancy and has been involved in the preparation of Air and Climate chapters for EIARs for over twenty wind energy projects. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway.

Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland. Between them, they have completed Air and Climate EIAR chapters for over twenty wind energy projects.

10.1.2 Air Quality Standards

In 1996, the Air Quality Framework Directive (96/62/EC) was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999. The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC) addresses sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC) addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (SI No. 271 of 2002).
- The third Daughter Directive, Council Directive (2002/3/EC) relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (SI No. 53 of 2004).
- The fourth Daughter Directive, published in 2007, relates to polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air and was transposed into Irish law by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2009 (S.I. No. 58 of 2009).

The Air Quality Framework Directive and the first three Daughter Directives have been replaced by the Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), which encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for $PM_{2.5}$ (fine particles) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.
- The possibility for time extensions of three years (for particulate matter PM_{10}) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 10.1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre ($\mu g/m^3$) and parts per billion (ppb). The notation PM_{10} is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. $PM_{2.5}$ represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). These Regulations supersede the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the Ambient Air Quality Assessment and Management Regulations 1999 (S.I. No. 33 of 1999).

Table 10.1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: https://www.epa.ie/air/quality/standards/)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO_2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO_2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO_2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM_{10})	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Particulate matter 2.5 ($PM_{2.5}$)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
Particulate matter 2.5 ($PM_{2.5}$) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015
Particulate matter 2.5 ($PM_{2.5}$) Stage 2	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020
Lead (Pb)	Protection of human health	Calendar year	0.5	-	Annual mean	1st Jan 2005
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8,620	-	1st Jan 2005
Benzene (C_6H_6)	Protection of human health	Calendar Year	5	1.5	-	1st Jan 2010

The Ozone Daughter Directive 2002/3/EC is different from the other Daughter Directives in that it sets target values and long-term objectives for ozone rather than limit values. Table 10.2 presents the limit and target values for ozone.

Table 10.2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020
Protection of human health	Maximum daily 8-hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	AOT40* calculated from 1-hour values from May to July	18,000 mg/m^3.h averaged over 5 years	6,000 mg/m^3.h
Information Threshold	1-hour average	180 mg/m^3	-
Alert Threshold	1-hour average	240 mg/m^3	-

*The sum of the differences between hourly ozone concentration and 40 ppb for each hour when the concentration exceeds 40 ppb during a relevant growing season, e.g. for forest and crops.

10.1.2.1 Air Quality and Health

The EPA report '*Air Quality in Ireland 2018*' noted that in Ireland, the premature deaths attributable to poor air quality are estimated at 1,180 people. A more recent European Environmental Agency (EEA) Report, '*Air Quality in Europe – 2019 Report*' highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 412,000 people in Europe in 2016, with regards to deaths relating to $PM_{2.5}$. The estimated impacts on the population in Europe of exposure to NO_2 and O_3 concentrations in 2016 were around 71,000 and 15,100 premature deaths per year, respectively. From this, 1,100 Irish deaths were attributable to fine particulate matter ($PM_{2.5}$), 50 Irish deaths were attributable to nitrogen oxides (NO_2) and 30 Irish deaths were attributable to Ozone (O_3) (Source: *Air Quality in Europe – 2019 Report'*, EEA, 2019). These emissions, along with others including sulphur oxides (SO_x) are produced during fossil fuel-based electricity generation in various amounts, depending on the fuel and technology used.

10.1.3 Air Quality Zones

The Environmental Protection Agency (EPA) has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The site of the proposed development lies within Zone D, which represents rural areas located away from large population centres.

10.1.4 Existing Environment

The EPA publishes Air Monitoring Station Reports for monitoring locations in all four Air Quality Zones. The ambient air quality monitoring carried out closest to the proposed development site is Ferbane, Co. Offaly, located approximately 9 kilometres north-northeast of the proposed development. EPA air quality data is available for Ferbane in the report '*Ambient Air Monitoring at Ferbane, Co. Offaly 4th October 2006 to 29th March 2007*,' as detailed below. This monitoring location lies within Zone D.

10.1.4.1 Sulphur Dioxide (SO_2)

Sulphur dioxide data for the 2006/2007 monitoring period at Ferbane is presented in Table 10.3. Neither the hourly limit value nor lower assessment threshold set out in the CAFE Directive were exceeded during the monitoring period.

Table 10.3 Sulphur Dioxide Data Ferbane 2006/2007

Parameter	Measurement
No. of hours	4,210
No. of measured values	4,103
Percentage Coverage	98.1%
Maximum hourly value	15.1 $\mu g/m^3$
99.7 percentile for hourly values	13.5 $\mu g/m^3$

Parameter	Measurement
Mean hourly value	3.2 µg/m^3
Maximum 24-hour mean	3.0 µg/m^3
98 percentile for 24-hour mean	2.9 µg/m^3

10.1.4.2 Particulate Matter (PM_{10})

Particulate matter (PM_{10}) data for the 2006/2007 monitoring period in Ferbane is presented in Table 10.4. The 24-hour limit value for the protection of human health (50 µg/m^3) was exceeded 35 times during the measurement period. The upper assessment threshold was exceeded on 19 days and the lower assessment threshold was exceeded on 56 days. The CAFE Directive stipulates that these assessment thresholds should not be exceeded more than 35 times in a calendar year. The mean of the daily values during the measurement period is below the annual limit value for the protection of human health (40 µg/m^3).

Table 10.4 Particulate Matter (PM_{10}) Data Ferbane 2006/2007

Parameter	Measurement
No. of days	175
No. of measured values	175
Percentage Coverage	100%
Maximum daily value	63.6 µg/m^3
Mean daily value	18.7 µg/m^3

10.1.4.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the 2006/2007 monitoring period at Ferbane is presented in Table 10.5. One hourly mean NO_2 value was above the lower assessment threshold of 200 µg/m^3. The CAFE Directive stipulates that this threshold should not be exceeded more than 18 times in a calendar year. The mean hourly NO_2 value of 5.2 µg/m^3 was below the annual lower assessment threshold for the protection of human health, which is 26 µg/m^3.

Table 10.5 Nitrogen Dioxide and Oxides of Nitrogen Data Ferbane 2006/2007

Parameter	Measurement
No. of hours	4,210
No. of measured values	4,153
Percentage Coverage	99.5%
Maximum hourly value (NO_2)	106.4 µg/m^3
99.8 percentile for hourly values (NO_2)	42.6 µg/m^3
Mean hourly value (NO_2)	5.2 µg/m^3

Parameter	Measurement
Mean hourly value (NOx)	6.7 µg/m^3 NO_2

10.1.4.4 Carbon Monoxide (CO)

Carbon Monoxide data for the 2006/2007 monitoring period at Ferbane is presented in Table 10.6. The mean hourly concentration of carbon monoxide recorded was 0.2 mg/m^3. The carbon monoxide limit value for the protection of human health is 10 mg/m^3. The lower Assessment Threshold is 5 mg/m^3. On no occasions were values in excess of the 10 mg limit value set out in the CAFE Directive/ Air Quality Standards Regulations 2011 (as amended) recorded.

Table 10.6 Carbon Monoxide Data Ferbane 2006/2007

Hourly Values	Result
No. of hours	4,210
No. of measured values	3,663
Percentage Coverage	87.6%
Maximum hourly value	1.7 mg/m^3
98 percentile for hourly values	0.7mg/m^3
Mean hourly value	0.2mg/m^3
Maximum 8-hour mean	1.4 mg/m^3
98 percentile for 8-hour mean	0.6 mg/m^3

10.1.4.5 Dust

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggests that a deposition of 10 mg/m^2/hour can generally be considered as posing a soiling nuisance. This equates to 240 mg/m^2/day. The EPA recommends a maximum daily deposition level of 350 mg/m^2/day when measured according to the TA Luft Standard 2002.

Construction dust has the potential to be generated from on-site activities such as excavation and backfilling. The extent of dust generation at any site depends on the type of activity undertaken, the location, the nature of the dust, i.e. soil, sand, peat, etc., and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

The potential dust-related effects on local air quality and the relevant associated mitigation measures are presented in Sections 10.1.5.2.2 and 10.1.5.3.2 below.

10.1.5 Likely Significant Effects and Associated Mitigation Measures

10.1.5.1 'Do-Nothing' Effect

If the proposed development were not to proceed, there would be no exhaust emissions from construction plant and vehicles, nor would there be dust emissions due to the movement of the same. However, the opportunity to further reduce emissions of carbon dioxide, oxides of nitrogen (NO_x), and sulphur dioxide (SO_2) to the atmosphere would be lost resulting in a continued dependence on electricity derived from fossil fuel, rather than renewable energy sources such as from the proposed wind farm. This will result in an indirect negative impact on air quality.

10.1.5.2 Construction Phase

10.1.5.2.1 *Exhaust Emissions*

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, the substation, underpasses, site roads, site entrances, anemometry mast bases, grid connection cabling and other onsite infrastructure will require the operation of construction vehicles and plant on site. Exhaust emissions associated with vehicles and plant will arise as a result of construction activities. This potential effect will not be significant and will be restricted to the duration of the construction phase and localised to works locations. Therefore, this is considered a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

N52/N62 Junction Bypass

The junction accommodation works along the proposed turbine haul route will encompass the bypass of the junction between the N52 and N62 National Secondary Roads, as outlined in Chapter 4 of this EIAR. The use of construction vehicles at this location will give rise to exhaust emissions, creating a short-term slight negative impact in terms of air quality. Mitigation measures in relation to exhaust emissions are presented below.

Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 4.4 in Chapter 4 of this EIAR), will also give rise to exhaust emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to exhaust emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Machinery will be switched off when not in use.
- Turbines and construction materials will be transported to the site on specified routes only, unless otherwise agreed with the Planning Authority.

- Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.

Residual Impact

Short-term Imperceptible Negative impact.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.1.5.2.2 *Dust Emissions*

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, underpasses, site roads, site entrances, anemometry mast bases and other onsite infrastructure will give rise to dust emissions during the construction phase. The potential for impacts on off-site receptors is limited due to the isolated nature of the site and the vegetative screening that exists surrounding the site. This potential effect will not be significant and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative impact. Dust suppression mitigation measures to reduce this impact are presented below.

Grid Connection

The construction of the substation and excavation of associated connection to the National Grid will give rise to localised dust emission during their construction. The potential for impacts on off-site receptors is limited due to the isolated nature of the site and the vegetative screening that exists surrounding the site. This is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

N52/N62 Junction Bypass

The junction accommodation works along the proposed turbine haul route will encompass the bypass of the junction between the N52 and N62 National Secondary Roads, as outlined in Chapter 4 of this EIAR, will also give rise to some localised dust, particularly during periods of dry weather. This is a short-term slight negative impact in terms of air quality. Mitigation measures to reduce this impact are presented below.

Transport to Site

The transport of turbines and construction materials to the wind farm site will also give rise to some localised dust emissions during periods of dry weather. This is a short-term slight negative impact. Mitigation measures to reduce the significance of this effect are presented below.

Mitigation

- Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compound to prevent the generation of dust where

required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.
- All plant and materials vehicles shall be stored in dedicated areas (on site).
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.
- Turbines and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary.
- The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4.3). The CEMP includes dust suppression measures.

Residual Impact

Short-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.1.5.3 Operational Phase

10.1.5.3.1 *Exhaust Emissions*

Exhaust emissions associated with the operational phase of the proposed development will arise from machinery and vehicles that are intermittently required onsite for maintenance. This will give rise to a long-term imperceptible impact.

Mitigation

Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order, thereby minimising any emissions that arise.

Residual Impact

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.1.5.3.2 *Air Quality*

Although exhaust emissions will arise during the construction phase, the proposed development, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2. The production of renewable energy from the proposed development will have a long-term significant positive impact on air quality. Further details on the carbon dioxide savings associated with the proposed development are presented in Section 10.2.3 below.

Residual Impact

Long-term Significant Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive direct and indirect effect.

10.1.5.3.3 Human Health

Long-term exposure to chemicals such as SO_2 and NOx are harmful to human health. The production of clean, renewable energy from the proposed development will offset the emission of these harmful chemicals by fossil fuel powered sources of electricity and, therefore, will have a long-term slight positive impact on human health. Further information on the impact of the proposed development on Human Health is contained in Chapter 5: Population and Human Health.

Residual Impact

Long-term Slight Positive Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.1.5.4 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.2 Climate

All relevant legislation and policy in relation to climate is outlined in detail in Chapter 2 of this EIAR. A summary of the same is provided in the following sections.

10.2.1 Climate Change and Greenhouse Gases

Although variation in climate is thought to be a natural process, the rate at which the climate is changing has been accelerated rapidly by human activities. Climate change is one of the most challenging global issues facing us today and is primarily the result of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in energy use. Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

10.2.1.1 Greenhouse Gas Emission Targets

Ireland is a Party to the Kyoto Protocol, which is an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It is a protocol to the United Nations Framework for the Convention on Climate Change. The Kyoto Protocol came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding.

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions in the period 2008 to 2012. Ireland's contribution to the EU commitment for the period 2008 – 2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

10.2.1.1.1 *Doha Amendment to the Kyoto Protocol*

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of five percent against 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020; however, the composition of Parties in the second commitment period is different from the first.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms such as international emissions trading can also be utilised.

10.2.1.1.2 *COP21 Paris Agreement*

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C above pre-industrial levels and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

10.2.1.1.3 *COP25 Climate Change Conference*

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology chemicals, textiles, cement and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind. The Commission will present draft laws for the new deal to the EU in January of 2020 and if accepted will likely be implemented in 2021. Decisions regarding the global carbon market were postponed until the next Climate Conference (COP26) which will be held in Glasgow in November 2020.

10.2.1.1.4 *Emissions Projections*

Ireland's target is to achieve a 20% reduction of non-Emissions Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the period 2013 – 2020. The Environmental Protection Agency (EPA) publish Ireland's Greenhouse Gas Emission Projection and at the time of writing, the most recent report, 'Ireland's Greenhouse Gas Emissions Projections 2018– 2040 was published in June 2019. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).

The 2019 emission projections report include the impact of new climate mitigation policies and measures which were outlined in the National Development Plan 2018. These projections see a greater impact from policies and measures and a greater reduction in emissions over the longer term, particularly in the "With Additional Measures" scenario. The 2019 emissions projections do not take into account policies and measures set out in the Climate Action Plan 2019. Such measures will be taken into consideration in an updated future projections report in 2020.

Greenhouse gas emissions are projected to 2040 using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 (latest national greenhouse gas emission inventory) are implemented. The 'With Additional Measures' scenario assumes the implementation of the "With Existing Measures" scenario and further implementation of the governments renewable and energy efficiency policies including those set out in the National Renewable Energy Action Plan (NREA), the National Energy Efficiency Action Plan (NEEAP) and the National Development Plan 2018-2027.

The EPA Emission Projections Update notes the following key trends:

- Total emissions are projected to increase from current levels by 1% and 6% by 2020 and 2030, respectively, under the "With Existing Measures" scenario.
- Under the "With Additional Measures" scenario, emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030, respectively.
- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 5% and 6% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction.
- Ireland has exceeded its annual binding limits in 2016 and 2017 under both scenarios, 'With Measures' and 'With Additional Measures'.
- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 10 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 9 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The report concludes:

- *"Projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52-67Mt CO_2 equivalent with the gap potentially narrowing to 7-22 Mt CO_2*

equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised."

- *"To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections."*
- *"A significant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat... [...] ... However, Ireland still faces significant challenged in meeting EU 2030 targets in the non-ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans."*

10.2.1.1.5 Progress to Date

The 'Europe 2020 Strategy' is the EU's agenda for growth and jobs for the current decade. The Europe 2020 Strategy targets on climate change and energy include:

- Reducing greenhouse gas (GHG) emissions by at least 20% compared with 1990 levels;
- Increasing the share of renewable energy in final energy consumption to 20%; and
- Moving towards a 20% increase in energy efficiency.

Further details on the Europe 2020 Strategy are included in Chapter 2: Background to the Proposed Development of this EIAR. Regarding progress on targets, the '*Europe 2020 indicators – climate change and energy*' report provides a summary of recent statistics on climate change and energy in the EU.

In 2015, EU greenhouse gas emissions, including emissions from international aviation and indirect carbon dioxide (CO_2) emissions, were down by 22.1% when compared with 1990 levels. However, regarding the progress of individual Member States, and Ireland in particular, the Europe 2020 indicators include the following statements:

- 24 countries are on track to meet their GHG targets, except Austria, Belgium, Ireland and Luxembourg.
- Luxembourg emitted the most GHG per capita in the EU in 2014 followed by Estonia, Ireland and the Netherlands.
- In 2015, Malta was the farthest from reaching their national target, followed by Ireland, Belgium and Luxembourg.

10.2.1.1.6 United Nations Sustainable Development Summit 2015

Transforming our World: the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs) and 169 targets was adopted by all UN Member States at a UN summit held in New York in 2015. The Agenda is universally applicable with all countries having a shared responsibility to achieve the goals and targets. Coming into effect on January 1st, 2016, the goals and targets are to be actions over the 15-year period, are integrated and indivisible i.e. all must be implemented together by each Member State.

The Sustainable Development Goals National Implementation Plan 2018-2020 was published by the Department of Communications, Climate Action & Environment in partnerships with OSI, Esri Ireland and the Central Statistics Office. The Plan sets out how Ireland will work to achieve the goals and targets of the Agenda for Sustainable Development both domestically and internationally. Relevant SDGs and how they are implemented into Irish National plans and policies can be found in Table 10.7.

Table 10.7 United Nations Sustainable Development Goals adopted in 2015. https://sustainabledevelopment.un.org/sdgs

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
SDG 7 Affordable and Clean Energy: *Ensure access to affordable, reliable, sustainable and modern energy for all*	- By 2030, ensure universal access to affordable, reliable and modern energy services - By 2030, increase substantially the share of renewable energy in the global energy mix - By 2030, double the global rate of improvement in energy efficiency - By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology - By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	The renewable energy share of total final energy consumption gradually increased from 16.6 per cent in 2010 to 17.5 per cent in 2016, though much faster change is required to meet climate goals. Global primary energy intensity (ratio of energy used per unit of GDP) improved from 5.9 in 2010 to 5.1 in 2016, a rate of improvement of 2.3 per cent, which is still short of the 2.7 per cent annual rate needed to reach target 3 of Sustainable Development Goal 7.	*Ireland's Transition to a Low Carbon Energy Future 2015-2030* *Strategy to Combat Energy Poverty in Ireland* *Ireland's Transition to a Low Carbon Energy Future 2015-2030* *National Mitigation Plan* *National Energy Efficiency Action Plan for Ireland # 4 2017-2020* *Better Energy Programme* *One World, One Future* *The Global Island*
SDG 13 Climate Action: *Take urgent action to combat climate change and its impacts** **Acknowledging that the United Nations Framework Convention on Climate Change is the primary international,*	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries Integrate climate change measures into national policies, strategies and planning Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention	In 2017, greenhouse gas concentrations reached new highs, with globally averaged mole fractions of CO_2 at 405.5 parts per million (ppm), up from 400.1 ppm in 2015, and at 146 per cent of pre-industrial levels. Moving towards 2030 emission objectives compatible with the 2°C and 1.5°C pathways requires a peak to be achieved as soon as possible, followed by rapid reductions.	*National Adaptation Framework* *Building on Recovery: Infrastructure and Capital Investment 2016-2021* *National Mitigation Plan*

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
intergovernmental forum for negotiating the global response to climate change.	on Climate Change to a goal of mobilising jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	During the period 1998–2017, direct economic losses from disasters were estimated at almost $3 trillion. Climate-related and geophysical disasters claimed an estimated 1.3 million lives. As of April 2019, 185 parties had ratified the Paris Agreement. Parties to the Paris Agreement are expected to prepare, communicate and maintain successive nationally determined contributions, and 183 parties had communicated their first nationally determined contributions to the secretariat of the United Nations Framework Convention on Climate Change, while 1 party had communicated its second. Under the Agreement, all parties are required to submit new nationally determined contributions, containing revised and much more ambitious targets, by 2020. Global climate finance flows increased by 17 per cent in the period 2015–2016 compared with the period 2013–2014. As at 20 May 2019, 75 countries are seeking support from the Green Climate Fund for national adaptation plans and other adaptation planning processes, with a combined value of $191 million.	*National Biodiversity Action Plan 2017-2021* *National Policy Position on Climate Action and Low Carbon Development*

10.2.1.1.7 Climate Action Network Europe Off Target Report 2018

The June 2018 '*Off Target Report*' published by the Climate Action Network (CAN) Europe which ranks EU countries ambition and progress in fighting climate change listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate (20% reduction in greenhouse gases) and renewable (40% increase in overall energy from renewable electricity sources) energy targets. Additionally, it was noted that Ireland is also off course for its 2030 emissions target.

In March 2019, the Minister for Communications, Climate Action, and the Environment, Richard Bruton, announced a renewable electricity target of 70% by 2030 for Ireland. Furthermore, the release of the Climate Action Plan in June 2019 has noted a 30% reduction in greenhouse gases by 2030. Considering only renewable energy from electricity as part of this plan and to meet the required level of emissions reduction by 2030, Ireland will:

- Reduce CO_2 eq. emissions from the sector by 50–55% relative to 2030 NDP projections.
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation.
- Increase electricity generated from renewable sources to 70%, indicatively comprised of:
  - at least 3.5 GW of offshore renewable energy;
  - up to 1.5 GW of grid-scale solar energy; and
  - up to 8.2 GW total of increased onshore wind capacity.
- Meet 15% of electricity demand by renewable sources contracted under Corporate PPAs.

Achieving 70% renewable electricity by 2030 will involve phasing out coal and peat-fired electricity generation plants, increasing our renewable electricity, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries), and putting systems in place to manage intermittent sources of power, especially from wind.

As noted previously, Ireland are not on track for meeting their 2020 renewable energy targets. It is now more critical than ever that we continue to progress renewable energy development in Ireland so as we are successful in meeting our 2030 target.

The Climate Action Plan noted specific sectors which are required to step-up in order to help Ireland achieve its EU targets. The renewable energy sector was cited alongside the country's commitment to increase onshore wind capacity by up to 8.2 GW. The proposed Derrinlough Wind Farm will help contribute towards this target.

Further detail on the EU 2030 targets are noted in Chapter 2, Section 2.3 of this EIAR.

10.2.1.1.8 Climate Change Performance Index

Established in 2005, the Climate Change Performance Index (CCPI) is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on: climate policies, energy usage per capita, renewable energy implementation and Greenhouse Gas Emissions (GHG) and ranks their performance in each category and overall. The 2020 CCPI was published in December 2019 and presented at the COP25. While the CCPI 2020 indicated signs of potential reductions in global emissions, no country achieved its Paris Climate targets and therefore the first three places of the ranking system remain unoccupied.

Ireland, ranked the worst performer in the CCPI 2019, climbed 7 places to 41st place and has moved from a "very low" performer to a "low" performer in international performance. However, it remains at "very low" at a national performance level. The CCPI report states that while some improvements have been made, GHG per capita emissions are at a high level and "significant challenges lie ahead in closing Ireland's emission gap, meeting the current (2030) target and aligning Ireland's emission trajectory with a net zero goal for 2050. Therefore, the country still ranks among the bottom ten performers in this indicator." Recognising Ireland's Climate Action Plan 2019, the CCPI states:

"*the government must go much further in implementing policies across all sectors that drive sustained emissions reductions over the next decade. Near-term ambition needs to be ratcheted up quickly by specifying deep cuts in fossil fuel and reactive nitrogen usage to put Ireland on a net zero emissions pathway aligned with the Paris temperature goals".*

10.2.2 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Birr, Co. Offaly, is the nearest weather and climate monitoring station to the proposed development site that has meteorological data recorded for the 30-year period from 1979-2008. The monitoring station is located approximately 6.9km southwest of the site. Meteorological data recorded at Birr over the 30-year period from 1979-2008 is shown in Table 10.8. The wettest month was October and the driest month on average was April. July was the warmest month with a mean temperature of 19.6° Celsius.

Table 10.8 Data from Met Éireann Weather Station at Birr 1979-2008: Monthly and Annual Mean and Extreme Values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	8.1	8.6	10.3	12.6	15.5	17.8	19.6	19.3	17.1	13.6	10.4	8.6	13.5
mean daily min	2.0	2.0	3.3	4.3	6.6	9.5	11.6	11.3	9.3	6.6	4.0	2.7	6.1
mean temperature	5.1	5.3	6.8	8.4	11.0	13.6	15.6	15.3	13.2	10.1	7.2	5.6	9.8
absolute max.	14.3	15.5	18.6	23.2	25.7	29.7	30.8	29.4	25.6	20.4	17.5	15.3	30.8
min. maximum	-3.5	-0.5	2.0	4.3	6.3	10.5	12.5	11.6	9.7	5.9	2.7	-1.0	-3.5
max. minimum	11.6	12.1	12.2	13.0	15.2	16.6	18.9	18.1	17.9	15.7	12.8	13.0	18.9
absolute min.	-14.6	-7.1	-7.8	-4.7	-2.3	0.2	3.7	2.0	-1.1	-5.2	-6.9	-8.6	-14.6
mean num. of days with air frost	8.2	7.7	4.9	3.5	0.9	0.0	0.0	0.0	0.2	1.6	4.8	7.0	38.8
mean num. of days with ground frost	16.0	15.0	13.0	12.0	7.0	1.0	0.0	0.0	2.0	6.0	11.0	15.0	98.0
mean 5cm soil	3.9	3.9	5.7	9.0	13.0	16.0	17.2	16.4	13.5	9.4	6.2	4.5	9.9
mean 10cm soil	4.1	4.2	5.6	8.2	11.8	14.8	16.3	15.6	13.0	9.4	6.5	4.8	9.5
mean 20cm soil	4.8	5.0	6.4	8.8	12.1	14.9	16.6	16.2	14.0	10.5	7.5	5.6	10.2
RELATIVE HUMIDITY (%)													
mean at 0900UTC	89.8	88.9	86.9	81.5	77.7	78.3	80.9	84.2	86.6	89.1	90.9	90.3	85.4
mean at 1500UTC	82.4	75.6	71.6	65.1	64.7	66.2	67.5	68.5	70.3	76.1	81.1	84.5	72.8
SUNSHINE (hours)													
mean daily duration	1.5	2.2	2.9	4.5	5.1	4.3	3.9	4.0	3.5	2.9	1.9	1.4	3.2
greatest daily duration	7.7	9.4	10.5	13.0	15.1	15.7	15.2	13.6	11.5	9.7	8.5	6.9	15.7
mean num. of days with no sun	11.0	7.1	5.8	2.9	2.2	2.9	2.5	2.5	3.5	6.2	8.8	12.0	67.4
RAINFALL (mm)													
mean monthly total	78.8	58.6	67.4	55.0	59.5	66.5	59.4	81.6	66.4	94.2	74.7	83.8	845.7
greatest daily total	39.2	28.0	22.0	26.3	19.7	41.1	44.5	59.1	35.7	32.3	29.7	37.5	59.1
mean num. of days with >= 0.2mm	19	15	19	15	16	16	16	18	17	19	18	18	206
mean num. of days with >= 1.0mm	14	11	14	11	12	11	11	12	11	14	13	13	147

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean num. of days with >= 5.0mm	5	4	4	3	4	4	3	5	4	6	5	6	53
WIND (knots)													
mean monthly speed	7.9	8.0	7.8	6.5	6.2	5.8	5.6	5.6	6.0	6.8	7.0	7.5	6.7
max. gust	75	77	64	58	55	49	49	46	51	64	54	69	59.2
max. mean 10-minute speed	40	38	33	29	29	27	24	27	30	37	32	38	32
mean num. of days with gales	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
WEATHER (mean no. of days with)													
snow or sleet	3.5	2.6	2.5	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.2	1.9	11.7
snow lying at 0900UTC	2.0	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.7
Hail	0.6	0.8	1.8	2.0	0.9	0.1	0.0	0.2	0.1	0.2	0.3	0.3	7.3
Thunder	0.1	0.1	0.2	0.3	0.4	0.8	0.9	0.5	0.3	0.1	0.2	0.1	3.9
fog	2.1	1.3	1.1	1.5	1.1	0.8	1.1	1.8	2.5	2.1	1.9	2.9	20.4

10.2.3 Calculating Carbon Losses and Savings from the Proposed Development

10.2.3.1 Background

Carbon dioxide (CO_2) emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is active and converts it to organic carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully, and the organic carbon is retained in the accumulating mass of the peatland.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When developments such as wind farms are proposed for peatland areas, there will be direct effects and loss of peat in the area of the development footprint. There may also be indirect effects where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

10.2.3.2 Calculating Carbon Losses and Savings

Bord na Móna developed a methodology based on their extensive experience for calculating carbon losses and savings from proposed wind farm development. The methodology was informed by the Scottish Governments Carbon Calculator[1] and other relevant information sources such as:

- Multiyear greenhouse gas balances at a rewetted temperate peatland. (Wilson et al., 2016;
- Greenhouse gas Emission Factors. (Wilson et al., 2016);
- Derivation of GHG emission factors for peatlands managed for extraction in the ROI and the UK. (Wilson et al. 2015); and
- The Effect of Management Strategies on Greenhouse Gas Balances in Industrial Cutaway Peatlands in Ireland (The CARBAL Report) (Wilson, D. and Farrell, E.P., 2007).

This was used to assess the effects of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage and operation of wind farm. The methodology reflects the specific nature of the cutaway peat lands upon which the project is proposed to be located.

The completed worksheet including the assumptions used in the model is provided as Appendix 10.1 to this EIAR. The peat losses are based on the volume of peat disturbed and redistributed, and takes a 'worst case' approach, by assuming that the in-situ peat had been rewetted and therefore had zero net emissions, and the redistributed peat has high emissions associated with rushes and birch/willow scrub habitat type.

The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and carbon losses due to peatland disturbance.

The model also calculates the carbon savings associated with the proposed wind farm development against three comparators:

1 Scottish Government (2016) http://informatics.sepa.org.uk/CarbonCalculator/

1. *The average fossil emissions on the Irish Grid – based on the SEM Reference mid-merit plant*
2. *The EU Fossil Fuel Comparator (a measure of the fossil intensity across the European market)*
3. *A displaced 'Load Following' combined cycle gas turbine plant.*

The expected and maximum, worst-case scenario CO_2 losses due to the proposed wind farm development are summarised in Table 10.9 and the total savings against the three comparators listed above are summarised in Table 10.10.

Table 10.9 CO_2 losses from the Proposed Development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)
Losses due to turbine life (e.g. manufacture, construction, decommissioning)	76,173
Losses due to Additional Cycling Emissions	110,811
Losses from peat land disturbance emissions	5,681
Total	192,665

The peat losses are based on the volume of peat disturbed and redistributed and takes a 'worst case' approach as described above.

Table 10.10 Wind Farm Lifetime Savings

Comparator	CO2 Savings (tonnes CO2 equivalent)	Payback (years)
SEM Mid-Merit Plant	5,141,287	1.12
EU Fossil Fuel Comparator (FFC)	4,549,469	1.27
'Load Following' Combined Cycle Gas Turbine Plant	2,725,552	2.12

Based on the Bord na Móna model calculations as presented above, 192,665 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment, changes in the cycling of mid-merit gas-fired generation units and due to the construction, operation and decommissioning of the proposed development. This represents a fraction (EU FFC – 4.2%) of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project as set out in Table 10.9. The volume of CO_2 that will be lost to the atmosphere will be offset by the proposed development between 1 and 2 years of operation, depending on the fuel source to which it is compared.

10.2.4 Likely Significant Effects and Associated Mitigation Measures

10.2.4.1 'Do-Nothing' Effect

If the proposed development were not to proceed, greenhouse gas emissions, e.g. carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated with construction vehicles and plant would not arise. However, the opportunity to further significantly reduce emissions of greenhouse gas emissions, including carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2), to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and EU law would also be lost. This would be a long-term slight negative impact.

The proposed Derrinlough Wind Farm development will be integrated into the Rehabilitation Plans for Clongawny and Drinagh Bogs. It will therefore not have a significant impact on the plans for rehabilitation in the Do-Nothing Scenario either with respect to habitat development or the carbon balance of the site. The Draft Rehabilitation Plans for Clongawny and Drinagh Bogs are included in Appendix 6.8.

10.2.4.2 Construction Phase

10.2.4.2.1 *Greenhouse Gas Emissions*

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, underpasses, site roads, site entrances, anemometry mast bases and all associated infrastructure will require the operation of construction vehicles and plant on site. Greenhouse gas emissions, e.g. carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated with vehicles and plant will arise as a result of the construction and demolition activities. This potential impact will be slight, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

Grid Connection

The construction of 1 No. 110 kV substation and excavation of associated cable trenches will require the use of construction machinery giving rise to greenhouse emissions. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

N52/N62 Junction Bypass

The junction accommodation works along the proposed turbine haul route will encompass the bypass of the junction between the N52 and N62 National Secondary Roads, as outlined in Chapter 4 of this EIAR. This will require the use of construction machinery giving rise to greenhouse emissions. This is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 4.4 in Chapter 4 of this EIAR), will also give rise to greenhouse gas emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to greenhouse gas emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority.
- Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.

Residual Impact

Short-term Imperceptible Negative Impact on Climate as a result of greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.2.4.3 Operational Phase

10.2.4.3.1 *Greenhouse Gas Emissions*

The proposed development will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. As detailed in Table 10.8 above, the proposed development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 30-year lifespan of the proposed wind farm. The proposed project will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the proposed wind farm will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect.

Residual Impact

Long-term Moderate Positive Impact on Climate as a result of reduced greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will be a direct long-term moderate, positive effect.

10.2.4.4 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.3 Cumulative Assessment

Potential cumulative effects on air quality and climate between the proposed development and other projects in the vicinity were also considered as part of this assessment. The projects considered as part of the cumulative effect assessment are described in Section 2.7 of this EIAR.

The nature of the proposed development is such that, once operational, it will have a long-term, moderate, positive impact on the air quality and climate.

During the construction phase of the proposed development and other projects described in Section 2.7 that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in this chapter are implemented, during the construction phase of the proposed development, there will be no cumulative negative effect on air and climate.

There will be no net carbon dioxide (CO_2) emissions from operation of the Derrinlough Wind Farm. Emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) or dust emissions during the operational phase of the proposed development will be minimal, relating to the use of operation and maintenance vehicles onsite, and therefore there will be no measurable negative cumulative effect with other projects on air quality and climate.

11. NOISE AND VIBRATION

11.1 Introduction

11.1.1 Background and Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts associated with the proposed Derrinlough Wind Farm Development (the 'Proposed Development'). The Proposed Development will encompass 21 No. wind turbines up to a tip height of 185 metres above the top of the foundation. A full description of the proposed development is provided in Chapter 4 of this EIAR.

Noise and vibration impact assessments have been prepared for both the operational, construction and decommissioning phases of the Proposed Development to the nearest noise sensitive location (NSL's). To inform this assessment, background noise levels have been measured at several representative NSL's in the vicinity of the proposed development site.

Existing operational, permitted and proposed wind farm developments with the potential for cumulative impacts were identified and assessed as part of this assessment namely the Meenwaun (existing and proposed) and Cloghan (permitted and proposed) wind farms. In line with best practice guidance the cumulative impact of these other developments has been included in the operational noise impact assessment. Further details on these other developments is provided in Chapter 2 of this EIAR.

11.1.2 Statement of Authority

This chapter has been prepared by Dermot Blunnie of AWN Consulting Ltd:

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

11.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level is adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPL's measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 11.1.

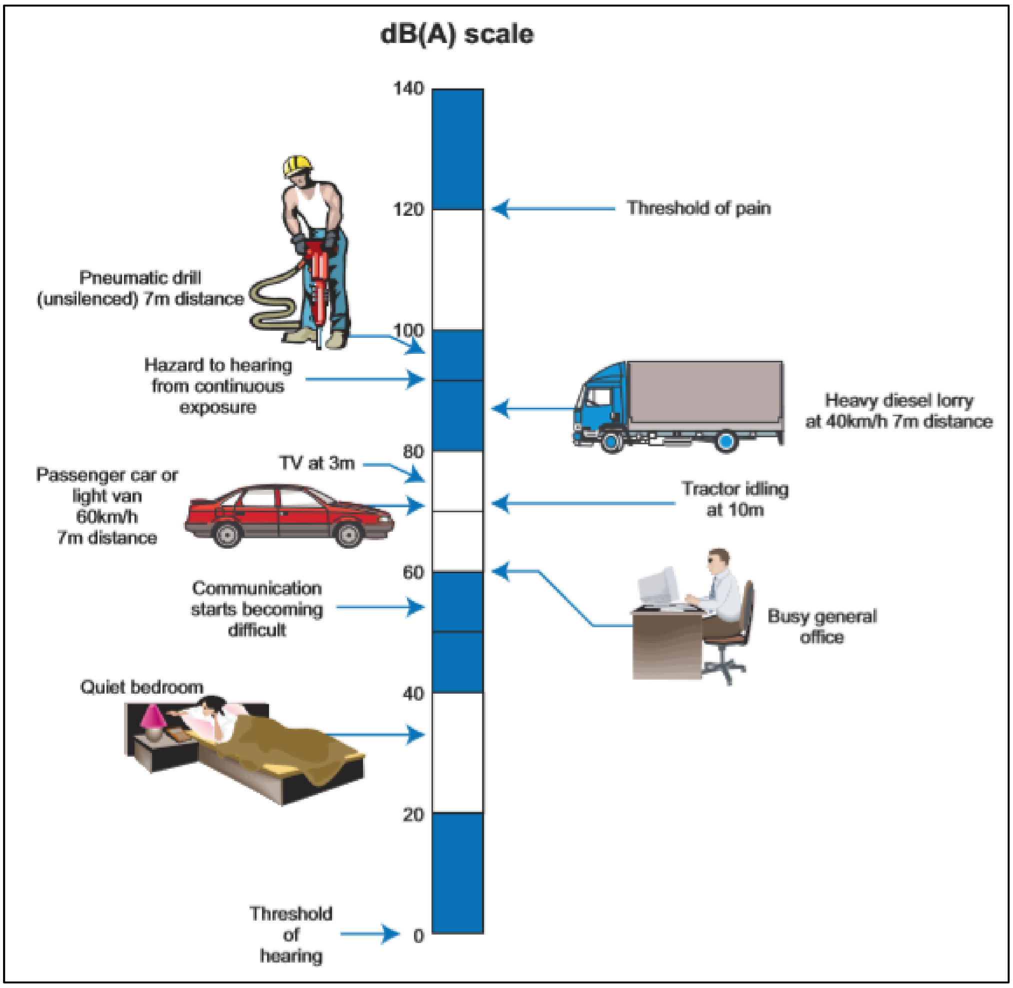

Figure 11.1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

For a glossary of terms used in this chapter please refer to Appendix 11-1.

11.3 Assessment Methodology

The assessment of impacts for the Proposed Development have been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in Section 11.3.2.

In addition to the specific guidance documents outlined in this chapter, the Environmental Impact Assessment (EIA) guidelines listed in Section 1.1.8 of Chapter 1 were considered and consulted for the purposes of preparing this EIAR chapter.

The methodology adopted for this noise impact assessment is summarised as follows:

- Review of appropriate guidance to identify appropriate noise and vibration criteria for both the construction and operational phases;
- Characterise the receiving environment through baseline noise surveys at various NSL's surrounding the proposed development;
- Undertake predictive calculations to assess the potential impacts associated with the construction phase of the proposed development at NSL's;
- Undertake predictive calculations to assess the potential impacts associated with the operational of the proposed development at NSL's; Evaluate the potential noise and vibration impacts and effects.
- Specify mitigation measures to reduce, where necessary, the identified potential outward impacts relating to noise and vibration from the proposed development; and
- Describe the significance of the residual noise and vibration effects associated with the proposed development.

11.3.1 EPA Description of Effects

The significance of effects of the proposed development shall be described in accordance with the EPA guidance document Draft *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), (EPA, 2017)*. Details of the methodology for describing the significant of the effects are provided in Table 1.1 of Chapter 1: Introduction.

The effects associated with the proposed development are described with respect to the EPA guidance in the relevant sections of this chapter.

11.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

11.3.2.1 Construction Phase

11.3.2.1.1 *Construction Noise*

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at the façade of residential receptors, (construction noise only), indicates a potential significant noise impact is associated with the construction activities.

Table 11.1 sets out the values which, if exceeded, potentially signify a significant effect as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 11.1 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period (T)	Threshold values, LAeq,T dB		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

This assessment method is only valid for residential properties. For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. In this instance, with the rural nature of the site, properties near the development have daytime ambient noise levels that typically range from 40 to 50 dB $L_{Aeq,1hr}$. Therefore, all properties will be afforded a Category A designation.

See Section 11.5.2 for the detailed assessment in relation to the proposed development. If the specific construction noise level exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,T}$ during daytime periods) then a significant effect is deemed to have occurred.

11.3.2.1.2 Additional Vehicular Activity

For the assessment of potential noise impacts from construction related traffic along public roads and haul routes it is proposed to adopt guidance from Design Manual for Roads and Bridges (DMRB), Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure 2019.

Table 11.2, taken from Section 13.7 of DMRB presents guidance as to the likely impact associated with any change in the background noise level ($L_{Aeq,T}$) at a noise sensitive receiver as a result of construction traffic.

Section 3.19 of DMRB states that construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights;
- A total number of days exceeding 40 in any 6 consecutive months.

Table 11.2 Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2011)

Change in Sound Level	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
>5	Major

The DMRB guidance outlined will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely impacts during the construction phase.

11.3.2.1.3 Construction Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (BSI, 1993); and
- BS 5228 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BSI, 2009+A1:2014).

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is generated the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (NRA, 2004) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 11.3.

Table 11.3 Allowable Transient Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

11.3.2.2 Operational Phase

11.3.2.2.1 Noise

The noise assessment in this chapter has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government in 2006. These guidelines are in turn based on detailed recommendations set out in the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication *The Assessment and Rating of Noise from Wind Farms* (1996). The ETSU document has been used to supplement the guidance contained within the *Wind Energy Development Guidelines* publication where necessary.

11.3.2.2.2 Wind Energy Development Guidelines

Section 5.6 of the Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

> "*An appropriate balance must be achieved between power generation and noise impact.*"

While this comment is noted it should be stated that the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from alternative and appropriate publications.

> "*In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed.*"

As will be seen from the calculations presented later in this chapter, the various issues identified in this extract have been incorporated into our assessment.

> "*In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.*"

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

> "*However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than*

> *30dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A).*"

In relation to night time periods the following guidance is given:

> "*A fixed limit of 43dB(A) will protect sleep inside properties during the night.*"

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night time lower limit noise criterion curve in relation to wind farm developments.

In summary, the Wind Energy Development Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

- an appropriate absolute limit level for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the current guidance it is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála. Therefore, a night time 5dB(A) above background allowance has also been adopted in the criteria for this assessment.

This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance. The proposed operational noise criteria curves for wind turbine noise at various noise sensitive locations are presented in Section 11.4.2.

11.3.2.2.3 The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

As stated previously the core of the noise guidance contained within the *Wind Energy Development Guidelines* is based on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms* (ETSU-R-97).

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive properties. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states on page 58, "*…absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question…*". Therefore, the noise contribution from all wind turbine development in the area should be included in the assessment.

11.3.2.2.4 Institute of Acoustics Good Practice Guide

The guidance contained within the institute of Acoustics (IoA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IOA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night time noise criterion curves.

Noise emissions associated with the wind turbine can be predicted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (1996). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is typically offered by modern wind turbine units.

For guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise the IoA GPG has been taking into account.

Assessment of Cumulative Turbine Noise Impacts

The IOA GPG states that cumulative noise exceedances should be avoided and where existing or permitted development is at the noise limit any new turbine noise sources should be designed to be 10 dB below the limit value.

Section 5.1 of the relevant IoA GPG states the following:

> *"5.1.1 ETSU-R-97 states at page 58, "...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question..."*
>
> *5.1.2 The HMP[1] Report states that "If an existing wind farm has permission to generate noise levels up to ETSU-R-97 limits, planning permission noise limits set at any future neighbouring wind farm would have to be at least 10 dB lower than the limits set for the existing wind farm to ensure there is no potential for cumulative noise impacts to breach ETSU-R-97 limits (except in such cases where a higher fixed limit could be justified)". Such an approach could prevent any further wind farm development in the locality, and a more detailed analysis can be undertaken on a case by case basis.*
>
> *5.1.3 As with the assessment of noise for all wind farm developments, sequential steps need to be taken, but such steps require more detailed attention due to the added complexity of cumulative noise impacts. The advice of the EHO[2] could be invaluable to this part of the assessment."*
>
> *Cumulative impact assessment necessary*
>
> *5.1.4 During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*

1 HMP: Hayes McKenzie Partnership Ltd. Report on "Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications" Ref HM: 2293/R1 dated 6th April 2011.
2 Environmental Health Officer

5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."

11.3.2.2.5 Future Potential Guidance Change

Proposed changes to the assessment of noise impacts associated with on-shore wind energy developments are outlined in the *Draft Revised Wind Energy Development Guidelines* December 2019 prepared by the Department of Housing, Planning and Local Government. These Guidelines are currently in draft format and subject to public and stakeholder consultation. In line with best practice, the assessment presented in the EIAR is based on the current guidance outlined in Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities, 2006.

11.3.2.2.6 World Health Organisation (WHO) Noise Guidelines for the European Region

The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise.

Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, *"can be adopted as policy in most situations"* whereas a conditional recommendation, *"requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply".*

The objective of the WHO *Environmental Noise Guidelines for the European Region* is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> "*For average noise exposure, the GDG* ***conditionally*** *recommends reducing noise levels produced by wind turbines below 45 dB Lden, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure Lnight of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG* ***conditionally*** *recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

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

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

> "*Even though correlations between noise indicators tend to be high (especially between LAeq-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in Lden is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes…*
>
> *…Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."*

It is therefore considered that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) if applied, as target noise criteria for an existing or proposed wind turbine development in Ireland, should be done with caution. The L_{den} criteria has been adopted as part of this assessment, this is based upon the review set out above and the conclusion that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.

11.3.3 Special Characteristics of Turbine Noise

11.3.3.1 Infrasound/Low Frequency Noise

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

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

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

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

In 2010, the UK Health Protection Agency published a report entitled *Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation*. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

> *"Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.*

For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. In relation to the issue of infrasound, the article states the following:

> *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."*

The article concludes that:

> *"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, generally has adverse effects on wind farm neighbours".*

A report released in January 2013 by the South Australian Environment Protection Authority namely, *Infrasound levels near windfarms and in other environments* (EPA and Resonate Acoustics, 2013)[3] found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

[3] *EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf*

The study included several houses in rural and urban areas, both adjacent to and away from a wind farm, and measured the levels of infrasound with the wind farms operating and switched off.

There were no noticeable differences in the levels of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

> *"The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."*

A German report[4], titled "L*ow Frequency Noise incl. Infrasound from Wind Turbines and Other Sources*" presents the details of a measurement project which ran from 2013. The report was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016 and concluded the following in relation to infrasound from wind turbines:

> "*The measured infrasound levels (G levels) at a distance of approx. 150 m from the turbine were between 55 and 80 dB(G) with the turbine running. With the turbine switched off, they were between 50 and 75 dB(G). At distances of 650 to 700 m, the G levels were between 55 and 75 dB(G) with the turbine switched on as well as off.*"

"*For the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013 Draft)*[5]"

> *"The results of this measurement project comply with the results of similar investigations on a national and international level."*

11.3.3.2 Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (IOA, 2016) as:

> "*Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s).*"

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

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4 *Report available at https://www4.lubw.baden-wuerttemberg.de/servlet/is/262445/low-frequency_noise_incl_infrasound.pdf?command=downloadContent&filename=low-frequency_noise_incl_infrasound.pdf*

5 *DIN 45680:2013-09 – Draft "Measurement and Assessment of Low-frequency Noise Immissions" November 2013*

'Normal' AM	An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer. This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites. The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.
'Other' AM	In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies. On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction. It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency. Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade. The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

11.3.3.2.1 *Frequency of Occurrence of AM*

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report *Research into Aerodynamic Modulation of Wind Turbine Noise* (2007). The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, and a possible issue at a further 8, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the 4 sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system. The research has shown that AM is a rare and unlikely occurrence at operational wind farms.

It should be noted that AM is associated with wind turbine operation and it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule.

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F	"*even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent.*"

Page 6 Module F	"*It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months.*"
Page 61 Module F	"*There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed.*"

11.3.3.2.2 *Assessment of AM*

Research and Guidance in the area is ongoing with recent publications being issued by the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work and is currently the subject of a separate UK Government funded study. In the absence of published guidance to date, it is considered best practice to adopt the penalty rating and assessment scheme contained in an article published in the Institute of Acoustics publication *Acoustics Bulletin* (Vol. 42 No. 2 March/April 2017) titled, *Perception and Control of Amplitude Modulation in Wind Turbines Noise*.

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve log-term measurements. The 'Reference Method' for measuring AM outlined in the IoA AMWG document will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

11.3.4 Comments on Human Health Impacts

11.3.4.1 The National Health and Medical Research Council

The relevant Australian authority on health issues, the National Health and Medical Research Council (NHMRC), conducted a comprehensive independent assessment of the scientific evidence on wind farms and human health, the findings are contained in the NHMRC Information Paper: *Evidence on Wind Farms and Human Health* 2015, this report concluded:

> *"After careful consideration and deliberation, NHMRC concluded that there is no consistent evidence that wind farms cause adverse health effects in humans. This finding reflects the results and limitations of the direct evidence and also takes into account the relevant available parallel evidence on whether or not similar noise exposure from sources other than wind farms causes health effects"*

11.3.4.2 Health Canada

Health Canada, Canada's national health organisation, released preliminary results of a study into the effect of wind farms on human health in 2014[6]. The study was initiated in 2012 specifically to gather new data on wind farms and health. The study considered physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate, as well as measures of sleep quality. More than 4,000 hours of wind turbine noise measurements were collected and a total of 1,238 households participated.

No evidence was found to support a link between exposure to wind turbine noise and any of the self-reported illnesses. Additionally, the study's results did not support a link between wind turbine noise and stress, or sleep quality (self-reported or measured). However, an association was found between increased levels of wind turbine noise and individuals reporting of being annoyed.

11.3.4.3 New South Wales Health Department

In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government that stated existing studies on wind farms and health issues had been examined and no known causal link could be established.

NSW Health officials stated that fears that wind turbines make people sick are 'not scientifically valid'. The officials wrote that there was no evidence for 'wind turbine syndrome', a collection of ailments including sleeplessness, headaches and high blood pressure that some people believe are caused by the noise of spinning blades.

11.3.4.4 The Australian Medical Association

The Australian Medical Association put out a position statement, *Wind Farms and Health* 2014[7]. The statement said:

> *"The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects."*

11.3.4.5 Journal of Occupational and Environmental Medicine

The review titled, *Wind Turbines and Health: A Critical Review of the Scientific Literature* was published in the Journal of Occupational and Environmental Medicine, 2014. An independent review of the literature was undertaken by the he Department of Biological Engineering of the Massachusetts Institute of Technology (MIT). The review took into consideration health effects such as stress, annoyance and sleep disturbance, as well as other effects that have been raised in association with living close to wind turbines. The study found that:

> *"No clear or consistent association is seen between noise from wind turbines and any reported disease or other indicator of harm to human health."*

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6 *Health Canada 2014, Wind Turbine Noise and Health Study: Summary of Results. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html*

7 *Australian Medical Association, 2014, Wind farms and health. Available at https://ama.com.au/position-statement/wind-farms-and-health-2014*

The report concluded that living near wind farms does not result in the worsening of the quality of life in that region.

11.3.4.6 Summary

The peer reviewed research outlined in the preceding sections supports that there are no negative health effects on people with long term exposure to wind turbine noise. Please refer to Chapter 5 of the EIAR for further details of potential health impacts associated with the proposed development.

11.3.5 Vibration

A recent report published in Germany by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "*Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources*", Conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

Considering the distances from nearest NSL's to any of the proposed turbines (>750m), levels of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria have not been specified for the operational phase of the proposed development.

11.3.6 Noise Conditions for Other Wind Farm Developments

The following Planning Permission relating to the other wind farm developments are discussed in the following sections. As previously stated, it is a requirement that turbine noise emissions from all existing, permitted and proposed wind energy developments are included in the noise impacts assessment.

11.3.6.1 Cloghan Wind Farm

The permissible noise limits for the Cloghan development are contained in Condition No. 11 of An Bord Pleanála Reference PL19.244053

The permitted development provides, by way of condition of consent, that noise levels at all dwellings shall not exceed the greater of 43dB(A) or 5dB(A) above background.

For the assessment presented in this report we have assumed that the absolute noise limit of 43dB $L_{A90\ 10min}$ on turbine noise from the Cloghan wind farm will apply to all NSL's unless a property is listed as a landowner with financial involvement in the project. In these instances, a limit of 45dB L_{A90} has been applied in line with best practice guidance.

11.3.6.2 Meenwaun Wind Farm

The grant of planning for the Meenwaun development does not stipulate noise conditions; however, it does refer to the noise limits outlined in the EIS chapter. The methodology adopted in the Meenwaun EIS is in line with the assessment of Derrinlough presented in this Chapter i.e. the noise level limits presented in the Meenwaun EIS are in line with the current best practice.

In the absence of specific noise limits in the grant of planning, and for the purpose of undertaking a robust assessment, the cumulative turbine limits derived by AWN for the proposed development outlined in Section **Error! Reference source not found.** shall be applied to NSL's in the vicinity of the Meenwaun development. This approach is line with best practice.

11.3.7 Background Noise Assessment

An environmental noise survey was undertaken to determine typical background noise levels at representative NSL's surrounding the development site. The background noise survey was conducted through installing unattended sound level meters at 7 no. representative locations in the surrounding area.

All measurement data collected during the background noise surveys has been carried out in accordance with the Institute to Acoustic's *Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IoA GPG, 2013) and accompanying, Supplementary Guidance Note 1: Data Collection (2014) discussed in the following Section.

11.3.7.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary cumulative turbine noise model contour at an early stage of the assessment. Any locations that fell inside the predicted 35 dB L_{A90} noise contour were considered for noise monitoring in accordance with the threshold level defined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits and supplemented by reviewing aerial images of the study area and other online sources of information (e.g. Google Earth, Bing Maps, etc.).

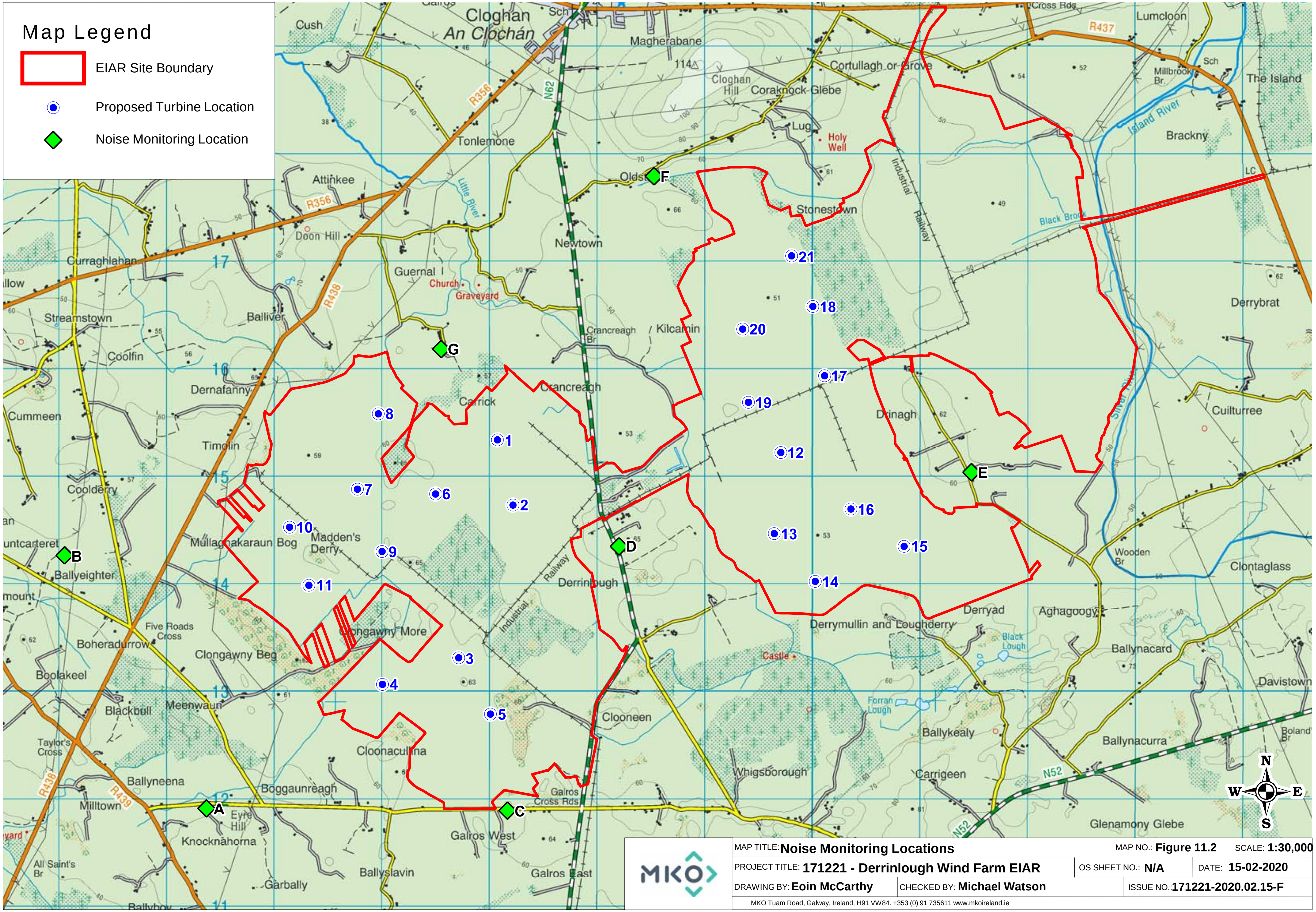
The locations selected for the noise monitoring are outlined in the following sections. Coordinates for the noise monitoring locations are detailed in Table 11.4 and illustrated in Figure 11.2.

Table 11.4 Measurement Location Coordinates

		Coordinates – Irish Grid (IG)	
Location	(ID Ref)	Easting	Northing
A	R186	204,371	211,915
B	n/a	203,052	214,270
C	R156	207,170	211,894
D	R071	208,208	214,353
E	R131	211,485	215,043
F	R062	208,533	217,795
G	R051	206,553	216,175
Met Mast Anemometer	n/a	205673	214805

The NSL's are spread over a relatively large area and the noise monitoring locations were selected to obtain background noise levels representative of the noise environments at noise sensitive locations surrounding the site. Consideration was also given to the potential for noise from existing turbines effecting the survey when selecting the locations.

The background noise away from any significant sources were typically noted to be distant traffic movements, activity in and around the residences and wind generated noise from nearby foliage and other typical anthropogenic sources typically found in such rural settings. Additional descriptions of the



Map Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Noise Monitoring Location

MAP TITLE: Noise Monitoring Locations		MAP NO.: Figure 11.2	SCALE: 1:30,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR		OS SHEET NO.: N/A	DATE: 15-02-2020
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 171221-2020.02.15-F	

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noise environments from observations made on site during installation, interim visits and collection are presented below for each monitoring location where relevant.

Site visits were carried out during the morning and afternoon time; therefore, no observations were made during night-time periods. There was no perceptible source of vibration noted at any of the survey locations.

Plate 11-1 to Plate 11-14 illustrate the installed noise monitoring equipment at each location. Yellow ellipses are added to the photographs to highlight the position of the noise monitoring equipment.

11.3.7.1.1 Location A

The noise meter at Location A was positioned at the side of the house which provided screening to the two nearest turbines at Meenwaun wind farm and the boiler flue on the façade of the garage. Farm machinery was audible in the distance and occasional local traffic was also noted. The nearest turbine at Meenwaun is approximately 1.35km to the northeast and the turbines were not audible during site visits.

Plate 11-1 Location A - Picture 1

Plate 11-2 Location A – Picture 2

11.3.7.1.2 Location B

The noise meter at Location B was positioned at the eastern side of the house. There was a line of sight to the Meenwaun turbines, the nearest turbine being located approximately 1.8km to the southeast. It was noted that these turbines were operating but not audible during site visits. Distant road traffic and birdsong were noted to be the main noise sources at this location.

Plate 11-3 Location B – Picture 1

Plate 11-4 Location B – Picture 2

11.3.7.1.3 Location C

The noise meter at Location C was positioned in the garden on the western side of the house. The nearest turbine at Meenwaun is approximately 1.7km to the northwest. Distance plant machinery noise, road traffic noise and birdsong were noted at this location.

Plate 11-5 Location C – Picture 1

Plate 11-6 Location C – Picture 2

11.3.7.1.4 Location D

Location D was positioned approximately 35m from the edge of the N62 road to the rear of the property. Road traffic noise dominated the noise environment. The Briquette Factory is located approximately 200m to the north and steady broadband noise from this facility was noted to be dominating the background noise during lulls in road traffic.

Plate 11-7 Location D – Picture 1

Plate 11-8 Location D – Picture 2

11.3.7.1.5 Location E

Location E was noted to be a quiet location, distant from any significant environmental noise sources. Road traffic noise from the N62 was audible in the background. The location of the meter at the rear of the house provided screening from the local road (L7005) and distant road traffic noise.

Plate 11-9 Location E – Picture 1

Plate 11-10 Location E – Picture 2

11.3.7.1.6 Location F

The only noise source noted at Location F was distant road traffic from the N62. Local traffic was also noted along the adjacent road (L7009). The meter was positioned at the rear of the house to provide screening from the local road.

Plate 11-11 Location F – Picture 1

Plate 11-12 Location F – Picture 2

11.3.7.1.7 Location G

Location G was noted to be a quiet location, isolated from any significant environmental noise sources. Distant road traffic noise from the N62 was slightly audible but it was noted to be upwind conditions at the time. There was some noise associated with work activity in the stables at the rear of the house but was not considered significant.

Plate 11-13 Location G – Picture 1

Plate 11-14 Location G – Picture 2

11.3.7.2 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the period outlined in Table 11.5.

Table 11.5 Measurement Periods

Location	Start Date	End Date
All	17 January 2019	20 February 2019

The survey was completed when an adequate number of datasets had been measured as recommended in the IOA GPG to determine a suitable representation of the typical background noise.

11.3.7.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. Battery checks and meter calibrations were carried out during the survey periods. The following instrumentation was used at each location.

Table 11.6 Instrumentation Details

Location	Equipment	Serial Number	Maximum Calibration Drift Noted between Checks
A	RION – NL-52	3702	0.1 dB
B	RION – NL-52	12154	0.2 dB
C	RION – NL-52	3392	0.2 dB
D	RION – NL-52	3432	0.1 dB

Location	Equipment	Serial Number	Maximum Calibration Drift Noted between Checks
E	RION – NL-52	3789	-0.1 dB
F	RION – NL-52	4569	0.1 dB
G	RION – NL-52	13789	0.0 dB

Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator where appropriate. Instruments were calibrated on each interim visit and any drift noted. All calibration drifts were less than ±0.5 dB and within acceptable tolerances outlined in the IOA GPG. Relevant calibration certificates are presented in Appendix 11.2.

Rain fall was monitored and logged using a Texas Instruments TR-525 console and a data logger that was installed at Location D for the duration of the survey. The logged rainfall data allows for the identification and removal of sample periods affected by rainfall from the data sets during analysis in line with best practice when calculating the prevailing background noise levels.

Wind data was measured at met mast anemometers located within the site of the proposed development and was supplied to AWN for the data analysis.

11.3.7.4 Procedure

Measurements were conducted at seven locations over the survey periods outlined in Table 11.5 Data samples for all measurements (noise, rainfall and wind) were logged continuously over 10-minute intervals for the duration of the survey.

Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site. Description of the observed noise environment at each of the monitoring locations is presented below. $L_{Aeq,10min}$ and $L_{A90,10min}$ parameters were measured in this instance.

11.3.7.5 Analysis of Background Noise Data

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened form the data sets. The assessment methods outlined above are in line with the guidance contained in the IoA *GPG*.

Consideration has been given to removing contributing noise from the existing Meenwaun turbines for the measured noise data. For guidance, reference has been made to Section 5.2.3 of the IOA GPG which states:

> *"5.2.3 In the presence of an existing wind farm, suitable background noise levels can be derived by one of the following methods:*
>
> - *switching off the existing wind farm during the background noise level survey (with associated cost implications);*
> - *accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by*

the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels;

- *utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established)."*

The approach adopted here is to apply wind directional filtering to the measured data in order to assess background noise data when it was not influenced by the existing turbines e.g. upwind of the receptor.

Upwind filtering has been applied at the relevant locations (i.e. Locations A, B, C and D)

The results presented in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IoA *GPG*. These periods are defined as follows:

- Daytime Amenity hours are:
  - all evenings from 18:00 to 23:00hrs;
  - Saturday afternoons from 13:00 to 18:00hrs, and;
  - all day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

The background noise levels are derived for each location with reference to the standardised 10m height wind speed relative to the assessment hub height of 110m.

11.3.7.5.1 Consideration of Wind Shear

Wind shear is defined as the increase of wind speed with height above ground. As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. The issue of wind shear has been considered in this assessment and followed relevant guidance as outlined in the IoA GPG. It is standard procedure to reference noise data to standardised 10 metre height wind speed.

Wind speed measurements at 84m and 100m heights have been corrected to a height of 110m (the hub height adopted for the noise assessment) in accordance with Method B of Section 2.6 of the IOA GPG. The calculated hub height wind speeds were then corrected to standardised 10 metre height wind speed.

The IoA GPG presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Shear Exponent Profile: $U = U_{ref} \times [(H \div H_{ref})]^m$

Where:

U	Calculated wind speed
U_{ref}	Measured HH wind speed.
H	Height at which the wind speed will be calculated.
H_{ref}	Height at which the wind speed was measured.
m	shear exponent = $\log(U/U_{ref})/\log(H/H_{ref})$

The Calculated hub height wind speeds have been standardised to 10 m height using the following equation:

Roughness Length Shear Profile: $U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured or calculated HH wind speed.
U_1	The wind speed to be calculated.
U_2	The measured or calculated HH wind speed.
z	The roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This 'normalisation' procedure was adopted for comparability between test results for different turbines.

Any reference to wind speed in this chapter should be understood to be the standardised 10m height wind speed reference unless otherwise stated.

11.3.8 Turbine Noise Calculations

A series of computer-based prediction models have been prepared to quantify the cumulative noise level associated with the operation of the permitted and proposed developments. This section discusses the methodology for the noise modelling process.

11.3.8.1 Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, (ISO, 1996).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. *iNoise* calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

11.3.8.2 Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections. Additional information relating to the noise model inputs and calculation settings is provided in Appendix 11.3

11.3.8.2.1 *Turbine Details*

Table 11.7 details the co-ordinates of the 21 no. proposed turbines that are being considered in this assessment.

Table 11.7 Proposed Derrinlough Turbine Co-ordinates

Turbine Ref.	Coordinates – Irish Grid (IG)	
	Easting	Northing
T01	207,077	215,344
T02	207,257	214,738
T03	206,717	213,317
T04	206,008	213,069
T05	207,012	212,792
T06	206,503	214,841
T07	205,775	214,884
T08	205,969	215,587
T09	206,005	214,306
T10	205,144	214,531
T11	205,324	213,991
T12	209,713	215,226
T13	209,652	214,472
T14	210,033	214,027
T15	210,859	214,353
T16	210,364	214,701
T17	210,119	215,941
T18	210,010	216,585
T19	209,411	215,693
T20	209,358	216,375
T21	209,813	217,056

For the purposes of this assessment, the turbine type assumed for the development site is the Vestas V136 4.2/4.0MW. The turbine is a pitch regulated upwind turbine with a three-blade rotor and is considered to be representative to the type of turbine that would be installed or available on the market.

For the purposes of this assessment predictions have assumed the source of noise at a hub height of 110m.

While the noise profiles of the Vestas V136[8] wind turbine has been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process and could include turbines not amongst the turbine models currently available. The turbine eventually selected for installation on site will not give rise to noise levels of greater significance than that used for the purposes of this assessment, to ensure the findings of this assessment remain valid. Any references to the Vestas V136 turbines in this assessment must be considered in the context of the above and should not be construed as meaning it is the only make or model of wind turbine that could be used for the proposed development.

Sound power levels (L_{WA}) have been supplied for the Vestas V136 turbine under consideration. Table 11.8 details the noise emission values used for noise modelling of the proposed Derrinlough turbines.

For the purposes of all predictions presented in this report to account for various uncertainties in the measurement of turbine source levels, a +2dB uncertainty factor has been added to the turbine noise emission values in line with guidance for wind turbine noise assessment contained in the IOA GPG unless otherwise stated below.

Table 11.8 L_{wa} Spectra Used for Prediction Model – Derrinlough Turbine Noise Emissions for Hub Height at 110m.

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	72.2	80.1	85.0	86.9	85.8	81.6	74.5	64.3	91.7
4	75.9	83.9	88.7	90.6	89.4	85.2	78.0	67.7	95.4
5	81.0	88.9	93.8	95.6	94.4	90.2	83.0	72.7	100.4
6	84.5	92.2	96.9	98.7	97.6	93.5	86.6	76.5	103.6
≥7	84.9	92.5	97.2	99.0	97.9	93.8	86.9	76.9	103.9

Table 11.9 details the noise emission values used for noise modelling of the Meenwaun turbines. The noise emission data has been taken from information presented in the relevant EIS chapter[9] for the Meenwaun development and where necessary supplemented with information from AWN's database using data for a similar turbine type.

Table 11.9 L_{wa} Spectra Used for Prediction Model - Meenwaun Turbine Noise Emissions for Hub Height at 109m.

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB LWA
	63	125	250	500	1000	2000	4000	8000	
3	81.1	86.7	89.3	91.3	92.0	88.9	79.3	63.5	97.2
4	83.5	89.4	92.2	93.9	94.3	91.1	81.7	65.9	99.7
5	85.5	92.4	97.0	99.8	100.2	96.4	86.3	69.5	105.0

[8] Vestas Wind Systems A/S Document Ref – DMS no.: 0067-4732_03 dated 2018-05-03. Noise emission values for the Power Optimized (PO1) 4.2MW turbine with Serrated Trailing Edge (STE) blades have been used in this assessment for standard operation mode. The full manufacturer's data is not presented in this chapter for commercial reasons and associated non-disclosure agreements with the manufacturer.
[9] Environmental Impact Statement for The Proposed Meenwaun Wind Farm, Co. Offaly. Volume 2 – Main EIS. Chapter 10 – Noise and Vibration. February 2015.

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB LWA
	63	125	250	500	1000	2000	4000	8000	
≥6	88.5	94.8	98.4	100.4	100.6	97.5	89.1	72.0	106.0

Table 11.10 details the noise emission values used for noise modelling of the Cloghan turbines. The noise emission data in has been taken from information presented in the relevant EIAR chapter submitted to Offaly County Council in 2019 as part of the planning application for proposed amendments to the consented Cloghan Wind Farm[10] development.

Table 11.10 L_{wa} Spectra Used for Prediction Model – Cloghan Turbine Noise Emissions for Hub Height at 100.5m.

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	72.9	78.7	82.5	85.5	88.2	88.1	79.8	65.3	93.1
4	77.3	83.1	86.9	89.9	92.6	92.5	84.2	69.7	97.4
5	82.3	88.1	91.9	94.9	97.6	97.5	89.2	74.7	102.4
6	85.7	91.5	95.3	98.3	101.0	100.9	92.6	78.1	105.9
≥7	86.8	92.6	96.4	99.4	102.1	102.0	93.7	79.2	107.0

An uncertainty factor of +1.1 dB is included, in line with the uncertainty factor used in the proposed Cloghan wind farm development. The predicted turbine noise levels from the proposed Cloghan development are greater than the turbine noise levels presented in the EIS for the permitted development therefore the turbine noise emissions for the proposed Cloghan development have been used in this assessment.

As outlined, appropriate guidance is couched in terms of a L_{A90} criterion. The provided turbine noise is referenced in terms of the L_{Aeq} parameter. Best practice guidance contained within the IoA GPG states that *"L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB"*. Therefore, in accordance with best practice guidance, a 2dB reduction has been applied to the predicted results in this assessment.

Best practice specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility. For this assessment, a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine to ensure that the noise output will not require a tonal noise correction under best practice guidance.

Appendix 11.3 presents additional details relation to the turbine noise model inputs and the turbine location coordinates for other turbines.

[10] *Cloghan Wind Farm – Revised Turbine Dimensions and Site Layout Environmental Impact Assessment Report / Environmental Impact Statement – Volume 1, July 2019*

11.3.8.3 Consideration of Wind Direction and Noise Propagation

When considering noise impacts of wind turbines, the effects of propagation in different wind directions should be considered. The day to day operations of the optimised development will not result in a worst-case condition of all noise locations being downwind of all turbines at the same time i.e. omni-directional predictions. Therefore, to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IoA GPG Guidance.

For any given wind direction, a property can be assigned one of the following classifications in relation to turbine noise propagation:

- Downwind (i.e. 0° ±80°);
- Crosswind (i.e. 90° ±10° and 270° ±10°);
- Upwind (i.e. 180° ±70°).

Figure 11.2 illustrates the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (downwind is represented by 0° with upwind being 180°).

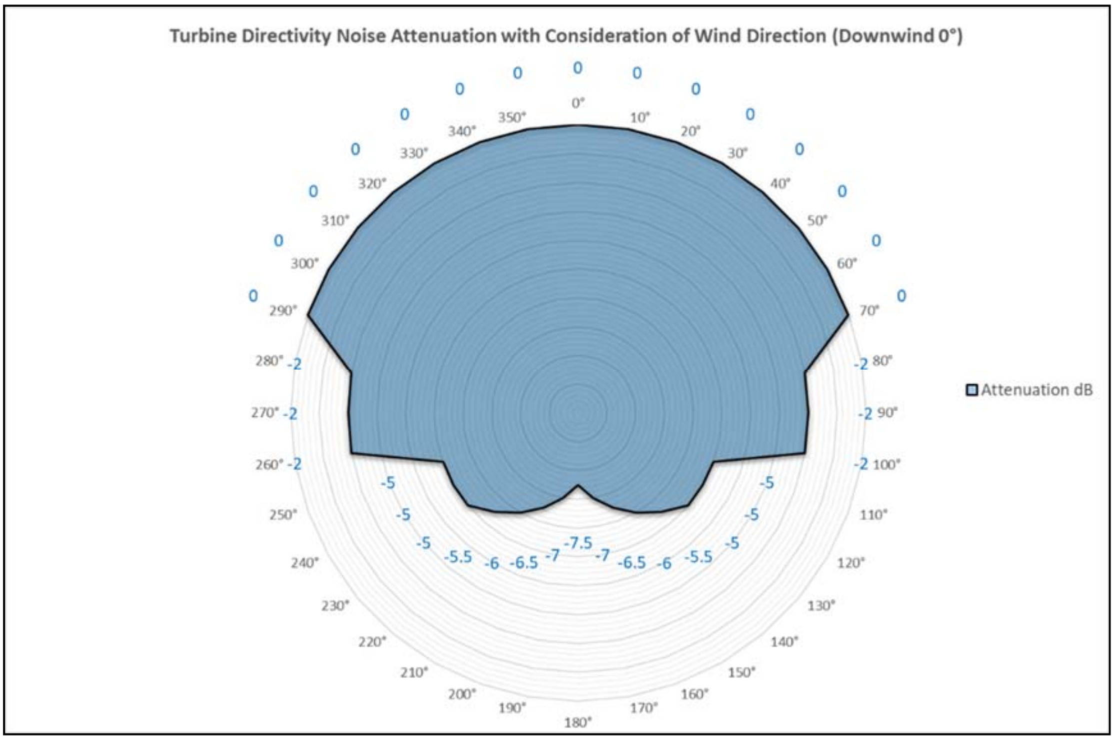


Figure 11.2 Turbine Directivity Attenuation with Consideration of Wind Direction

11.3.8.4 Assessment of Turbine Noise Levels

The predicted cumulative turbine noise level from the proposed development, and all permitted and proposed development in the area will be compared against the derived turbine noise limits and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be outlined.

The following presents a breakdown of the various steps involved in the assessment of operational turbine noise level:

- Screen the cumulative turbine noise predictions against the lowest potential (worst-case) criteria outlined in Table 11.11 to identify any locations with a potential exceedance.
- Undertake directional noise prediction calculations to refine the noise prediction results as described in Section 11.3.8.3.
- Identify locations with potential cumulative exceedances that occur as result of the proposed development only (i.e. Derrinlough turbines).
- Calculate the level of attenuation required from the Derrinlough turbines to achieve the adopted turbine noise criteria or the attenuation required to Derrinlough such that the predicted contribution of the Derrinlough turbines is 10 dB below the cumulative turbine limit value in accordance with best practice guidance.

11.3.9 Assessment of Construction Impacts

The potential impacts of the construction phase noise and vibration in addition to the potential impacts from additional vehicular activity on public roads will be assessed in accordance with best practice guidance as outlined in 11.3.2.1.

11.4 Receiving Environment

This stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive locations (NSL's) in proximity to the proposed development. The methodology for the assessment is outlined in 11.3.7 and the results of the assessment are outlined in the following sections.

A variety of wind speed and weather conditions were encountered over the survey period outlined in Section 11.3.7.2. Figure 11.3 illustrates the distributions of wind speed and wind direction standardised to 10 metre height over the baseline noise survey period detailed in Table 11.15.

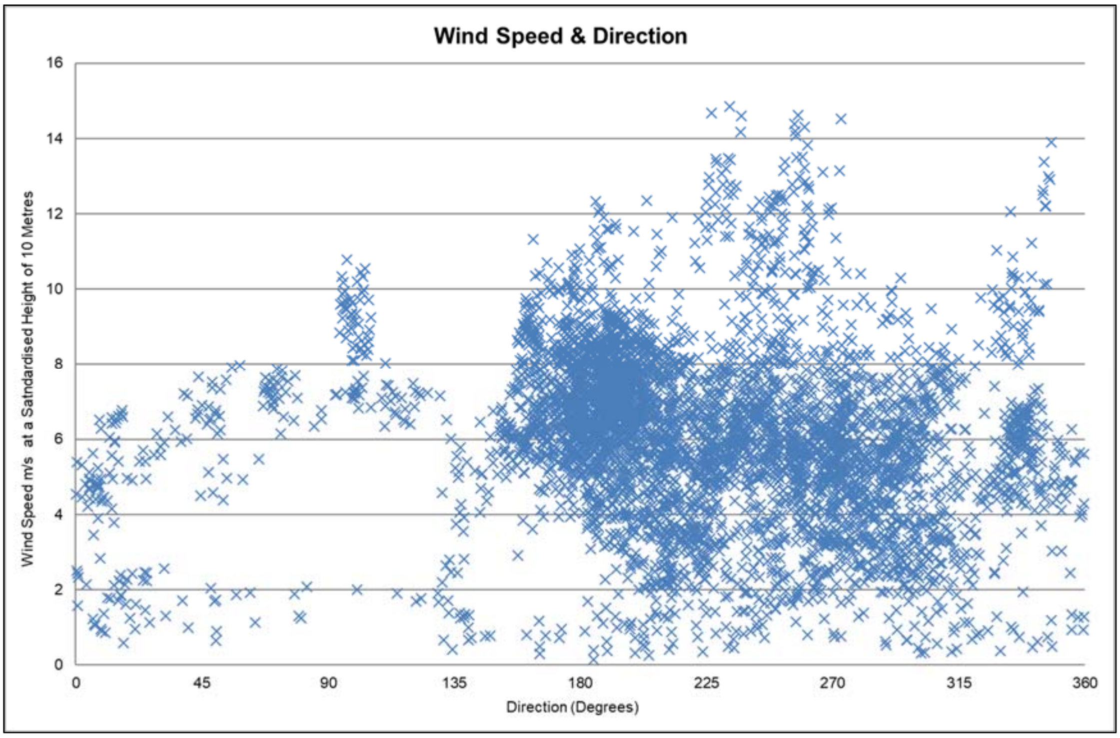


Figure 11.3 Distributions of Wind Speeds and Directions Over the Survey Period

11.4.1 Background Noise Levels

The following sections present an overview and results of the noise monitoring data obtained from the background noise survey in accordance with the methodology set out in Section 11.3.7 and 11.3.7.5. For each location two graphs are presented one shows the screened noise datasets used to derive the daytime background noise levels and the other shows the night time datasets.

11.4.1.1 Location A

11.4.1.1.1 *Daytime Quiet Periods*

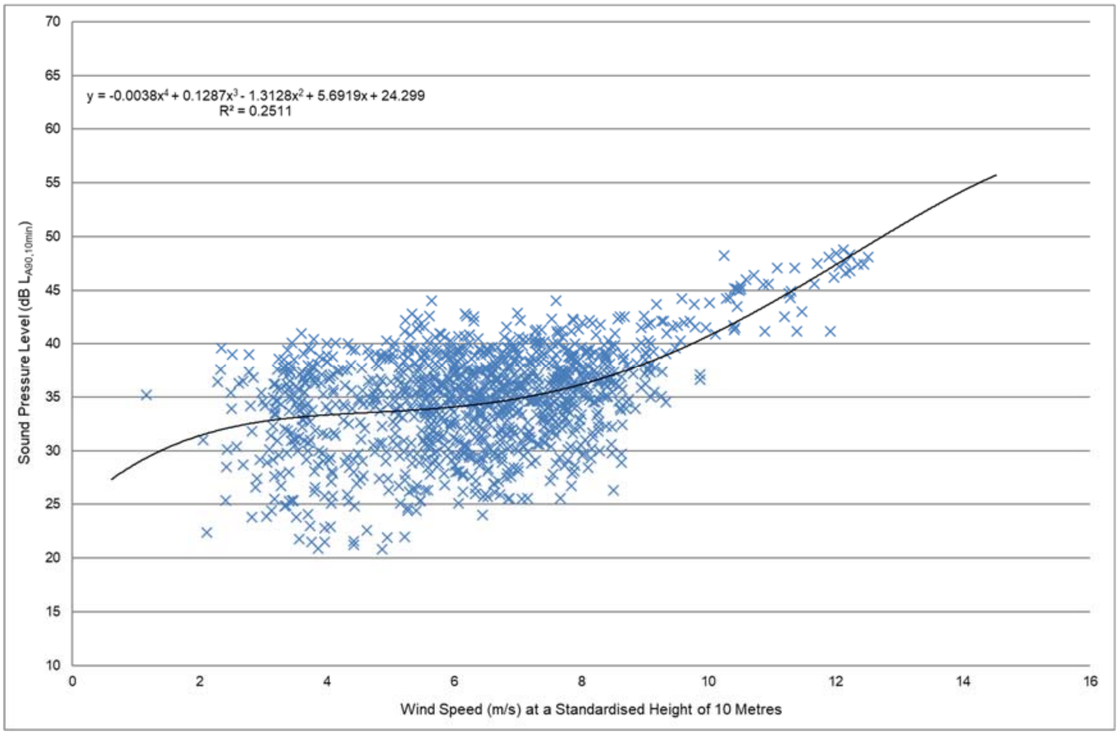


Figure 11.4 Location A - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime

11.4.1.1.2 *Night-time Quiet Periods*

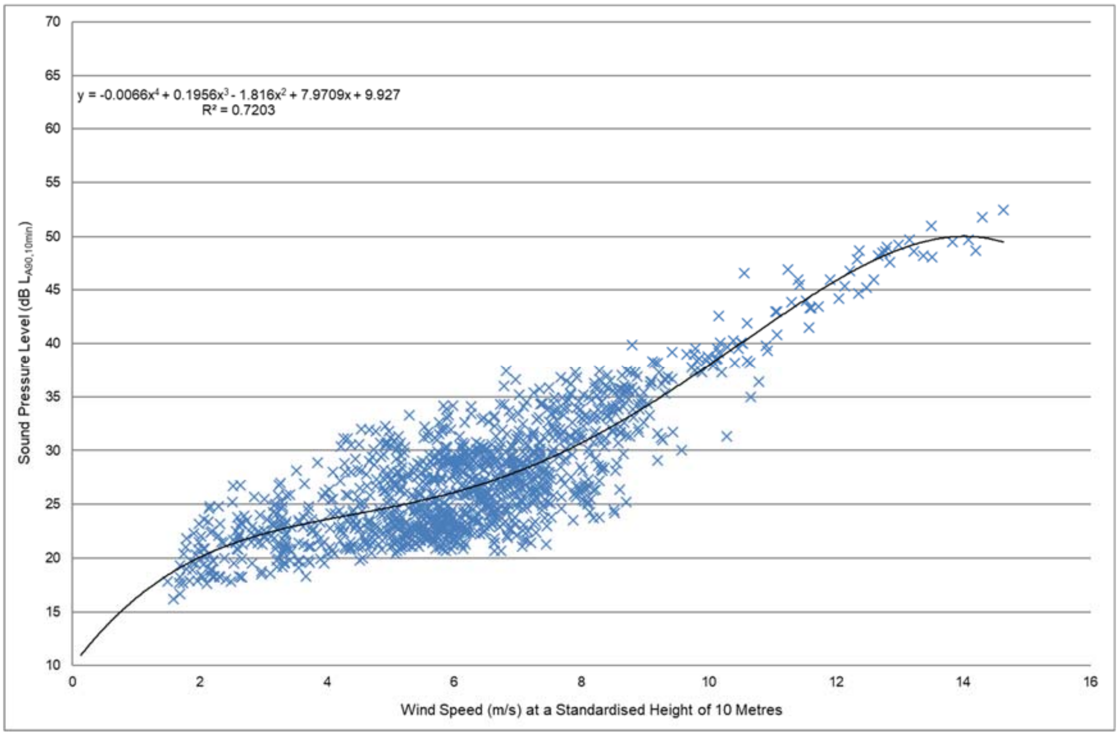


Figure 11.5 Location A - Background Noise Levels dB $L_{A90,\ 10\ min}$–Night -time

11.4.1.2 Location B

11.4.1.2.1 *Daytime Quiet Periods*

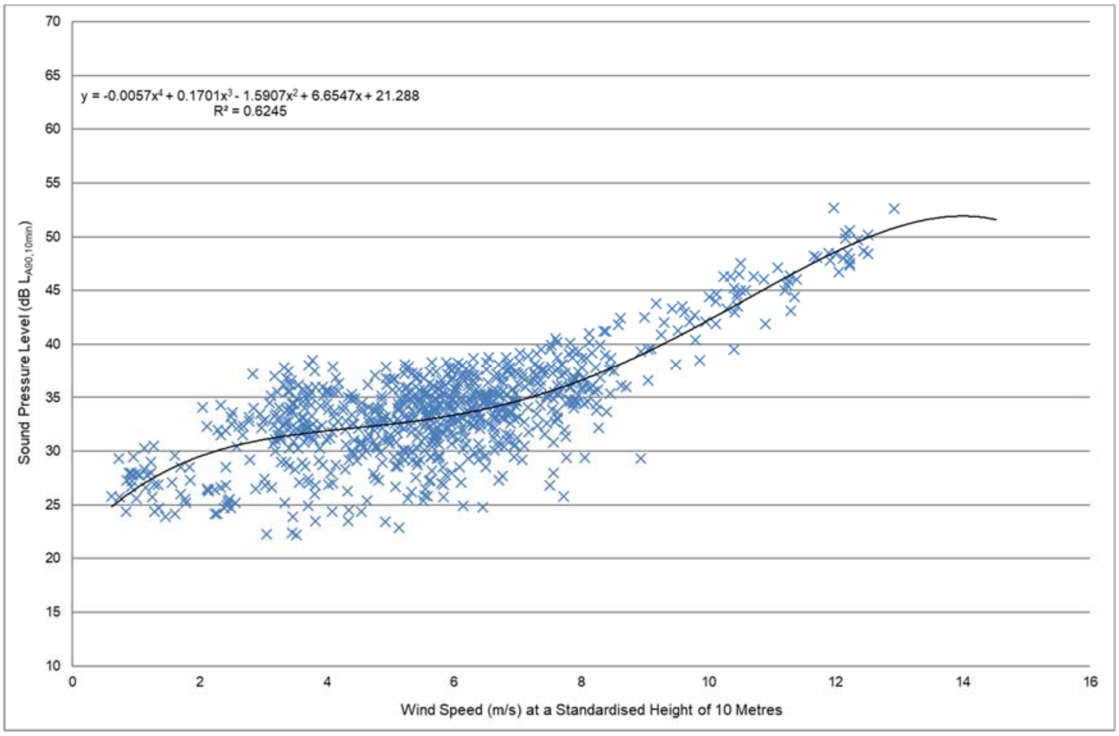


Figure 11.6 Location B - Background Noise Levels dB $L_{A90,\ 10\ min}$–Daytime

11.4.1.2.2 *Night-time Quiet Periods*

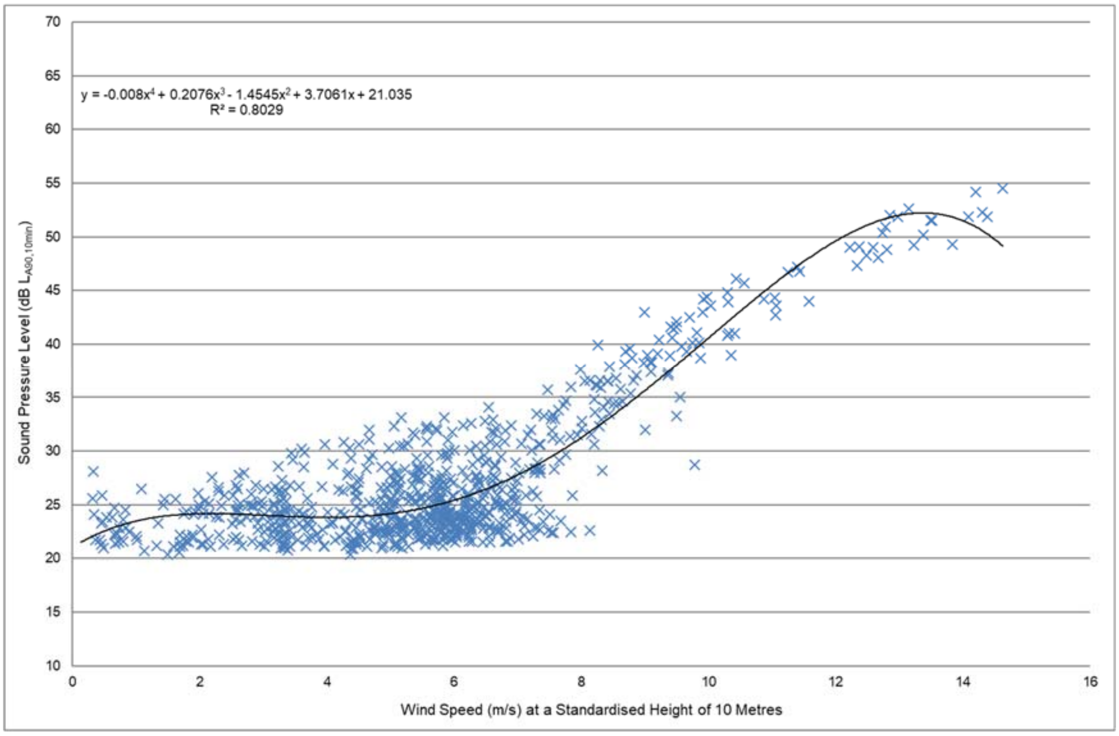


Figure 11.7 *Location B - Background Noise Levels dB $L_{A90,\ 10\ min}$–Night -time*

11.4.1.3 Location C

11.4.1.3.1 *Daytime Quiet Periods*

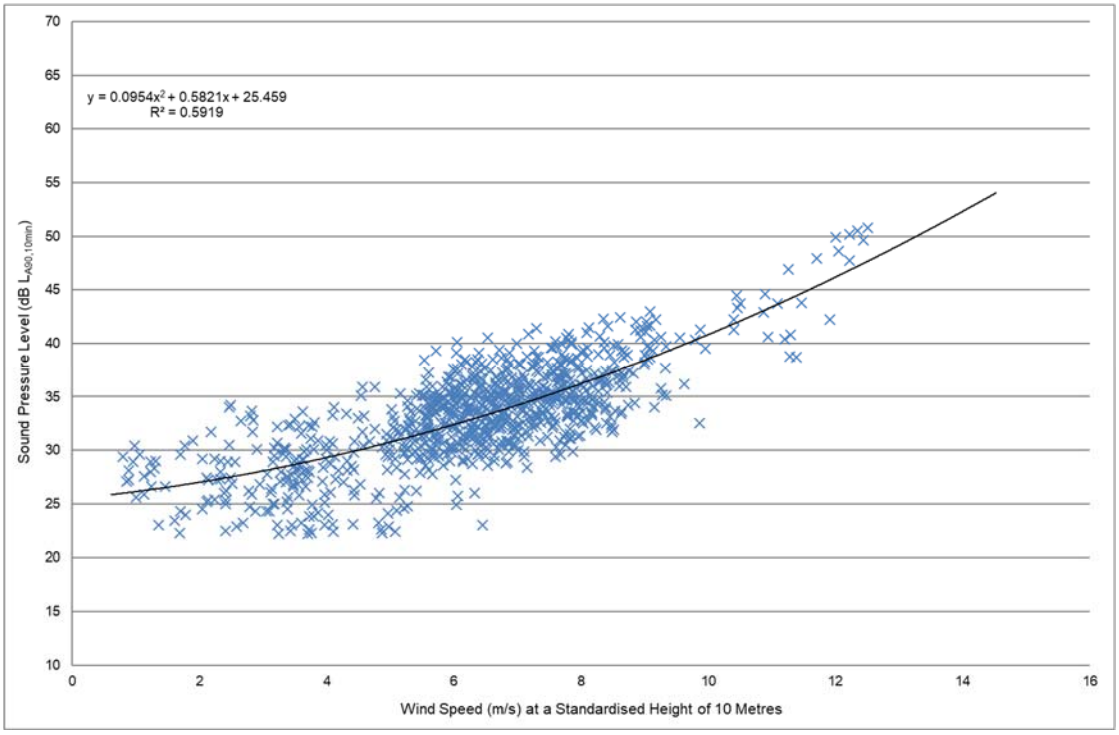


Figure 11.8 *Location C - Background Noise Levels dB $L_{A90,\ 10\ min}$–Daytime*

11.4.1.3.2 *Night-time Quiet Periods*

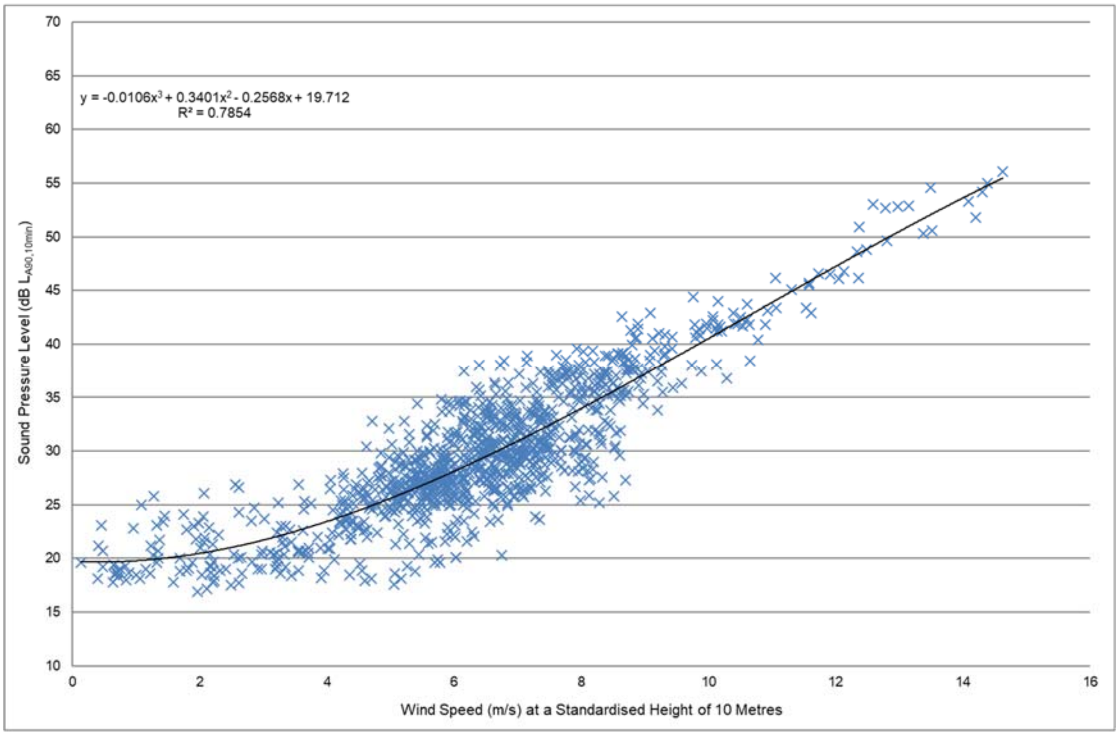


Figure 11.9Location C - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time

11.4.1.4 Location D

11.4.1.4.1 *Daytime Quiet Periods*

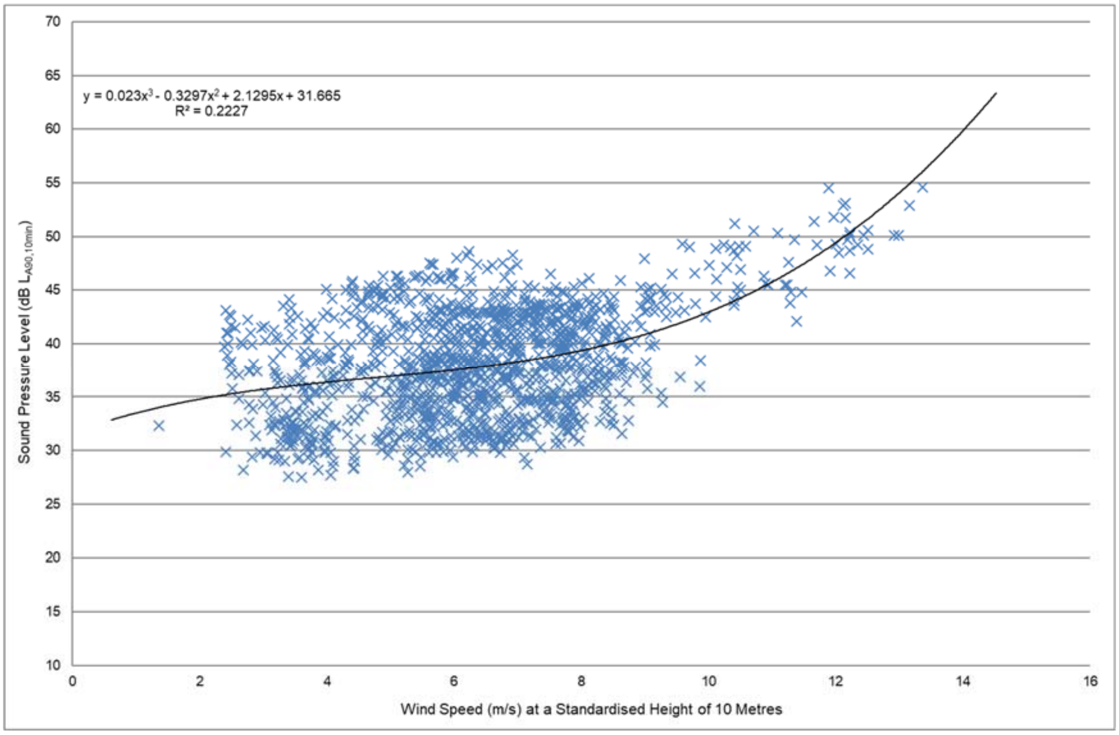


Figure 11.10 Location D - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime

11.4.1.4.2 Night-time Quiet Periods

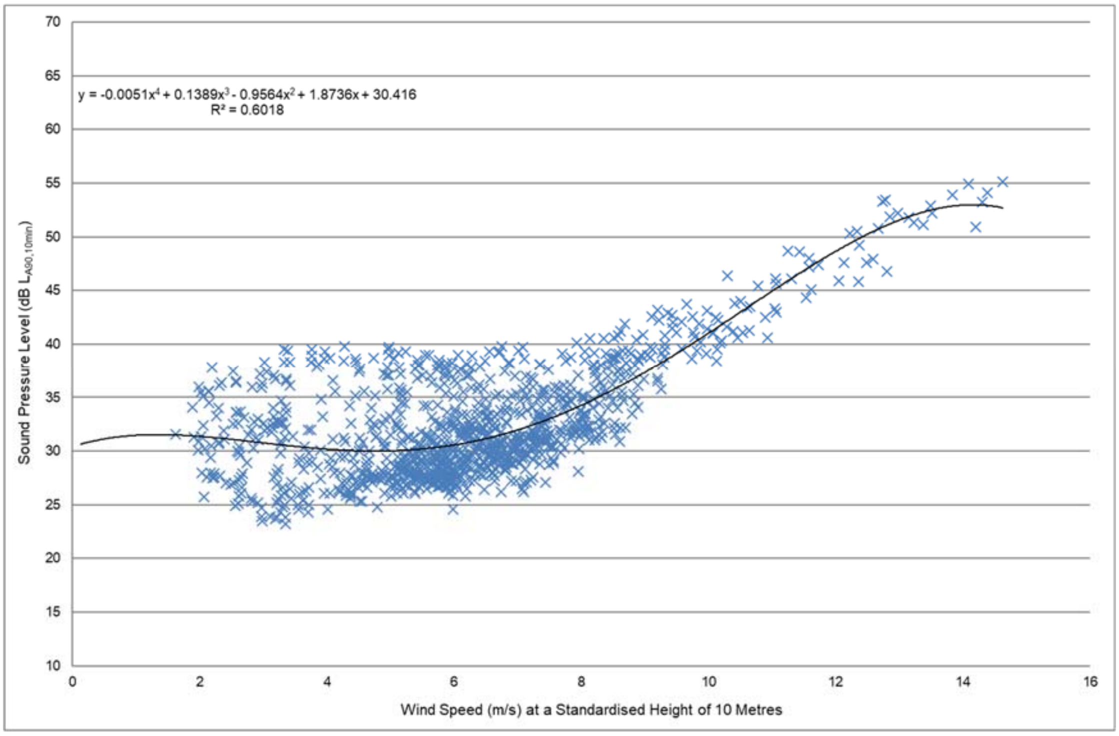


Figure 11.11 Location D - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time

11.4.1.5 Location E

11.4.1.5.1 Daytime Quiet Periods

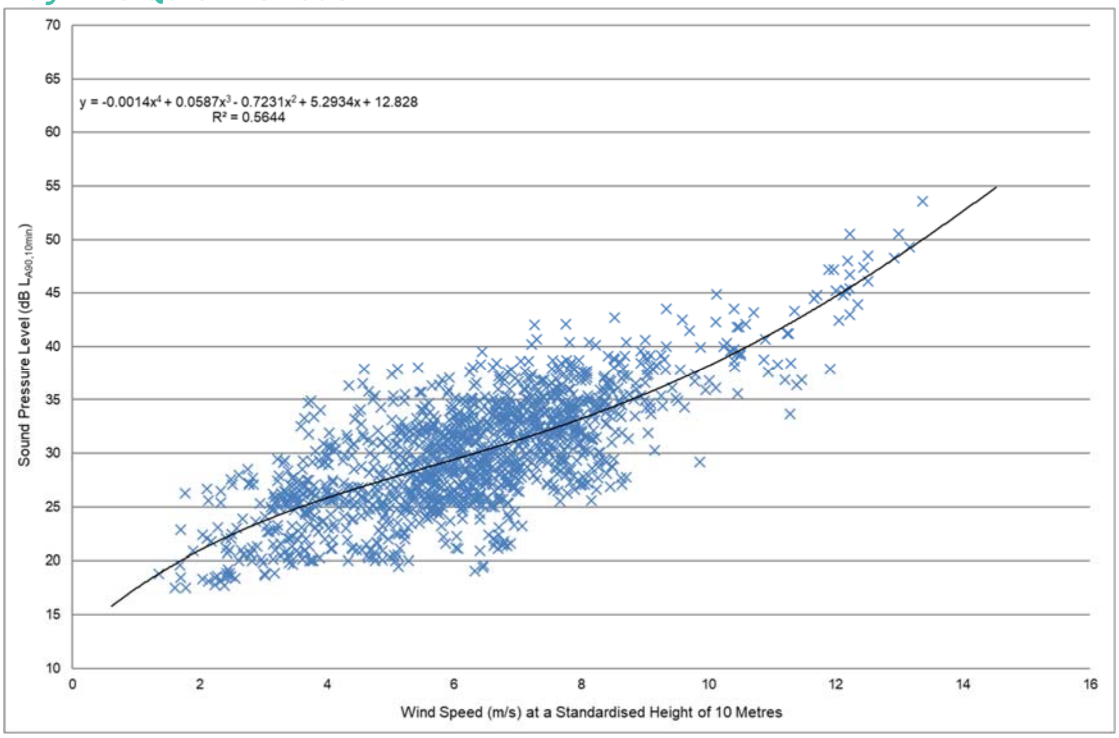


Figure 11.12 Location E - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime

11.4.1.5.2 *Night-time Quiet Periods*

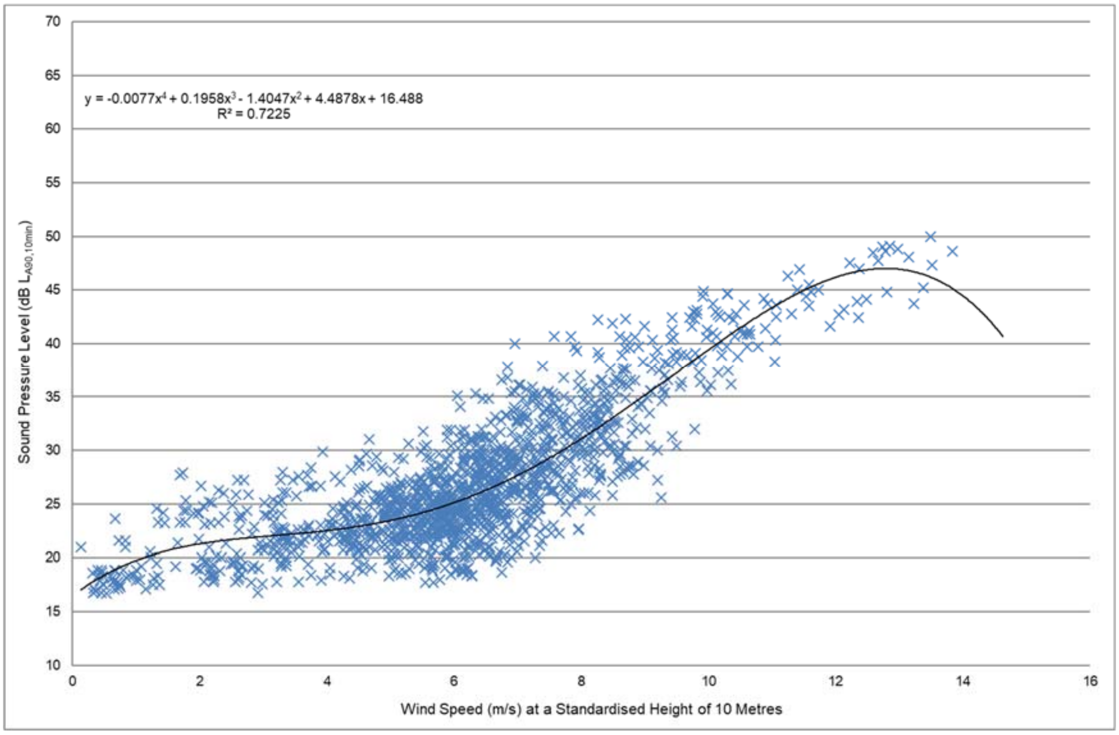


Figure 11.13 Location E - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time

11.4.1.6 Location F

11.4.1.6.1 *Daytime Quiet Periods*

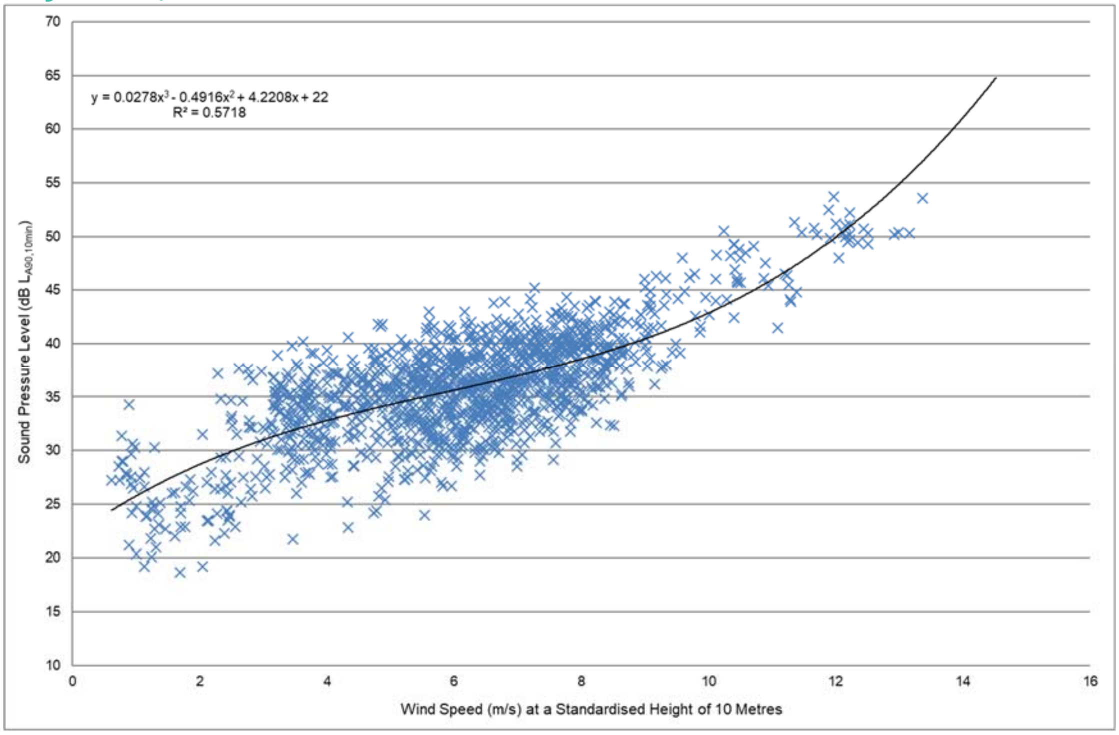


Figure 11.14 Location F - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime

11.4.1.6.2 *Night-time Quiet Periods*

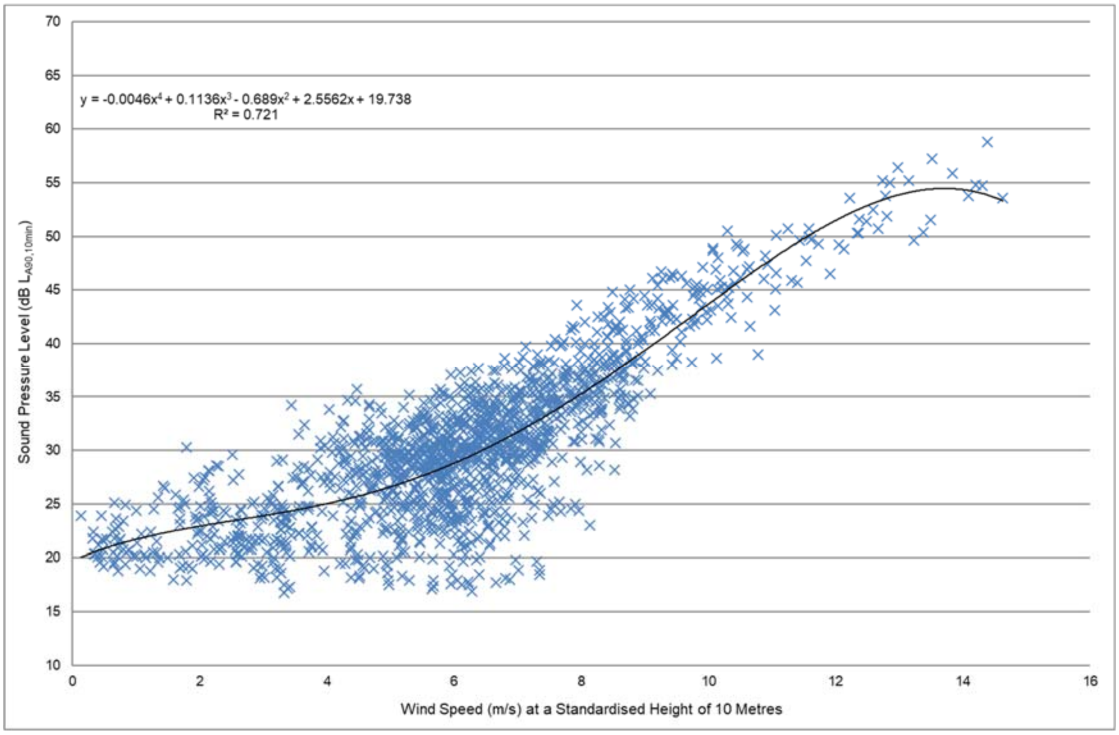


Figure 11.15 Location F - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time

11.4.1.7 Location G

11.4.1.7.1 *Daytime Quiet Periods*

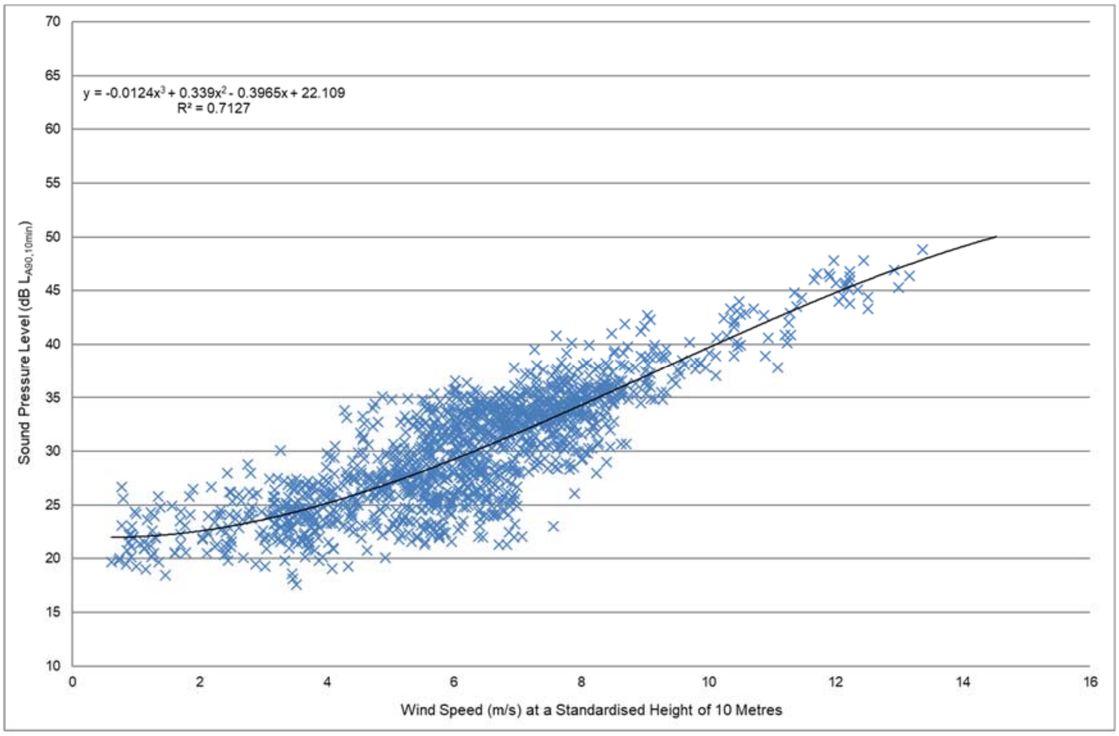


Figure 11.16 Location G - Background Noise Levels dB $L_{A90,\ 10\ min}$– Daytime

11.4.1.7.2 Night-time Quiet Periods

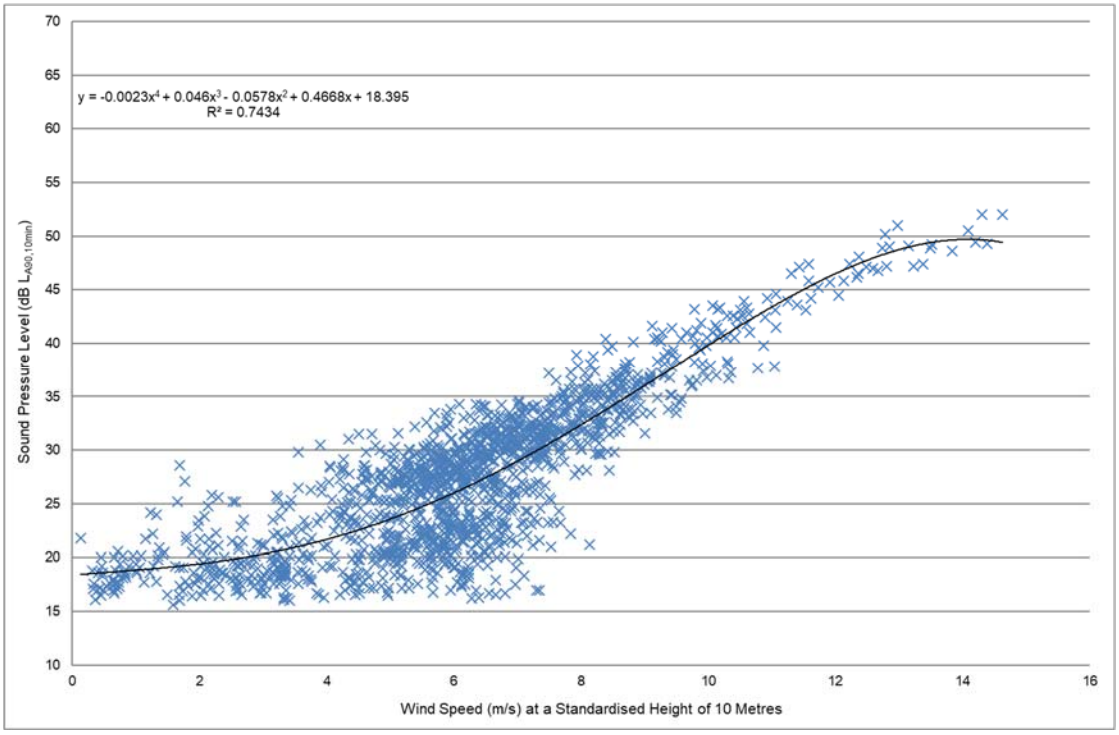


Figure 11.17 Location G - Background Noise Levels dB $L_{A90,\ 10\ min}$– Night -time

11.4.1.8 Summary of Background Noise Levels

Table 11.11 presents the various derived LA90,10min noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using regression analysis carried out on the data sets in line with guidance contained the IoA GPG and the *Supplementary Guidance Note (SGN) No. 2 Data Processing & Derivation of ETSU-R-97 Background Curves.*

Table 11.11 Derived Background Noise Levels

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A	Day	32.7	33.3	33.7	34.1	34.8	36.1	38.1	40.6
	Night	22.2	23.6	24.7	26.1	28.0	30.6	33.9	37.6
B	Day	31.1	31.9	32.5	33.3	34.6	36.5	38.9	41.9
	Night	23.8	23.8	24.2	25.4	27.7	31.1	35.4	40.2
C	Day	28.1	29.3	30.8	32.4	34.2	36.2	38.4	40.8
	Night	21.7	23.4	25.6	28.1	30.9	34.0	37.2	40.6
D	Day	35.7	36.4	36.9	37.5	38.3	39.4	40.9	43.0
	Night	30.0	30.0	30.0	30.6	32.1	34.4	37.6	41.4
E	Day	23.7	25.8	27.7	29.4	31.2	33.2	35.5	38.2
	Night	22.0	22.5	23.5	25.2	27.7	31.2	35.3	39.7

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
F	Day	31.0	32.8	34.3	35.6	37.0	38.5	40.4	42.8
	Night	23.9	25.0	26.6	28.8	31.8	35.4	39.6	44.0
G	Day	23.6	25.2	27.1	29.3	31.7	34.3	37.0	39.6
	Night	20.3	21.7	23.6	26.1	29.1	32.6	36.4	40.3
Envelope	Day	23.6	25.2	27.1	29.3	31.2	33.2	35.5	38.2
	Night	20.3	21.7	23.5	25.2	27.7	30.6	33.9	37.6

A worst-case envelope based on the lowest average levels at the various wind speeds for both day and night time is presented in Table 11.11. It is proposed to adopt this envelope limit to derive turbine noise thresholds for the initial screening phase of the assessment. In a situation where measurements have been conducted near another receiver or the location is deemed to be representative of the measured background noise levels at other locations, these can be used for establishing appropriate noise limits at other locations.

The background noise data shall be used to derive appropriate noise limits for each of the noise sensitive locations.

11.4.2 Wind Turbine Noise Criteria

A lower daytime threshold of 40 dB $L_{A90,10\text{-}min}$ has been adopted for low noise environments where the background noise is less than 30 dB(A). This follows a review of the prevailing background noise levels and is deemed appropriate considering of the following:

- The EPA document *'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)'* (EPA, 2016) proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. The proposed lower threshold here is 5 dB more stringent than this level.
- The nearby Cloghan wind farm has permitted noise limits are as per Condition No. 11 of An Bord Pleanála Reference PL19.244053 with a lower threshold for turbine noise of 43 dB $L_{A90,10\text{-}min.}$
- The grant of planning for the Meenwaun development refer to the noise limits outlined in the EIS chapter which proposed a lower threshold for turbine noise of 40 dB $L_{A90,10\text{-}min}$.
- It is reiterated that the 2006 *Wind Energy Development Guidelines* states that "*An appropriate balance must be achieved between power generation and noise impact.*"

Based on other national guidance (EPA, 2016) in relation to acceptable noise levels in areas of low background noise and grant of planning conditions for other permitted wind turbine development in the area it is considered that the criteria adopted as part of this assessment are robust.

Following comparison of the previously presented guidance the proposed operational limits in $L_{A90,10min}$ for the proposed development are:

- 40 dB $L_{A90,10min}$ for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;

- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night time periods.

With respect to the methodology in relevant guidance documents outlined in Section 11.3.2.2 the noise criteria curves in Table 11.12 have been derived for the NSL's surrounding the proposed development. These limit values are determined through applying the criteria to the derived background noise levels in Table 11.11.

Table 11.12 Noise Criteria Curves

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A	Day	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.6
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
B	Day	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.9
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.2
C	Day	40.0	40.0	45.0	45.0	45.0	45.0	45.0	45.8
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.6
D	Day	45.0	45.0	45.0	45.0	45.0	45.0	45.9	48.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.4
E	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.7
F	Day	45.0	45.0	45.0	45.0	45.0	45.0	45.4	47.8
	Night	43.0	43.0	43.0	43.0	43.0	43.0	44.6	49.0
G	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.3
Envelope	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

11.5 Likely Significant Effects and Associated Mitigation Measures

11.5.1 Do-Nothing Scenario

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

If development were not to proceed then the existing noise environment will remain largely unchanged notwithstanding other proposed and permitted wind turbine developments in the area. In areas where traffic noise is a significant source in the environment, increases in traffic volumes on the local road network would be expected to result in slight increases in overall ambient and background noise in the area over time.

11.5.2 Construction Phase Potential Impacts

A variety of items of plant will be in use for the purposes of site preparation, construction of turbines, roads, substation and other site works. There will be vehicular movements to and from the site that will make use of existing roads. Due to the nature of these activities, there is potential for generation of significant levels of noise. These are discussed in the following Sections.

Due to the nature of the construction activities it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels at the nearest sensitive receptor using guidance set out in *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

The predicted noise levels referred to in this section are indicative only and are intended to demonstrate that the contractor can comply with current best practice guidance. It should also be noted that the predicted "worst case" levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the proposed development.

There are several stages and elements associated with the construction phase of the proposed development which will include the following:

- Turbines and Hardstands;
- Substation and Grid connection;
- Site entrances;
- Internal roads;
- Met Masts;
- Underpasses;
- Internal amenity pathways;
- Additional amenity links; and
- Amenity Carpark.

Detailed information is included in Chapter 4: Description of the Proposed Development.

In general, the distances between the construction activities associated with the proposed development and the nearest NSL's are such that there will be no significant noise and vibration impacts at NSL's. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration impacts, all other stages and element are considered not to have significant noise and vibration impacts at NSL's.

11.5.2.1 Turbines, Hardstands, Substation, Grid Connection and Internal Roads

11.5.2.1.1 *Noise*

Turbine and Hardstands

Several indicative sources that would be expected on a site of this nature have been identified and predictions of the potential noise emissions calculated at the nearest sensitive receptor. The assessment is considered to be a worst-case, construction noise levels will be lower at properties located further from the works. The nearest sensitive location (NSL) (R130) is situated approximately 762m from proposed Turbine 15.

Table 11.13 outlines the noise levels associated with the typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8-hours over a 12-hour assessment period.

Table 11.13 Typical Construction Noise Emission Levels for Turbine Construction

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [11]	Predicted Noise Level at 750m (dB $L_{Aeq,T}$)
HGV Movement (C.2.30)	Removing soil and transporting fill and other materials.	79	31
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	29
Piling Operations (C.12.14)	Standard pile driving.	88	40
General Construction (Various)	All general activities plus deliveries of materials and plant.	84	33
Dewatering Pumps (D.7.70)	If required.	80	32
JCB (D.8.13)	For services, drainage and landscaping.	82	34
Grid Connection Works	Breaking, excavation, loaders and road roller	82	34
Vibrating Rollers (D.8.29)	Road surfacing.	77	29

[11] *All plant noise levels are derived from BS 5228: Part 1*

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [11]	Predicted Noise Level at 750m (dB $L_{Aeq,T}$)
Total Construction Noise (cumulative for all activities)			44

At the nearest noise sensitive location, the predicted noise levels from construction activities are in the range of 29 to 40 dB $L_{Aeq,T}$ with a total worst-case construction level of the order of 44 dB $L_{Aeq,T}$. In all instances the predicted noise levels at the nearest NSL's are below the appropriate criteria outlined in Section 11.4.1 (Category A - 65 dB $L_{Aeq,T}$ during daytime periods).

This assessment is considered representative of worst-case and construction noise levels will be lower at properties located further than 750 m from the works.

There is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Section 11.4.1 and this assessment took into account all items of plant operating simultaneously.

It is concluded that there will be no significant noise impacts associated with the construction of the turbine and hardstands and therefore no specific mitigation measures will be required.

Substation and Grid Connection Works

The proposed substation is located in north-east Drinagh (refer to site layout drawings in Appendix 4.4 of the EIAR). The noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the construction of the Substation at the nearest NSL.

The nearest NSL to the substation site is at approximately 330m with grid connection works expected to take place at a closer distance of 270m to the same NSL at the closest point of the works. Based on the same construction activities as outlined in Table 11.13 it is predicted that the likely worst-case potential noise level due to construction activities associated with the substation will be in the order of 53 dB $L_{Aeq,T}$ at the nearest NSL which is well below the significance threshold of 65dB $L_{Aeq,1hr.}$ outlined in Section 11.4.1.

It is concluded that there will be no significant noise impacts associated with the construction of the substation and grid connection and therefore no specific mitigation measures will be required.

Internal Roads

It is proposed to construct new and upgrade existing internal roads to access the proposed turbines and associated infrastructure as part of the proposed development. Review of the internal road layout has identified that the nearest NSL is R184 which is located 200m from the proposed works. All other locations are at greater distances with the majority at significantly greater distances. The full description of the proposed internal roads is outlined in Chapter 4 of the EIAR.

Table 11.14 outlines the typical construction noise levels associated with the proposed works for this element of the construction. Calculations have assumed an on-time of 66% for each item of plant.

Table 11.14 Typical Construction Noise Emission Levels for Roads

Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [12]	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)
		200m
HGV Movement (C.2.30)	79	43
Mini Tracked Excavator with Rock Breaker (C5.2)	83	47
Vibrating Rollers (D.8.29)	77	41
Total Construction Noise (cumulative for all activities)		49

At the nearest noise sensitive location, the predicted noise levels from construction activities are of the order of 49 dB $L_{Aeq,T}$, which is well below the significance threshold of 65dB $L_{Aeq,1hr.}$ outlined in **Error! Reference source not found.**. The calculated noise levels presented are considered to present a worst-case scenario as they are assessed at the closest point along all roads.

It is concluded that there will be no significant noise impacts associated with the construction of internal roads and therefore no specific mitigation measures will be required.

11.5.2.1.2 *Vibration*

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

It is concluded that there will be no significant vibration impacts associated with the construction phase of the proposed development and therefore no specific mitigation measures will be required.

11.5.2.1.3 *Description of Effects*

With respect to the EPA criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with the construction of Turbines, Hardstands, Substation, Grid Connection and Internal Roads of the proposed development are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

It is not expected that there will be any significant cumulative impacts at NSL's should the various elements of the construction phase be undertaken simultaneously.

11.5.2.2 Construction Traffic

This section has been prepared in order to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 14 (Section 14.1 Traffic and Transport) has been used to inform the assessment here.

[12] *All plant noise levels are derived from BS 5228: Part 1*

The following situations are commented upon here:

- Stage 1a – Site Preparation – Concrete Pouring
- Stage 1b – Site Preparation and Ground Works
- Stage 2a – Extended Artic Deliveries (large turbine components)
- Stage 2b – Other Deliveries (small turbine components)

Changes in the traffic noise levels associated with the additional traffic for each of the construction stages listed above have been calculated for several routes. Table 11.15 presents a summary of the data used for the calculations in this assessment. The figures in Table 11.15 have been derived from the traffic data in Chapter 14 with corrections applied for the passenger car unit (PCU) factors.

Table 11.15 Construction Traffic Data for Assessment

Route	Stage	Traffic Units	%HGV
1. N52 – Tullamore	Baseline year (2022)	5,383	7.2
	1a	5,653	9.5
	1b	5,674	9.9
	2a	5,473	7.3
	2b	5,469	7.2
2. N52 – Birr	Baseline year (2022)	8,221	7.2
	1a	8,491	8.7
	1b	8,513	9.0
	2a	–	–
	2b	–	–
3a. N62 - North of access	Baseline year (2022)	2,967	11.0
	1a	3,237	14.7
	1b	3,259	15.3
	2a	–	–
	2b	–	–
3b. N62 – South of access	Baseline year (2022)	2,967	11.0
	1a	3,237	14.7
	1b	3,259	15.3
	2a	3,057	11.0
	2b	3,054	10.9

Route	Stage	Traffic Units	%HGV
4. R357	Baseline year (2022)	2,346	7.2
	1a	–	–
	1b	2,637	12.9
	2a	–	–
	2b	–	–

Based on the traffic data presented in Table 11.15 the changes in noise level relative to the expected traffic noise from the baseline year (2022) have been calculated and are outlined in Table 11.16.

Table 11.16 Calculated Changes in Traffic Noise Levels

Stage	Route	Change in Traffic Noise Level dB(A)	Estimated Number of Days
1a – Site Preparation – Concrete Pouring	1. N52 – Tullamore	1.1	6
	2. N52 – Birr	0.7	4
	3a. N62 - North of access	1.4	11
	3b. N62 – South of access	1.4	10
	4. R357	–	–
1b – Site Preparation and Ground Works	1. N52 – Tullamore	1.2	147
	2. N52 – Birr	0.8	98
	3a. N62 - North of access	1.5	245
	3b. N62 – South of access	1.5	245
	4. R357	2.4	7
2a – Extended Artic Deliveries (large turbine components)	1. N52 – Tullamore	0.1	38
	2. N52 – Birr	–	–
	3a. N62 - North of access	–	–
	3b. N62 – South of access	0.1	38
	4. R357	–	–
2b – Other Deliveries (small turbine components)	1. N52 – Tullamore	0.1	21
	2. N52 – Birr	–	–
	3a. N62 - North of access	–	–

Stage	Route	Change in Traffic Noise Level dB(A)	Estimated Number of Days
	3b. N62 – South of access	0.1	21
	4. R357	–	–

The predicted increases in traffic noise levels during each of the construction stages of the proposed development are less than 3 dB along all routes. With reference to the criteria set out in Section 11.3.2.1.2 the potential impacts are minor are worst case and no additional mitigation measures are proposed.

It is concluded that there will be no significant noise impacts associated with the additional traffic generated during the construction phase of the proposed development and therefore no specific mitigation measures will be required.

11.5.2.2.1 Description of Effects

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest noise sensitive associated with the additional traffic generated during the construction phase of the proposed development are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

11.5.3 Operational Phase Potential Impacts

11.5.3.1 Turbine Noise Assessment

The predicted noise levels for the proposed development has been calculated for all noise sensitive locations identified within a minimum radius of 2 km of the proposed turbines.

A worst-case omni-directional assessment has been completed assuming all noise locations are downwind of all turbines at the same time (an impossible scenario) and noise predictions have been made using the ISO 9613-2 standard relate to worst-case conditions favorable to noise propagation (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions).

Due to the number of NSL’s included in the assessment, an initial screening of the cumulative omni-directional noise levels has been undertaken by comparing the worst-case predicted turbine noise levels against the worst-case criteria curves based on the lowest background noise level envelope for day and night. This screening exercise identified a total of 19 no. NSL with potential exceedance of the worst-case noise criteria curve envelope. The 19 NSL’s are listed in Table 11.17. At all other NSL’s the cumulative turbine noise levels are predicted to be below the criteria curves. Figure 11.19 overleaf presents a map of the proposed development showing all NSL’s

Table 11.17 List of Location with Potential Exceedances

NSL Ref.	Coordinates – Irish Grid (IG)	
	Easting	Northing
R007	204,416	212,866

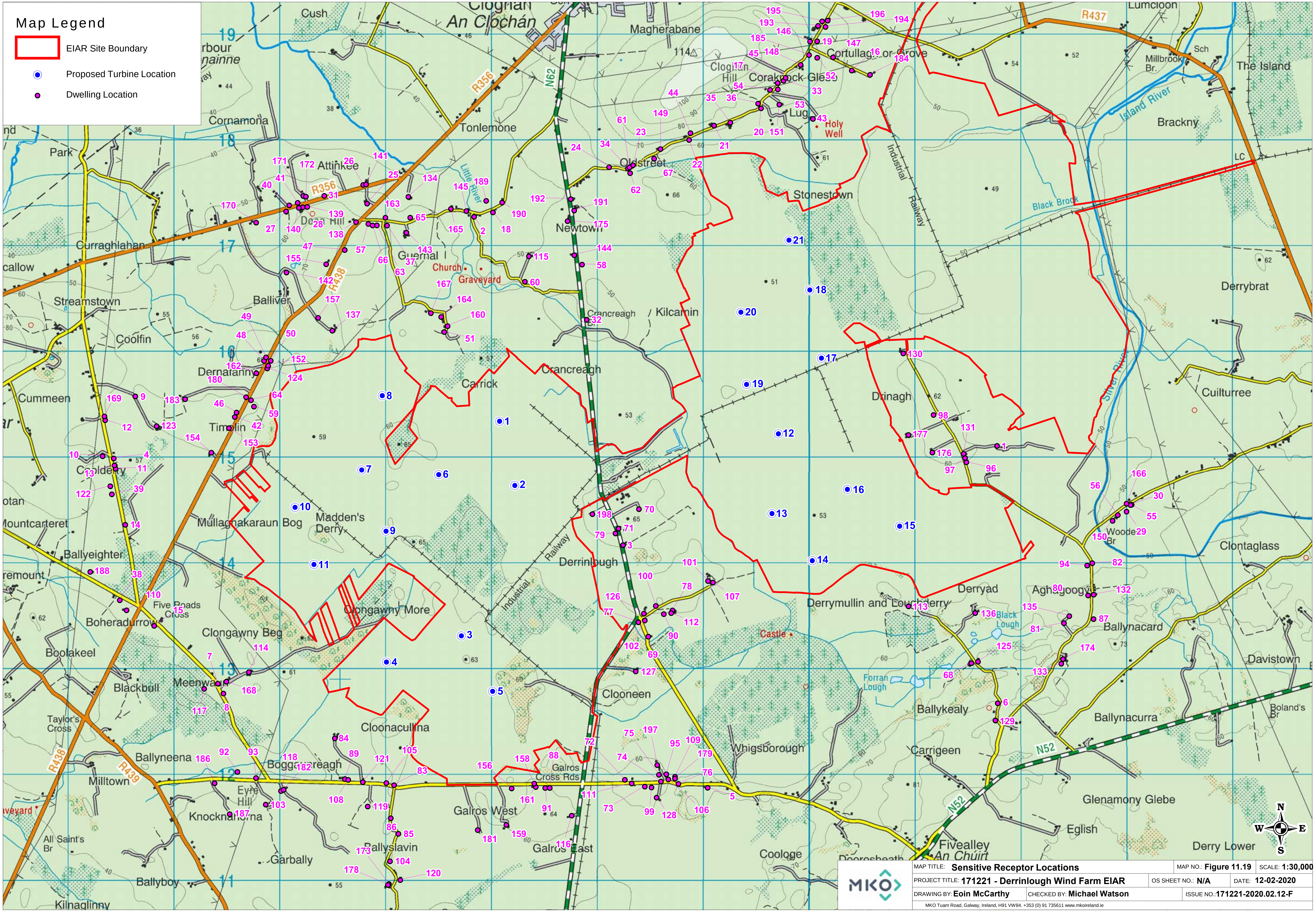
NSL Ref.	Coordinates – Irish Grid (IG)	
	Easting	Northing
R008	204,468	212,772
R032	207,901	216,303
R058	207,857	216,826
R070	208,395	214,514
R083	206,081	211,906
R084 Note 1	205,521	212,349
R089	205,616	211,963
R093	204,776	211,973
R105	206,008	211,926
R108	205,648	211,956
R114	204,709	212,974
R117	204,286	212,816
R118	205,012	211,850
R121	205,786	211,934
R144	207,784	216,914
R168	204,495	212,884
R182	205,037	211,862
R198	207,955	214,466

Note 1: In relation to NSL R084, the EIS (Noise Chapter) for Meenwaun stated that if the windfarm was permitted that this property would no longer be used as a dwelling by any person and therefore it was not assessed as a receptor in that EIS and is not be considered a NSL in this assessment.

The omni-directional cumulative turbine noise predictions and the predictions from the proposed Derrinlough turbines in isolation are presented in Appendix 11.4.

The turbine noise emissions from the proposed Derrinlough turbines are all below the worst-case criteria curves based on the lowest background noise level envelope for day and night at all locations. However, the noise contribution from the Derrinlough turbines increases the overall cumulative turbine noise levels which result in potential exceedances of the criteria at certain NSL's. These NSLs will be addressed in the following sections. It should also be noted that some of the potential exceedances can be attributed to the contribution of the worst case predicted turbine levels from other developments i.e. the predicted turbine noise levels would be the same if the contribution from the Derrinlough turbines were omitted.

The turbine noise level contribution of each wind farm development at NSL's with potential exceedances must be analysed to determine if mitigation is required to the proposed Derrinlough turbines. The various stages of this assessment are set out in the following Sections. As previously stated, the initial screening for this assessment applied the worst-case criteria curves based on the lowest background noise level envelope. Following a review of the 19 no. locations identified from the initial screening and listed in Table 11.12, appropriate noise limits have been assigned to each of the relevant NSL's based on professional judgement in line with best practice guidance of representative background noise levels measured as part of the survey. The noise criteria curves for Location C are deemed to be appropriate for all locations where the predicted omni-direction cumulative noise emissions have indicated a potential exceedance.


Map Legend
EIAR Site Boundary
Proposed Turbine Location
Dwelling Location
MAP TITLE: Sensitive Receptor Locations
MAP NO.: Figure 11.19
SCALE: 1:30,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm EIAR
OS SHEET NO.: N/A
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Two of the seven locations included in the background noise survey attract lower noise criteria curves than Location C, namely Location E and G. As described in Section 11.3.7.1, both these locations were isolated from any significant environmental noise source which is not deemed to be representative of the list of NSL's in Table 11.12. All other locations in the background noise survey attract a higher noise criteria curve. Therefore, adopting the background noise from Location C is robust and appropriate for this assessment

The predicted omni-directional cumulative noise levels at the 18 no. locations have been compared against the adopted noise criteria curves and are presented in Table 11.18.

Table 11.18 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria at Screened NSL's

House ID	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)				
		3	4	5	6	≥7
R007	Dwelling	33.8	36.5	41.7	42.8	42.9
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	1.7	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R008	Dwelling	33.8	36.5	41.7	42.9	42.9
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	1.7	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R032	Dwelling	31.8	36.1	41.1	44.4	45.4
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance Daytime Exceedance	–	–	1.1	4.4	0.4
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	1.4	2.4
R058	Dwelling	30	34.3	39.3	42.6	43.6
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	–	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	0.6
R070	Dwelling	28.1	32	37	40.2	40.9
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	–	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R083	Dwelling	30.8	33.6	38.8	40.2	40.3
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	–	–	–
	Night Limits	43	43	43	43	43

House ID	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)				
		3	4	5	6	≥7
	Potential Night time Exceedance	–	–	–	–	–
R089	Dwelling	34	36.7	41.9	43.1	43.1
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	1.9	–	–
	Night Limits	43	43	43	43	43
	Night time Exceedance	–	–	–	0.1	0.1
R093	Dwelling	31.2	33.9	39.1	40.3	40.3
	Daytime Limits	40	40	40	40	45
	Daytime Exceedance	–	–	–	0.3	–
	Night Limits	43	43	43	43	43
	Night time Exceedance	–	–	–	–	–
R105	Dwelling	31.5	34.2	39.4	40.8	40.9
	Daytime Limits	40	40	40	40	
	Potential Daytime Exceedance	–	–	–	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R108	Dwelling	33.8	36.5	41.7	42.9	43
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	1.7	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R114	Dwelling	37.7	40.3	45.5	46.6	46.6
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	0.3	5.5	1.6	1.6
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	2.5	3.6	3.6
R117	Dwelling	32.4	35	40.3	41.4	41.5
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	0.3	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R118	Dwelling	31.3	34	39.2	40.4	40.4
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	–	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R121	Dwelling	32.9	35.6	40.8	42.1	42.1
	Daytime Limits	40	40	40	45	45

House ID	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)				
		3	4	5	6	≥7
	Potential Daytime Exceedance	–	–	0.8	–	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R144	Dwelling	28.9	33.2	38.2	41.5	42.5
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	–	1.5	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–
R168	Dwelling	34.7	37.3	42.6	43.7	43.7
	Daytime Limits	40	40	40	45	45
	Potential Daytime Exceedance	–	–	2.6	–	–
	Night Limits	43	43	43	4343	43
	Night time Exceedance	–	–	–	0.7	0.7
R182	Dwelling	31.5	34.2	39.4	40.6	40.7
	Daytime Limits	40	40	40	40	45
	Daytime Exceedance	–	–	–	0.6	–
	Night Limits	43	43	43	43	43
	Night time Exceedance	–	–	–	–	–
R198	Dwelling	28.5	32.3	37.3	40.4	41
	Daytime Limits	40	40	40	40	45
	Daytime Exceedance	–	–	–	0.4	–
	Night Limits	43	43	43	43	43
	Potential Night time Exceedance	–	–	–	–	–

A noise contour for the omni-directional rated power wind speed (i.e. highest noise emission) for the cumulative scenario and the proposed development in isolation is presented in Appendix 11.5.

Where predicted levels from Meenwaun or Cloghan, at a given NSL, are at or above the assessment criteria limit, then the contribution from the Derrinlough turbines at the same NSL will be limited to 10 dB below the noise limit value to ensure there are no cumulative exceedances of the noise limits as a result of the proposed development, this approach is in line with best practice guidance presented in Section 11.3.2.2.4.

The predicted omni-directional turbine noise levels from the proposed Derrinlough turbines in isolation are below the worst-case criteria curves based on the lowest background noise level envelope for day and night at all NSL's. However, predicted noise levels due to Derrinlough turbines increases the overall cumulative turbine noise levels, which in some cases results in a predicted exceedance of criteria. Some worked examples of the logarithmic calculations at 7m/s wind speed during night-time periods are set out in Table 11.19 to demonstrate how the cumulative noise sources combine on the logarithmic scale and how the reduction required to the Derrinlough turbines has been calculated.

Table 11.19 Example of Logarithmic Addition of Noise Sources in This Assessment

NSL	Representative Background Noise Level, dB	Noise Level Derrinlough Turbine, dB	Noise Level Other Wind Turbines, dB	Cumulative Turbine Level, dB	Cumulative Exceedance Level, dB	Reduction required to Derrinlough Turbine Noise
R089	30.9	34.1	42.5	43.1	0.1	0.7
R114	30.9	35.2	43.0	43.7	0.7	2.2

An overview of this assessment methodology is provided in Section 11.3.7.4 and the relevant guidance for assessment of cumulative impacts in Section 11.3.2.2.

11.5.3.1.1 Consideration of Wind Direction

The preceding section considered omni-directional cumulative noise i.e. assuming all noise locations being downwind of all turbines at the same time. The next step in the assessment is to consider wind directionality and turbine noise propagation in the noise prediction model using the methods outlined in Section 11.3.8.3.

A full suite of directional noise prediction results for all NSL's is presented in Appendix 11.6.

Analysis of the directional noise prediction results has been carried out to determine the level of attenuation (dB) required to the Derrinlough turbines in each wind speed bin, to achieve cumulative turbine noise levels that comply with the assessment criteria. The calculated attenuation requirements are outlined in Table 11.20 and Table 11.21. Section 11.5.6.1 presents outline mitigation measures to demonstrate compliance by achieving the relevant attenuation requirements to address potential cumulative exceedances at 5 no. NSL's.

As previously stated, where levels of existing or proposed turbine noise are predicted to be at or above the noise limit i.e. there is no headroom for additional turbine noise, the Derrinlough turbine noise should be designed to 10dB below this limit to ensure that there is no exceedance of the noise limits. This is in accordance with best practice guidance outlined in Section 11.3.2.2.4.

Table 11.20 Daytime Attenuation Requirements for Derrinlough during Daytime Periods

NSL	Wind Speed	Attenuation (dB) Required to Derrinlough Turbines at Various Wind Speeds and Direction Sector - Daytime							
		N	NE	E	SE	S	SW	W	NW
R114	≥7m/s	–	0.2	0.2	–	–	–	–	–

Table 11.21 Night-time Attenuation Requirements for Derrinlough during Night-time Periods

NSL	Wind Speed	Attenuation (dB) Required to Derrinlough Turbines at Various Wind Speeds and Direction Sector – Night Time							
		N	NE	E	SE	S	SW	W	NW
R032	≥7m/s	–	–	–	1.0	1.8	–	–	–
R058		–	–	–	1.1	–	–	–	–
R089		0.6	–	–	–	–	–	–	–
R114		1.6	2.2	2.1	0.4	–	–	–	0.1
R168		–	0.9	0.9	–	–	–	–	–
R032	6m/s	–	0.3	0.3	1.8	2.3	–	–	–
R089		0.3	–	–	–	–	–	–	–
R114		1.3	1.9	1.8	0.1	–	–	–	–
R168		–	0.6	0.6	–	–	–	–	–

The following should be noted in relation to the attenuation requirement for Derrinlough presented in Table 11.20 and Table 11.21:

- The predicted turbine noise levels from the proposed Derrinlough turbines in isolation are below the noise criteria at all NSL's;
- At all of the NSL's identified in Table 11.20 and Table 11.21 the predicted turbine noise levels are dominated by noise associated with the Meenwaun or Cloghan Wind Farms;
- The predicted turbine noise levels are worst-case in terms of the calculation methods used for noise propagation and include an uncertainty factor of +2dB; and
- The level of turbine noise from the Derrinlough turbines has been attenuation to achieve the adopted turbine noise criteria or attenuation such that the predicted contribution of the Derrinlough turbines is 10 dB below the turbine noise limit values in accordance with best practice guidance.

It is concluded that due to predicted turbine noise levels from other permitted and proposed developments that mitigation in the form of slight attenuation of the Derrinlough turbines may be required under certain wind speeds and directions in order avoid cumulative turbine noise levels exceeding the turbine noise limit values adopted for this assessment at 5 no. NSL's (see Section 11.5.6.1). It should be noted that the assessment has been undertaken in accordance with best practice guidance outlined in the IOA GPG and as previously stated, calculated using the ISO 9613-2 standard and relate to worst-case conditions favourable to noise propagation (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions).

11.5.3.2 Internal Roads

Considering that there is no significant traffic expected on internal roads during the operational phase and the significant distances from any internal road to the nearest NSL; there are no noise and vibration impacts anticipated from internal roads during the operational phase.

11.5.3.2.1 *Description of Effects*

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest noise sensitive location associated with the operation of internal roads are described below.

Quality	*Significance*	*Duration*
Negative	Imperceptible	Long-term

11.5.3.3 Substation

As previously stated, the proposed substation location is shown in the site layout drawings in Appendix 4.1 of this EIAR. The substation will typically operational 24/7 and the noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the operation of the Substation at the nearest NSL.

The following extract from the *EirGrid Evidence Based Environmental Studies Study 8: Noise – Literature review and evidence-based field study on the noise effects of high voltage transmission development* (May 2016) states the following in relation to noise impacts associated with 110KvA substation installations:

> *"The survey on the 110kV substation at Dunfirth indicated that measured noise levels (L_{Aeq}) were less than 40dB(A) at 5m from each of the boundaries of the substation. This is below the WHO night-time free-field threshold limit of 42dB for preventing effects on sleep and well below the WHO daytime threshold limits for serious and moderate annoyance in outdoor living areas (i.e. 55dB and 50dB respectively). Spectral analysis of the data recorded at this site demonstrated that there were no distinct tonal elements to the recorded noise level. To avoid any noise impacts from 110kV substations at sensitive receptors, it is recommended that a minimum distance of 5m is maintained between 110kV substations and the land boundary of any noise sensitive property."*

The substation installation will have comparable noise emissions to the 110kV unit discussed above and considering the distance between the substation and the nearest noise sensitive location (i.e. 330m) the noise from the proposed substation is not considered to be an issue off-site. The expected noise emissions at location R184 will be less than 23dBA.

It is therefore concluded that there will be no significant noise emissions from the operation of the substation.

Noise from the operation of a substation will not have any significant cumulative impact on the overall noise levels associated with the operation of the proposed development at any noise sensitive location.

11.5.3.3.1 *Description of Effects*

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest noise sensitive location associated with the operation of the Substation are described below.

Quality	*Significance*	*Duration*
Negative	Not significant	Long-term

11.5.4 Decommissioning Phase Potential Impacts

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used.
The noise and vibration impacts associated with any decommission of the site are considered to be comparable to those outlined in relation to the construction of the Project (as per Section 11.5.2).
There is no item of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Section 11.4.1.

11.5.4.1 Description of Effects

With respect to the EPA criteria for description of effects, the anticipated associated effects at the nearest noise sensitive locations associated with the decommissioning phase are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

It is not expected that there will be any significant cumulative impacts at NSL's should the various elements of the decommissioning phase be undertaken simultaneously.

11.5.5 Construction Phase Mitigation

The assessment of potential impacts has demonstrated that the proposed development is expected to comply with the identified criteria for the construction phase. However, a schedule of mitigation measures has been developed and is set out in the following sections.

Regarding construction activities, BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise* and BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration* have been taken into account.

11.5.5.1 Construction Phase Mitigation Measures – Noise

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

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

- keeping site access roads even to mitigate the potential for vibration from lorries.

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

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

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

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Section 11.3.2 using methods outlined in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it will be necessary on occasion to work outside of these hours.

11.5.5.2 Construction Phase Mitigation Measures – Vibration

While it was concluded in Section 11.5.2.1.2 that there will be no significant vibration impacts associated with the construction of the proposed development and that no specific mitigation measures were required, it is recommended that vibration from construction activities will be limited to the values set out in Section 11.3.2.111.3.2.1.

It should be noted that these limits are not absolute but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

11.5.6 Operational Phase Mitigation Measures

An assessment of the operational noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 11.3.2.2 of this Chapter.

The findings of the assessment confirmed that the predicted operational noise levels from the internal site roads, amenity facilities and substation will be within the relevant best practice noise criteria. Therefore, no mitigation measures are required for these elements.

Mitigation measures for the management of turbine related noise are outlined in the following section.

11.5.6.1 Turbine Curtailment

The turbine noise assessment has identified that attenuation of the Derrinlough turbine noise emissions will be required under certain wind conditions to ensure that the cumulative turbine noise levels comply with best practice noise criteria at all NSL's. The required attenuation for various wind speeds and directions has been calculated and is presented in Table 11.20 and Table 11.21. It should be noted that in all instances the levels of attenuation calculated for the Derrinlough turbines are based on the contribution of noise from other wind turbine development at the specific locations listed in Table 11.20 and Table 11.21. At all stages of this assessment conservative assumptions have been made on the noise emission for the other windfarm developments to present a typical worst-cast assessment. Therefore, mitigation measures are specific to this assessment and the turbines noise emissions details outlined in Section 11.3.8.2.

Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve the calculated attenuation required in the specific wind conditions (i.e. wind speed and direction). Operating the turbines in reduced noise modes is generally referred to as curtailment.

Should predicted exceedances be confirmed at the commissioning stage of the development, it is possible to mitigate for this through curtailment of some turbines in the relevant wind speed and directions. The curtailment strategy would ultimately be developed for the specific turbine technology installed on the site and the associated noise emissions at the various operational wind speeds. If necessary, a detailed curtailment strategy matrix will be developed at the detailed design stage in order to achieve the relevant noise criteria (cumulative) at all NSL's.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions will comply with the noise criteria as per best practice guidance outlined in Section 11.3.2.2 and/or the relevant operational criteria associated with the grant of planning for the Proposed Development. If necessary, suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

11.5.6.1.1 *Indicative Curtailment Strategy*

The turbine technology adopted for the assessment of the proposed development is the Vestas V136 4.2/4.0MW as detailed in Section 11.3.8.2. The proposed technology offers several low noise modes of operation. Based on a review of the turbine data available from the manufacturer Table 11.22 outlines the overall dBA sound power (LW) reduction offered by the various modes of operation considered for this assessment.

Table 11.22 Reduced Noise Modes for Indicative Curtailment

Wind Speed	Reduction in Turbine Noise for Various Modes compared to Mode P01 (dB)			
	S01	S02	S011	S012
7 m/s	1.8	4.2	5.9	4.1
6 m/s	2.1	4.4	5.0	4.0

A curtailment matrix has been calculated by applying the overall reduction offered by the reduced noise modes outlined in Table 11.22 to the various turbine noise immissions calculated at each NSL operating in the power optimised mode - Mode PO1 (blades with serrated trailing edge). Table 11.3 presents an indicative curtailment matrix that would achieve the attenuation required at Derrinlough turbines as set out in Table 11.20 and Table 11.21 to ensure that the relevant criteria is complied with at all NSL's.

Table 11.23 Indicative Curtailment Strategy Matrix for Derrinlough to Achieve Criteria

Period	Wind Speed	Turbine Operating Mode in Various Wind Direction Sectors					
		N	NE	E	SE	S	NW
Day	≥7m/s	–	T11 = SO1	T11 = SO1	–	–	–
Night		T04 = SO1 T10 = SO1 T11 = SO2	T04 = SO2 T09 = SO1 T10 = SO1 T11 = SO2	T04 = SO2 T09 = SO1 T10 = SO1 T11 = SO2	T01 = SO1 T02 = SO1 T04 = SO1 T19 = SO1 T20 = SO2	T01 = SO2 T02 = SO2 T19 = SO2 T20 = SO2	T11 = SO1
Day	6m/s	–	–	–	–	–	–
Night		T04 = SO1 T10 = SO1 T11 = SO2	T04 = SO2 T09 = SO1 T10 = SO1 T11 = SO2 T12 = SO1	T04 = SO2 T10 = SO1 T11 = SO2 T20 = SO1	T01 = SO1 T02 = SO2 T04 = SO1 T19 = SO2 T20 = SO2	T01 = SO11 T02 = SO2 T06 = SO1 T08 = SO1 T12 = SO1 T19 = SO2 T20 = SO2	–

11.5.6.2 Low Frequency Noise

In the unlikely event that an issue with low frequency noise is associated with the proposed development, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document entitled *Procedure for the assessment of low frequency noise complaints*, Revision 1, December 2011.

11.5.6.3 Amplitude Modulation

In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, the operator shall employ an independent acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (9 August 2016) or subsequent revisions.

The measurement method outlined in the IoA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

11.5.6.4 Monitoring

Commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IoA GPG and *Supplementary Guidance Note 5: Post Completion Measurements* (July 2014) should be followed and relevant corrective actions will be taken. For example, implementation of noise operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind farm operations.

For post-commissioning of the proposed turbine units, it is recommended that the noise monitoring detailed in Section 11.3.7 be repeated with consideration of the guidance outlined in the IoA GPG and Supplementary Guidance Note 5.

11.5.7 Decommissioning Phase Mitigation Measures

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development, i.e. as per Section 11.5.2.

11.5.8 Description of Residual Effects

11.5.8.1 Construction and Decommissioning Phase

During the construction and decommissioning phase of the project there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other construction activities. However, given the distances between the main construction works and nearby noise sensitive properties and the fact that the construction phase of the development is temporary in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration effects are kept to a minimum. It is reiterated here that the assessment has concluded that the expected noise and vibration phase levels will be well within the criteria outlined in Section 11.3.2.1 and therefore there are no significant effects associated with the construction and decommissioning phases.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated residual effects at the nearest noise sensitive locations associated with the various elements of the construction and decommissioning phases are described below.

11.5.8.2 General Construction – Turbines and Hardstands Substation and Grid Connection

11.5.8.2.1 *Turbines and Hardstands*

The predicted residual noise and vibration effect associated with this element of the construction phase is described follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

11.5.8.2.2 *Substation and Grid Connection*

The predicted residual noise and vibration effect associated with this element of the construction phase is described follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

11.5.8.3 Internal Roads Construction

The predicted residual noise and vibration effect associated with the proposed internal road construction operations at NSL's is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers one location with the greatest potential impact.

11.5.8.4 Construction Traffic

With reference to the criteria set out in Section 11.3.2.1.2. The predicted increases in traffic noise levels due to the construction traffic of the proposed development were at worst case minor. The potential worse case residual effect associated with construction traffic with respect to the EPA criteria is described as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the route and stage with the greatest potential impact.

11.5.8.5 Operational Phase

11.5.8.5.1 *Wind Turbine Noise*

At some NSL's were there is existing wind turbine noise from operational development the contribution from Derrinlough will be inaudible and there would be no significant changes to the noise environment while at others NSL's situated closer to the proposed development a slight increase in the cumulative turbine noise level may be noticeable.

The assessment has demonstrated that the turbine noise emissions from the Derrinlough Wind Farm can be mitigated for any potential cumulative exceedances of the overall turbine noise levels and shall be within best practice noise criteria curves recommended in Irish guidance '*Wind Energy Development Guidelines for Planning Authorities'* published by the Department of the Environment, Heritage and Local Government in 2006. Therefore, it is not considered that a significant effect is associated with the development.

The worst-case predicted omni-directional turbine noise levels from the operation of the proposed Derrinlough turbines in isolation are considered low and well within best practice guidance noise limits albeit a new source of noise will be introduced into the soundscape at some NSL's. Mitigation has been outlined to address potential cumulative exceedances which are predicted to be dominated by noise from other permitted and proposed wind farm developments.

The predicted residual operational turbine noise effects are summarised as follows at the closest noise sensitive locations to the site:

Quality	*Significance*	*Duration*
Negative	Moderate	Long-tern

The above effect should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

For most of the NSL's assessed the effect of the operational turbines can be described as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Long-tern

11.5.8.5.2 *Substation Noise*

The associated residual effect from the operation of the substation is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Not significant	Long-term

11.5.8.6 Vibration

There are no expected sources of vibration associated with the operational phase of the proposed development. In relation to of vibration the associated residual effect is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Imperceptible	Long Term

11.5.9 Cumulative Effects

A review of existing, proposed and permitted wind turbine developments in the wider study has been undertaken in accordance with the guidance contained in the IOA GPG. This assessment has considered the potential cumulative impacts of the proposed development in combination with other wind energy developments in the area as required by best practice guidance discussed in Section 11.3.2.2.

12. LANDSCAPE AND VIUAL

12.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) addresses the potential landscape and visual impacts of the proposed Derrinlough Wind Farm. The emphasis in this chapter is on the likely significant direct and indirect effects of the proposed development. It covers the assessment methodology, a description of the proposed development and the existing landscape based on relevant guidance. It includes a description of the landscape policy with specific reference to wind energy and the study area in which the proposed development site is located.

The landscape of the area is described in terms of its existing character, which includes a description of landscape values and the landscape's sensitivity to change. The landscape and visual impact assessment of the proposed wind farm uses visibility mapping, representative viewpoints and photomontages. The potential impacts in both landscape and visual terms are then assessed, including cumulative impacts.

A full description of the proposed development is provided in Chapter 4 of this EIAR.

12.2 Statement of Authority

This chapter was prepared by Joanna Mole, a Landscape and Visual Impact Assessment Specialist and Chartered Landscape Architect with McCarthy Keville O'Sullivan Ltd. with over 15 years of experience in both private practice and local authorities. Joanna holds a BSc (Hons) in Landscape Design and Plant Science from Sheffield University, a Postgraduate Diploma in Landscape Architecture from Leeds Beckett University and a MSc in Renewable Energy Systems Technology from Loughborough University. Joanna is a Chartered Landscape Architect with specialist knowledge in Landscape and Visual Impact assessments for projects ranging from individual houses to large windfarms, solar farms, cycle route design and landscape contract management. Joanna holds chartered membership of the British Landscape Institute since 1998 and has been an examiner for the British Landscape Institute professional practice exam. Joanna was also aided by Michael Watson, a qualified Environmental Scientist and environmental consultant with 18 years' experience of EIA and LVIA.

12.2.1 Mitigation by Design

Through the iterative project design process, informed by early-stage impact assessment work, landscape modelling, ZTV mapping and photomontage preparation, every effort has been made to bring forward the optimum design for the proposed development with respect to landscape and visual factors. The final project layout that is the subject of this LVIA, already incorporates the following landscape and visual design considerations for good wind farm design:

- The turbines have been located within a vast flat site surrounded by lands of similar elevations which limits open views of the project, particularly from potentially sensitive receptors such as settlements (Note the Photomontage outputs).
- The turbine layout has been designed to create a coherent cluster, contiguous and connected to each other visually and with consistent spacing.
- The turbine layout and scale has been designed to fit with the existing and permitted turbines located in the vicinity of the development which are at a similar elevation and with similar turbine size envelopes to the proposed development.
- All turbines have been located greater than 4x tip height from sensitive receptors in order to protect residential visual amenity.

The internal site road layout makes use of the existing tracks wherever possible (to be upgraded for construction and the delivery of wind turbine components), to minimise the requirement for new tracks within the site. The site location and current layout minimises the potential for visibility from sensitive receptors and the site visits and assessment tools show that the actual visibility is far less than the theory. Where visibility does occur, the design is in accordance with best practice and a coherent project, sympathetic to its neighbouring wind turbines, is evident.

12.2.2 Assessments of other alternative turbine designs

This LVIA also assessed whether different turbine designs may give rise to visual effects. For the purpose, one viewpoint was chosen as a representative viewpoint and an additional photomontage was prepared using different turbine dimensions, e.g. lower hub height with longer rotor diameter. The two different turbine designs shown from the same viewpoint were then compared to see if a different turbine design would change the assessment of visual effects of the proposed development.

12.2.3 Scoping Replies/Pre-Planning Meetings

A scoping and consultation exercise has been carried out by MKO, as detailed in Chapter 2 of this EIAR. Pre-planning meetings were held with An Bord Pleanála on 12th March 2019 and Offaly County Council on 29th August 2018 and 6th March 2019 details of which are also outlined in Chapter 2 of this EIAR.

12.3 Brief Methodology and Assessment Criteria

This section broadly outlines the methodology and the guidance used to undertake the landscape and visual impact assessment of the proposed development; a more detailed description of the methodology is outlined in Appendix 12.1. There are four main sections to this assessment:

- Landscape Baseline
- Visual Baseline
- Cumulative Baseline
- Likely and Significant Effects – outlining the assessment of landscape, visual and cumulative effects

12.3.1 Scope and Definition of Landscape and Visual Impact (LVIA) Study Area

For the purposes of this chapter, where the ‘proposed development site’ or ‘the site’ is referred to, this relates to the primary study area for the proposed development, as shown on Figure 1.1. The proposed development site is discussed in some detail in terms of its landscape character.

However, the landscape and visual baseline mapping and viewpoint selection are based on wider study areas. On the basis of the desktop study and survey work undertaken, the professional judgement of the assessment team, experience from other relevant projects and policy guidance or standards (Appendix 3, DoEHLG ‘Draft Revised Wind Energy Development Guidelines’ 2019 and GLVIA 2013, see below) the LVIA study area has been chosen as 20 kilometres for visual and landscape effects and 15 kilometres from the proposed wind turbines for effects on landscape character. These are the study areas for which the baseline maps and viewpoint locations are produced and are referred to as the ‘study area’. Furthermore, on the basis of desk studies and survey work undertaken, the professional judgement of the assessment team, experience from other relevant projects and policy guidance or standards, the following topic areas have been scoped out of the assessment:

- Effects on landscape and visual receptors that have minimal or no theoretical visibility (as predicted by the ZTV) and/or very distant visibility, and are therefore unlikely to be subject to significant effects;

- Effects on designated landscapes beyond a 20km radius from the proposed development, from where it is judged that potential significant effects on key characteristics and/or special qualities, or views are judged unlikely to occur;
- Effects on landscape character beyond a 15km radius from the proposed development, where it is judged that potential significant effects on landscape character are unlikely to occur;
- Effects on visual receptors beyond a 20km radius from the proposed development, where it is judged that potential significant effects are unlikely to occur;
- Cumulative effects in relation to single turbines (except where otherwise stated);
- Cumulative landscape effects beyond a 15km radius and cumulative visual effects beyond a 20km radius from the proposed development, where it is judged that potential significant effects on landscape character are unlikely to occur;
- All potential effects occurring during decommissioning of the Proposed Development.
- Areas in Counties Roscommon, Westmeath and Laois due to distance from the proposed development and the lack of significant visual or landscape receptors within the small area of the county falling within the study area

12.3.2 Guidelines

While the legislation and general guidance on Environmental Impact Assessment is set out in Chapter 1 of this report only guidance specifically pertaining to the Landscape and Visual Impact are outlined below.

Ireland signed and ratified the European Landscape Convention (ELC) in 2002, which introduces a pan-European concept which centres on the quality of landscape protection, management and planning. The Department of Arts, Heritage and the Gaeltacht has published a National Landscape Strategy for Ireland in 2015. The Strategy aims to ensure compliance with the ELC and contains six main objectives, which include developing a national Landscape Character Assessment and Developing Landscape Policies.

In 2000, the Department of the Environment and Local Government published 'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities', which recommended that all Local Authorities adopt a standardised approach to landscape assessment for incorporation into Development Plans and consideration as part of the planning process. However, this DoEHLG 2000 guidance remains in draft form.

The landscape and visual impact assessment was primarily based on the *Guidelines for Landscape and Visual Impact Assessment* or GLVIA (The Landscape Institute/Institute of Environmental Management and Assessment, UK, 2013). A range of other guidelines also inform the preparation of this landscape and visual impact assessment, which include:

- Wind Energy Development Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government, 2006),
- Draft Revised Wind Energy Development Guidelines (Department of the Environment, Heritage and Local Government, 2019),
- Visual Assessment of Wind Farms: Best Practice (Scottish Natural Heritage, 2002).
- Visual Representation of Wind Farms: Version 2.2 (Scottish Natural Heritage, 2017).
- Siting and Designing Wind Farms in the Landscape, Version 3a (Scottish Natural Heritage, 2017).
- Assessing the Cumulative Impact of Onshore Wind Energy Developments. (Scottish Natural Heritage, 2012)
- Photography and photomontage in landscape and visual impact assessment (Landscape Institute Advice Note 01/11, 2011)
- Visual representation of development proposals (Landscape Institute Technical Guidance Note 02/17, 2017)

- Assessing the Cumulative Impact of Onshore Wind Energy Developments (Scottish Natural Heritage, 2012)
- Spatial Planning for Onshore Wind Turbines – natural heritage considerations (Scottish Natural Heritage, 2015)
- Siting and Designing Wind Farms in the Landscape Version 3a (Scottish Natural Heritage, 2017)
- Cumulative Impact of Wind Turbines on Landscape and Visual Amenity (Carmarthenshire County Council, 2013)
- Offaly County Development Plan 2014-2020 (Offaly County Council, 2014)
- Wind Energy Strategy for County Offaly - Methodology Statement 2014 (Offaly County Council, 2014)
- Tourism Strategy for County Offaly 2017-2022 (Offaly County Council, 2017)
- Galway County Development Plan 2015 to 2021 (Galway County Council, 2015)
- Landscape and Landscape Character Assessment for County Galway for the Galway County Development Plan 2015-2021 (Galway County Council, 2015)
- North Tipperary County Development Plan 2010 – 2016 (As Varied) (Tipperary County Council, 2015)
- Landscape Character Assessment of Tipperary 2016 (Tipperary County Council, 2016)

12.3.3 Baseline Landscape and Visual Information

In order to carry out this assessment, an initial desk study was undertaken which identified:

Landscape

- Landscape Receptors
- Policies and objectives contained in the relevant county development plans pertaining to landscape and wind energy
- Landscape designations in the study area
- Landscape character of the study area
- Landscape character of the proposed development site based on
  - Site Surveys undertaken in Winter 2018 and Spring and Summer of 2019
  - Landscape Character Types identified in 'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' (Department of the Environment and Local Government, 2006)

Visual

- Identification of Visual Receptors
- Zone of Theoretical Visibility (ZTV) mapping

12.3.4 Assessment of Potential Impacts

The methodology includes clearly documented methods based on the GLVIA guidelines, in order to arrive at an assessment. These include consideration of landscape and visual sensitivity balanced with the magnitude of the effect to determine the significance of effects. Mitigating factors are then taken into consideration to arrive at residual landscape and visual effects. Throughout this chapter 'theoretical visibility, is referred to. This is based on Zone of Theoretical Visibility (ZTV) mapping. Further details of which along with other information on the methodology of landscape and visual impact assessment are presented in Appendix 12.1.

12.4 Landscape Baseline

This part of the LVIA focusses on identifying the key landscape receptors that should form part of the assessment. As the LVIA study area includes significant areas of Counties Tipperary and Galway along with County Offaly, landscape policy for all three counties was referenced in this section.

Baseline Landscape Receptors:

- **Landscape Designations** based on:
  - Offaly County Development Plan 2014-2020
  - Galway County Development Plan 2015 to 2021
  - North Tipperary County Development Plan 2010 – 2016
- **Landscape Character of the Proposed Development Site** and its immediate environment based on:
  - Landscape Type identified using DoEHLG Guidelines 2006
  - Site Visits
- **Landscape Character of the Study Area** based on:
  - Provisional Landscape Character Assessment of County Offaly areas within the LVIA study area (prepared by MKO)
  - Landscape and Landscape Character Assessment for County Galway
  - Landscape Character Assessment of Tipperary 2016

12.4.1 Landscape Designations and Policy

The County Development Plans of Offaly, Galway and Tipperary were consulted to identify landscape designations and policy.

While the policy on designated views and scenic routes is outlined for the respective counties below, the list of views and scenic routes within 20km of the proposed turbines, mapped in Figure 12.1are set out under the Visual Baseline, as they are in their nature a visual designation, and assessed and form part of the basis of viewpoint selection.

Figure 12.1 Landscape Designations

12.4.1.1 County Offaly

12.4.1.1.1 Landscape Policy

Offaly County Council Development Plan 2014-2020 (CDP) sets out policies on landscape in *Chapter 7 Heritage and Landscape*. The following policies and objectives deal with the Offaly landscape generally:

> ***NHP-08*** *It is Council policy to protect, conserve and enhance the county's biodiversity and natural heritage including wildlife (flora and fauna), habitats, landscapes and/or landscape features of importance to wildlife or which play a key role in the conservation and management of natural resources such as water.*
>
> ***LAP-01*** *It is Council policy that landscape considerations will be an important factor in all land use policy and decision making for the county, ensuring that a pro-active view of development is undertaken whilst maintaining respect for the environment and heritage, as per the general principles of sustainable development. Further it is policy to conserve, protect and enhance the landscape of Offaly at a number of levels:*
>
> - *The value of the landscape itself, as open countryside and the associated form and character of settlements.*
> - *The value of the landscape as a resource for economic growth in accordance with its physical and visual attributes.*
> - *The value of the landscape and its role with habitats and species whose diversity enriches the environment.*
>
> ***LAO-01*** *It is an objective of the Council to preserve and enhance the character of the county's landscape where, and to the extent that in the opinion of Offaly County Council, the proper planning and sustainable of the area requires it.*

Areas of High Amenity

The CDP classifies 'Areas of High Amenity' as areas with scenic and amenity value worthy of special protection. Twelve are listed and shown on Map 7.17 in the CDP They are also shown on Figure 12.1. Those wholly or partially within the LVIA study are:

- Slieve Bloom Mountains
- Clonmacnoise Heritage Zone
- Shannon River and Callows
- Lough Boora Parklands
- Grand Canal
- Pallas Lake
- Clara Bog
- Eiscir Riada, other eskers
- Mushroom Stones.

The eastern portion of the site falls within the Lough Boora Parklands High Amenity Area as illustrated in Figure 12.2 below.

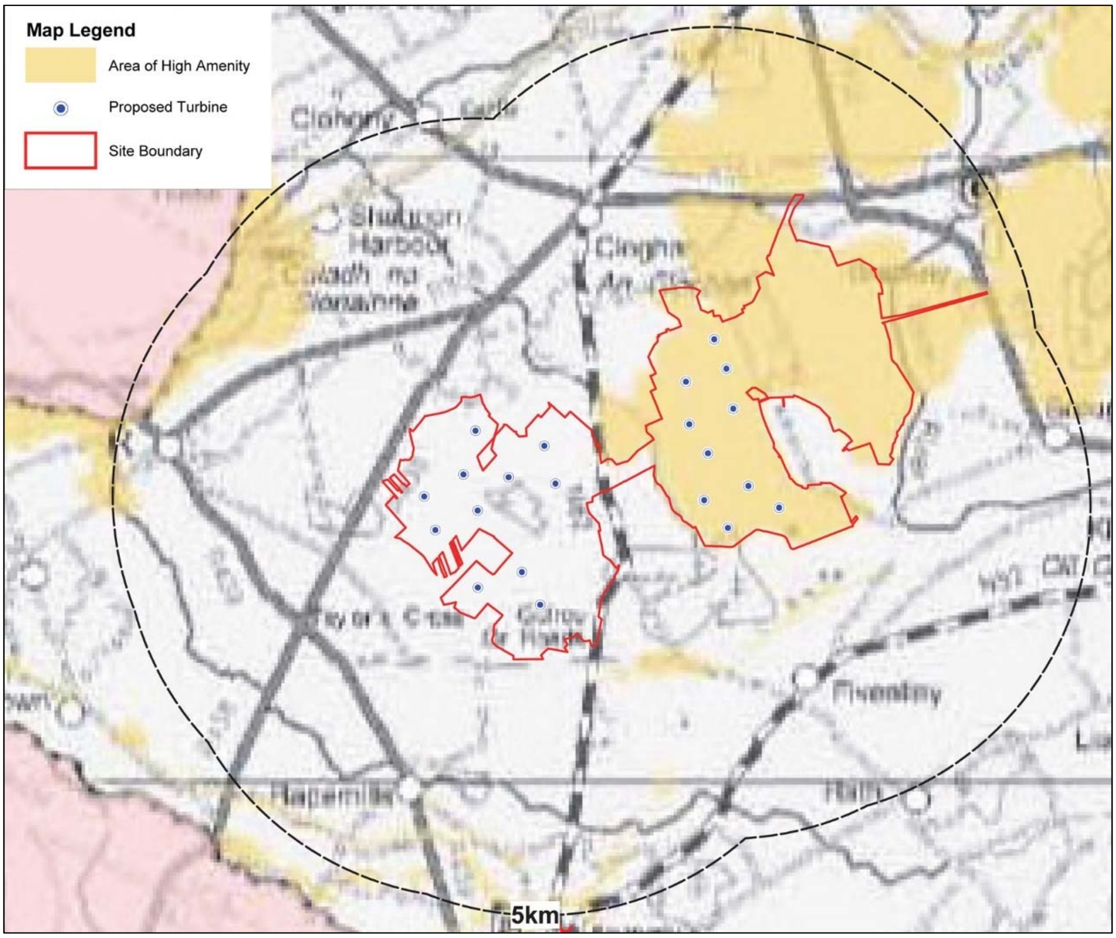

Figure 12.2 County Offaly Areas of High Amenity within 5 km of the prosed turbines (not to scale)

It is the council's priority to protect and preserve these areas. Policies and objectives relating to Areas of High Amenity are as follows:

> ***AHAP-01** It is Council policy to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey and surrounding area, the River Shannon, Lough Boora Parklands, Grand Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers. These areas are indicated on Map 7.17.*
> *Notwithstanding the location of certain settlements, or parts of, for which there are settlement plans (towns, villages, 'sráids'), within the Areas of High Amenity, it is not the intention of this policy to hinder appropriate sustainable levels of development (as set out in the plans and subject to proper planning). Further, it is policy to facilitate the sustainable extension and expansion of existing visitor, tourist related or other rural enterprises within the Areas of High Amenity, where such development is appropriate and where it can be demonstrated that it gives 'added value' to the extending activity and to the immediate area which is the subject of the 'Area of High Amenity' designation.*
>
> ***AHAP-02** It is Council policy, in both cases above, to ensure that issues of scale, siting, design and overall compatibility (including particular regard to environmental sensitivities) with the site's location within an Area of High Amenity are of paramount importance when assessing any application for planning permission. The merits of each proposal will be examined on a case-by case basis.*
>
> ***AHAO-01** It is an objective of the Council to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey & surrounding area, the River Shannon, Lough Boora Parklands, Grand*

Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers.

The proposed development site comprises mainly cutover bog and forms part of the Lough Boora Bog Group. However, in Section 2.11.5 *Peatlands* of the CDP it is stated that promotion of the existing Lough Boora facilities '*and their expansion and also that any development of wind energy on cutaway bog should provide increased access and education'* will be an objective.

Landscape Sensitivity

In the CDP, landscape sensitivity is described as a measure of a landscape's ability *'to accommodate change or intervention without suffering unacceptable effects to its character and values'*. The three different categories of landscape sensitivity Low, Moderate and High, are marked on Map 7.15 *Landscape Classification* and described in Tables 7.11.1 to 7.11.4 of the CDP. The following policy relates to landscape sensitivity:

> ***LAP-02*** *It is Council policy to control development as per the county's landscape classification listed in Tables 7.11.1-7.11.4.*

The western portion of the proposed development is located within an area designated 'Moderate' sensitivity, as shown in Figure 12.3 below. Landscape characteristics of 'Moderate' sensitivity areas are described in Table 7.11.1 of the CDP these areas are described as '*generally 'open' in character with intrinsic quality and moderate capacity to absorb new development'.* Furthermore, in Table 7.11.3 of the CDP it is conceded that *'some of these cutaway bogs may be appropriate for other sensitively designed and located developments including renewable energy (wind farms, biomass crops) and/or industrial use'*.

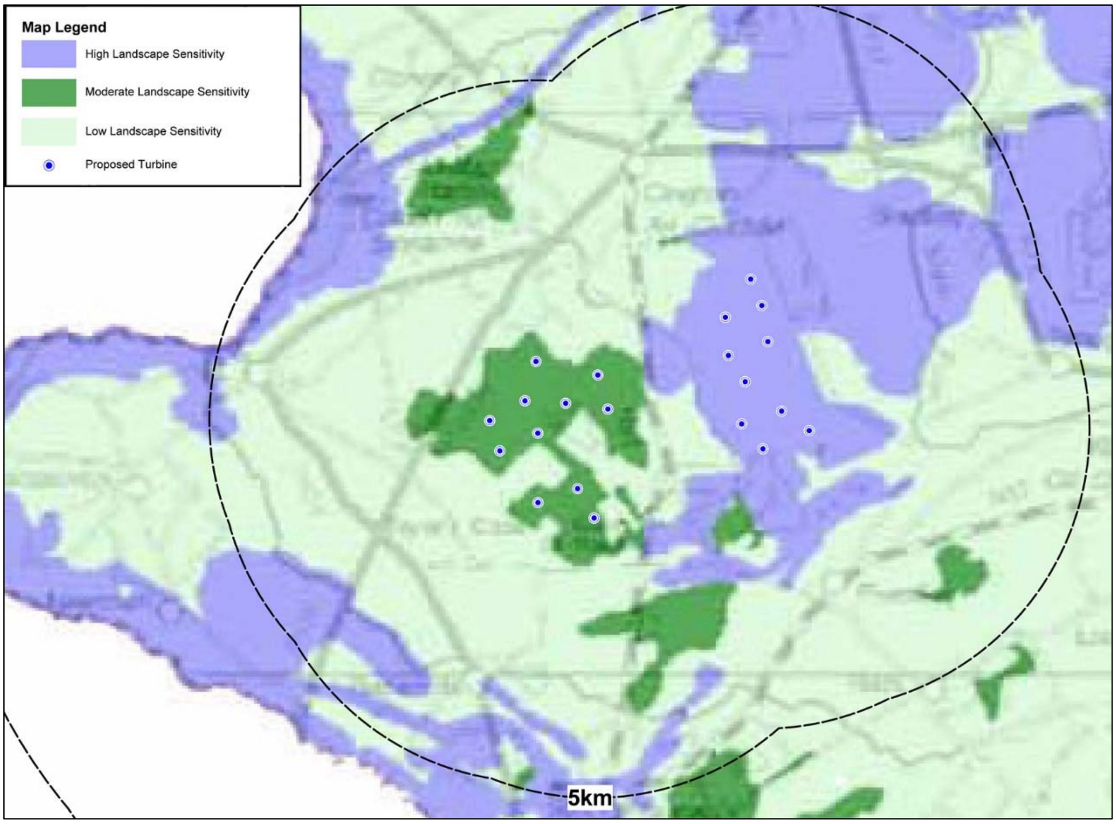

Figure 12.3 County Offaly Landscape Sensitivity within 5 km of the prosed turbines (not to scale)

The eastern portion of the proposed development is located within the Lough Boora High Amenity Area which is categorised as High Sensitivity. Table 7.11.1 of the CDP describes High Sensitivity Areas as having *"extremely low capacity to absorb new development"* and generally correlate to Areas of High Amenity. Table 7.11.4 of the CDP gives details specific to the type of high amenity area and for '*Wetlands*' states that '*any development proposed which occurs within these areas, should demonstrate a necessity to be developed in this location, be very small scale and have minimum visual impacts'*. Furthermore, various areas of the 'Lough Boora Parklands' including 'Turraun Wetlands, Finnamore Lakes Area and Loch Clochan Wetlands' are singled out for specific mention in Table 7.11.4 under 'C' Wetlands', however, the parts of the proposed development site are not referenced.

Scenic Routes and Views and Prospects

Protected views and prospects are identified on Map 7.18 and listed in Table 7.11.6 of the CPD. There is one objective set out in the CPD in relation to views and prospects:

> ***LAO-02*** *It is an objective of the Council to preserve scenic views and prospects throughout the county which will be assessed on a case-by-case basis, as part of the development management process. (Views are listed in Table 7.11.5 and shown on Map 7.18).*

Map 7.19 of the CDP shows two scenic routes throughout the county (referred to as the Northern and Southern Scenic Amenity Routes in this LVIA chapter):

- ***Northern Scenic Amenity Route (R357 Blueball to Shannonbridge)*** *- This route links the N52 at Blueball to Shannonbridge. It passes through esker landscape, peatlands, undulating agricultural lands, Lough Boora Parklands and the callows area of the River Shannon in particular.*
- ***Southern Scenic Amenity Route (R440 and R421 Birr to Kinitty and Ballard to Kinitty)*** *- This route provides an attractive drive within the open countryside to the attractions of the Slieve Bloom Mountains and around the foothills of the mountains themselves.*

Both fall within the LVIA study area with the R357 Blueball to Shannonbridge being the closest to the development site, approximately 2.3 km north of the nearest turbine at its closest point.

Offaly County has set out the following policies and objectives regarding protected views and scenic routes:

> ***LAP-03*** *It is Council policy to protect the county's scenic amenity routes from insensitive levels of roadside development and excessive levels of development. For development directly accessing onto restricted regional routes (key amenity routes) as shown on Map 7.19 (Chapter 4, Infrastructure and Environment Strategy) and on map 4.1, restrictions as per policy STAP-19 will apply.*

Views and prospects as well as scenic routes within 20km of the proposed turbines are mapped in Figure 12.8 and, as outlined above, listed in Section 0 *Visual Baseline* and assessed in that section of the landscape and visual impact assessment chapter.

Green Infrastructure

The CDP defines green infrastructure "*as strategically planned and interconnected networks of green space and water capable of delivering ecosystem services and quality of life benefits to people*". Green infrastructure can include parks, open spaces, farmland and rivers which are designed to provide and enhance economic, environmental and quality of life benefits for local communities. Conservation and enhancement of ecological features such as hedgerows result in corridors which allow for the exchange and movement of species between conservation areas.

The Proposed Development is located within Green Infrastructure area 'Bord na Móna Railway' and is illustrated on Map 7.15 of the CDP. Relevant Green Infrastructure policies and objectives are listed below:

> ***GIP-01*** *It is Council policy to recognise the economic, social, environmental and physical value of Green Infrastructure.*
>
> ***GIP-02*** *It is Council policy to protect existing green infrastructure within the county and to provide additional green infrastructure, where possible.*
>
> ***GIP-03*** *It is Council policy to require that all land use plans protect, manage and provide where possible green infrastructure in an integrated and coherent manner to integrate Green Infrastructure into future developments and ensure developments are cohesive with Green Infrastructure corridors linking adjoining lands.*
>
> ***GIO-03*** *It is an objective of the Council to encourage, pursuant to Article 10 of the Habitats Directive, the management of features of the landscape, such as traditional field boundaries, important for the ecological coherence of the Natura 2000 site network and essential for the migration, dispersal and genetic exchange of wild species.*
>
> ***GIO-04*** *It is an objective of the Council to develop and support the implementation of Green Infrastructure Strategy for Offaly working with chief stakeholders including Bord na Móna, NPWS, Coillte, WWI and Farmers, community groups and NGOs, where appropriate.*

12.4.1.1.2 Wind Energy Policy pertaining to Landscape

County Offaly policy on wind energy can be found in Chapter 3 Energy Strategy of the CDP as well as the *Wind Energy Strategy for County Offaly Methodology Statement* (WESO).

Policies and objectives related to landscape for the siting of wind energy developments can be found below:

> ***EP–02*** *- It is Council policy to facilitate the continual development of renewable energy sources having regard to the proper planning and sustainable development of the area concerned, the protection of amenities, landscape sensitivities, European Sites, biodiversity, natural heritage, and built heritage, and where such proposals comply with policy contained in the County Development Plan, in the interests of proper planning and sustainable development.*
>
> ***EP–03*** *- It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out.*
>
> ***EP–04*** *- Cumulative effects of wind farm development can arise as the combined consequences of proposals for more than one wind energy development within an area or proposal(s) for new wind energy development(s) in an area with one or more existing or permitted developments. Offaly County Council will monitor cumulative impact assessments of wind energy proposals over the lifetime of the plan and cumulative impacts will be a material consideration in the assessment of any planning application for wind energy development.*

> ***EO–01*** *- It is an objective of the Council to achieve a reasonable balance between responding to government policy on renewable energy and in enabling the wind energy resources of the county to be harnessed in an environmentally sustainable manner. This will be implemented having regard to the Council's Wind Energy Strategy as follows:*
>
> 1. *1. In Areas open for consideration for Wind Energy Development, as identified in Map 3.2, the development of Wind Farms and smaller wind energy projects shall be open for consideration.*
>
> *2. In all other areas Wind Energy Developments shall not normally be permitted – except as provided for under exemption provisions and as specifically described in Section 5.4 of the Wind Energy Strategy and Policy EP – 05.*

The wind strategy was arrived at through 'sieve mapping' analysis of the key environmental, landscape, technical and economic criteria, resulting in Map 3.2 in the CDP showing areas 'open for consideration for wind energy development'. The proposed development site is located within a rural setting on large areas of cutaway and cutover bog connected via rail links. Parts of both the eastern and western portion of the proposed development site fall within an area designated as suitable for wind energy development as illustrated on map 3.2 of the Offaly CDP and shown on Figure 12.4 below.

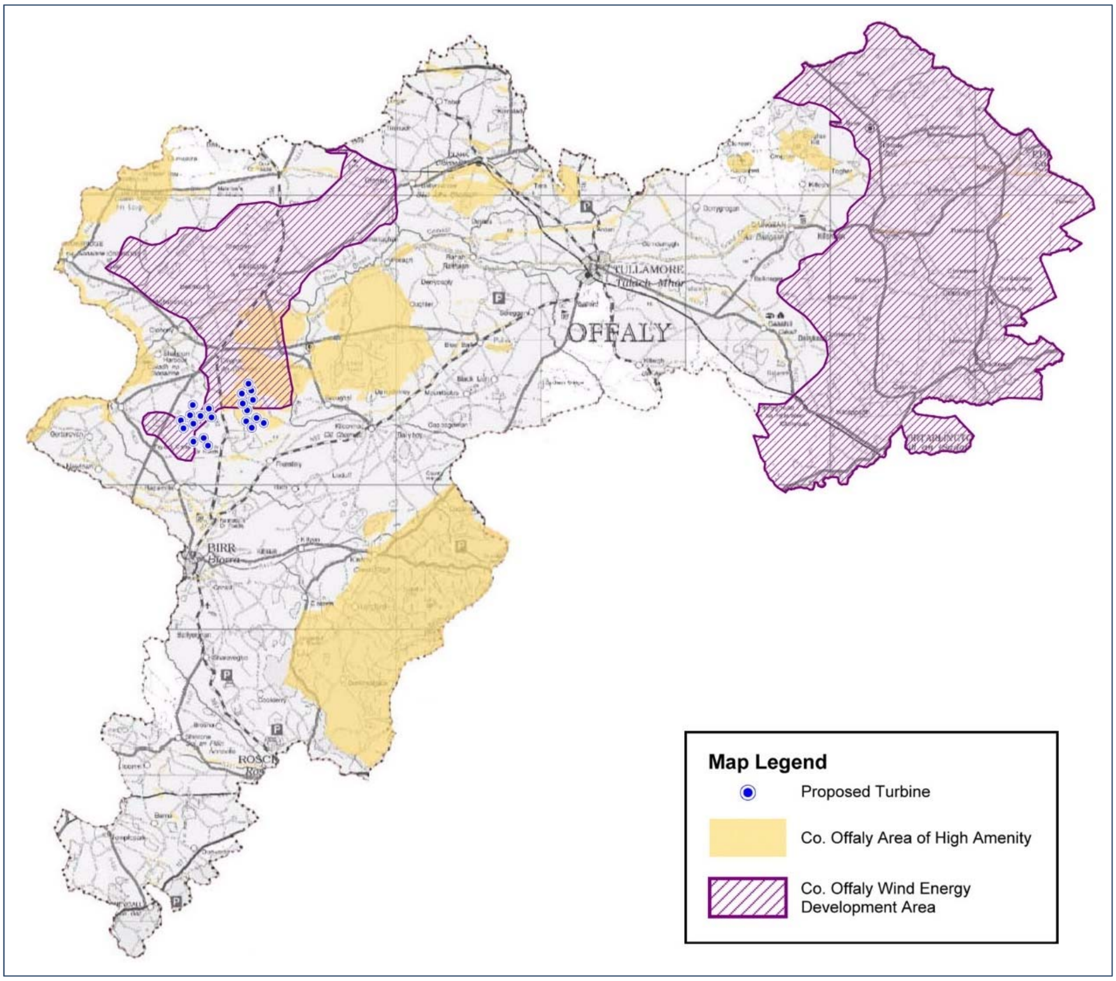

Figure 12.4 County Offaly Areas of High Amenity and Wind Energy Development Area (not to scale)

In Section 3.5 of the CDP it is stated that '*the characteristics of cutaway bog appear to be particularly suitable for wind development*', as they are '*generally large, uninterrupted by hedgerows, streams and natural features*'. Furthermore, they are '*already connected to each other via corridors i.e. bog railway routes, which will allow for transmission infrastructure and roadways to be built between sites, avoiding impacts on the public road in terms of traffic or visual impact*'. Their suitability is further underlined by their being '*the least densely populated areas of the county*'. Section 2.3.2 Peatlands of the CDP states that peatlands '*could potentially accommodate large scale energy production in the form of wind farms*' and adds further that '*the Council will encourage the sustainable and appropriate use of the peatlands for employment generating uses when all other planning and environmental considerations are met*'.

In Figure 3 of the WESO all the areas of the proposed development site are marked as 'Cutaway Peat', which is described in the document as '*areas generally having visually degraded landscape character, very low levels of residential settlement and large landholdings which give them a high potential for the development of windfarms – while avoiding conflicts with neighbours or scenery*'

In Table 1 the '*Area South of Cloghan*' is listed as one of the 12 main areas having wind energy development potential and is in fact deemed suitable for '*large scale wind farms*' due to its having '*low levels of adjacent dwellings, reasonable access to grid, proximity to access and areas of cut-over bog*'.

Furthermore, as can be seen in Figure 12.4 above, no significant Areas of High Amenity other than the eastern parts of the Lough Boora Parklands and some small areas of eskers and a section of the Grand Canal have been included in the '*Wind Energy Development Areas*'. This suggests that this Area of High Amenity is not sensitive to wind energy development.

In the WESO, landscape sensitivity is accommodated by a 2 km set-back distance from visually sensitive areas, which is deemed appropriate as it was assumed that '*at distances in excess of 2km, the turbines will not be visually dominant*'.

12.4.1.2 County Tipperary

Tipperary County Council was established on the 1st June 2014, following a decision in 2011 by the Department of Environment, Community and Local Government (DECLG) to amalgamate North and South Tipperary County Councils.

Therefore, Tipperary has at present two County Development Plans, these are:

- South Tipperary County Development Plan 2009, adopted in February 2009.
- North Tipperary County Development Plan 2010, adopted in July 2010.

The 20km study zone for the proposed development falls into the north of County Tipperary; thus, the North Tipperary County Development Plan (CDP) 2010 (as varied) is considered in this assessment.

North Tipperary County Development Plan 2010 (as varied)

Chapter 7 of the North Tipperary CDP relates to Landscape, Water Quality and Heritage and is informed by the county-wide Landscape Character Assessment 2016 (please see Section 12.4.4.9 below). The landscape of County Tipperary is considered as an important economic, community and cultural resource and following the National Landscape Strategy 2015-2030, it is an objective of the council to preserve and protect the landscape character of the county, while recognising the need for sustainable development in accommodating areas. The core aim of Tipperary County Council in relation to the natural and built heritage is as follows:

> *"To safeguard the natural and built heritage of the county, to maintain a high-quality environment while promoting sustainable appropriate developments to showcase the county's unique assets."*

Policies pertaining to the county-wide objectives are:

> ***Policy LH1: Landscape Management and Protection*** *It is the policy of the Council to facilitate new development which integrates and respects the character, sensitivity and value of the*

landscape in accordance with the designations of the County Landscape Character Assessments (or any review thereof).

The North Tipperary CDP has identified Primary and Secondary Amenity Areas which are notable for their scenic and visual quality and offer tourist and recreational opportunities.

> ***Policy LH2: Protection of Visual Amenity and Character of Primary and Secondary Amenity Areas.*** *It is the policy of the Council to ensure the protection of the visual amenity, landscape quality and character of designated Primary and Secondary Amenity Areas. Developments which would have an adverse material impact on the visual amenities of the area will not be permitted. New development shall have regard to the following: a) Developments should avoid visually prominent locations and be designed to use existing topography to minimise adverse visual impact on the character of primary and secondary amenity areas. b) Buildings and structures shall ensure that the development integrates with the landscape through careful use of scale, form, finishes and colour. c) Existing landscape features, including trees, hedgerows and distinctive boundary treatment shall be protected and integrated into the design proposal. d) Developments shall comply with the development standards set out in Chapter 10 and, as appropriate, the Rural Housing Design Guidelines contained in Appendix 5.*

There is one Primary Amenity Area and no Secondary Amenity Area within the study area as illustrated in Figure 12.1. This Primary Amenity area is approx. 14.3 kilometres from the nearest turbine and based on this distance, the ZTV mapping, local topography and vegetation it is highly unlikely that any of the proposed turbines will be visible from this area.

Scenic Routes and Views

Tipperary Council has designated views throughout the county which represent key views of natural and built heritage, provide visual amenity and attract tourism to the county and the following policy item applies to these:

> ***Policy LH3: Protection of Views of Scenic Value***
> *It is the policy of the Council to protect and enhance views identified in Appendix 4 Listed Views in Tipperary, and views to and from lakelands and waterways. The Council will not permit development which would obstruct or have a significant adverse impact on these views.*

There are 15 scenic routes listed in Appendix 4 of the North Tipperary CDP and 60 Scenic Routes and Views as well as 10 proposed Scenic Routes and Views listed for the whole of Tipperary in Appendix 2 of the Landscape Character Assessment of Tipperary. One of these, View 54, is within the study area and is shown on Figure 12.8 and as outlined above listed in in Section 0 Visual Baseline and assessed in that section of the landscape and visual impact assessment chapter.

Public Rights of Way and Way-Marked Ways

North Tipperary offers several way-marked ways and rights of ways in along waterways and areas of natural scenic beauty. The council is continually seeking to identify suitable areas to create way-marked ways and in particular, 'Blue Ways' along water features in the region.

> ***Policy LH4:*** *Public Rights of Way and Way-Marked Ways It is the policy of the Council to preserve and protect existing public rights-of-way and waymarked ways which give access to lakeshores, mountains, riverbanks or other places of natural beauty or recreational, tourism or heritage amenity, and to create new formal public rights-of-way as appropriate.*

There are no waymarked trails within the LVIA study area and the nearest Blueway is Lough Derg Blueway approximately 19.5 kilometres from the nearest turbine. The proposed turbines will not be visible from Lough Derg Blueway.

Green and Blue Infrastructure Masterplan Roadmap for Tipperary Waterways 2018

Tipperary Council has produced a draft infrastructure plan to connect and enhance green corridors and green spaces and waterways such as rivers, lakes, and pond systems. The aim of the masterplan is to enhance the existing natural heritage for the local communities and boost tourism and job creation in the region. Planning of water and shoreline activities is critical for the maintenance of tourism and health. Portions of the Upper Lough Derg and Shannon Callows LCAs which fall within the 20km study zone contain green and blue infrastructure areas which are noted for their ecological significance.

> ***SO5-12** It is an objective of the Council to support and seek funding opportunities for the development of greenway/blue ways, walking and cycling trails.*

Land-Use Compatibility

In Table 6.2 of the Landscape Character Assessment of Tipperary also gives '*generalised guidance on the likely compatibility – based on landscape sensitivity –between the Landscape Character Areas of the County and the most common types of land-uses*', which is reproduced here for the LCAs within the study area in Figure 12.5. Here, 'compatibility' refers to the likelihood that a particular development has the potential to give rise to significant visual effects on the landscape [Least Compatible] versus developments that have a low potential [Most Compatible]'. Figure 12.5 below, is a reproduction of Table 6.2. showing only LCAs 7 and 11, where the compatibility of LCAs 7 and 11 are low and least, respectively. However, this must be qualified by adding that these areas were assessed for their compatibility in terms of wind turbines being constructed within the LCA and did not address wind turbines being seen from them.

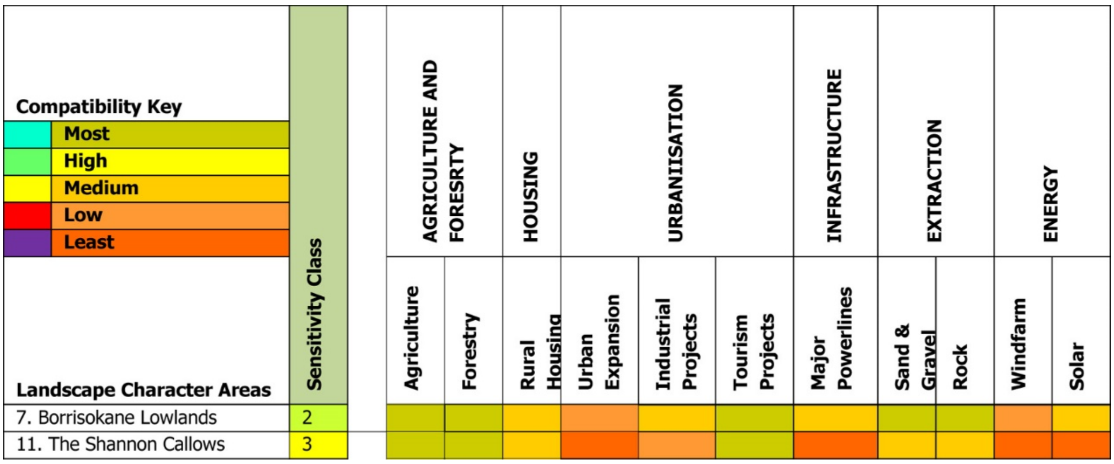

Figure 12.5 Compatibility between LCA 1 and Land-use Types (reproduced from Landscape Character Assessment of Tipperary)

12.4.1.2.1 Wind Energy Policy pertaining to Landscape

Tipperary Council have produced a county wide Renewable Energy Strategy which sets out the county's aim for reaching green energy targets by improving the sustainability of the county's energy, supporting enterprises in energy and growing the renewable energy sector. Tipperary has a substantial wind resource and are open to potential wind developments in areas considered suitable to this particular type of development.

> ***Policy RE2**: It is the policy of the Council to facilitate new development which integrates with and respects the character, sensitivity and value of the landscape in accordance with the*

> *guidelines set out in the Tipperary Landscape Character Assessment 2016 and the policies as set out in the County Development Plan (as varied) and the Development Management standards set out in Chapter 10.*

Appendix 1 of the Tipperary Renewable Energy Strategy contains the county-wide 'Tipperary Wind Energy Strategy 2016'. This strategy builds on the Tipperary Landscape Character Assessment 2016, The North and South County Development Plans, the 2006 DoEHLG guidelines and Wind Energy Strategies of adjoining counties Limerick, Cork, Waterford, Laois, Galway, Clare and Offaly. Map 11 of the *Tipperary Wind Energy Strategy 2016* shows the areas 'Unsuitable' and 'Open for Consideration' for new wind energy development. The area of this map included in the study area has been reproduced in Figure 12.6 below.

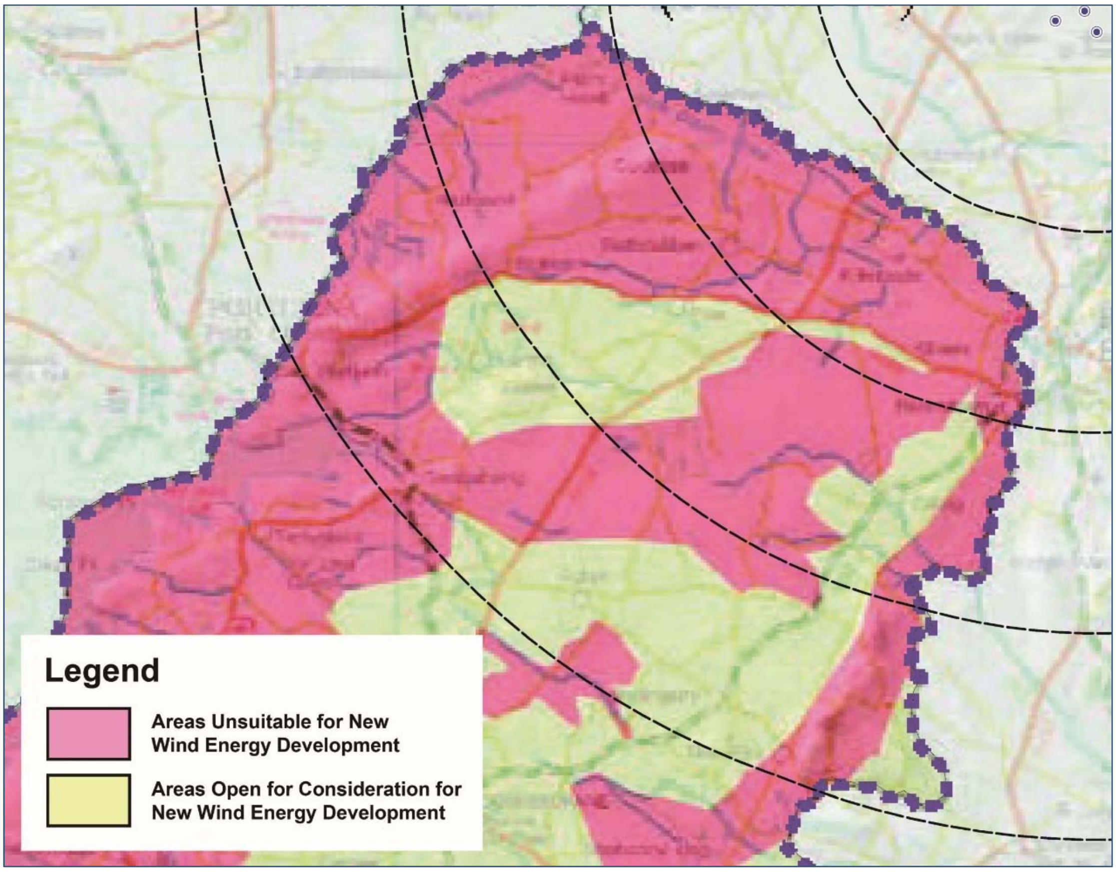

Figure 12.6 Tipperary Wind Energy Policy Areas in LVIA Study Area (Source: Tipperary Renewable Energy Strategy 2016)

The Tipperary Wind Energy Strategy 2016 lists county boundary areas which may be unsuitable for wind energy development. The wet lowlands and callows of South Offaly and north Tipperary which comprises the Shannon Callows and Borrisokane area included in these areas.

> ***TWIND 4.1*** *Proposals shall demonstrate conformity with existing and approved wind farms to avoid visual clutter. In this respect, developers should consider the cumulative impact of new development in the context of the location of both existing and permitted developments.*

> ***TWIND 4.2*** *Proposals in Areas 'Open for Consideration' shall be sited having consideration to the landscape sensitivity and capacity analysis set out in the Tipperary Landscape Character Assessment 2016 and the provisions of the County Development Plan (as varied) in relation to landscape (Chapter 7). All applications shall have regard to the visual impact of turbines and ancillary development (such as access roads, boundary fencing, control buildings and grid connections).*

> ***TWIND 4.6*** *All proposals for wind energy development will have regard to the cumulative effect of the development on the environment when considered in conjunction with other existing and permitted wind energy developments in the area.*

> ***TWIND 4.8*** *All applications will have regard to the impact of any proposal for wind energy development on surrounding tourism and recreational related activities and the compatibility of same will be carefully considered in the assessment of any planning application.*

12.4.1.3 County Galway

Chapter 9 of the Galway County Development Plan 2015-2021 relates to Heritage, Landscape and Environmental Management and sets out the county's policies and objectives for landscape protection, management and enhancement:

> ***Policy LCM 1 – Preservation of Landscape Character*** *Preserve and enhance the character of the landscape where, and to the extent that, in the opinion of the Planning Authority, the proper planning and sustainable development of the area requires it, including the preservation and enhancement, where possible of views and prospects and the amenities of places and features of natural beauty or interest.*

> ***Objective LCM 1 Landscape Sensitivity Classification*** *The Planning Authority shall have regard to the landscape sensitivity classification of sites in the consideration of any significant development proposals and, where necessary, require a Landscape/Visual Impact Assessment to accompany such proposals. This shall be balanced against the need to develop key strategic infrastructure to meet the strategic aims of the Plan....*

> ***Objective LCM 2 Landscape Sensitivity Ratings*** *Consideration of Landscape Sensitivity Ratings shall be an important factor in determining development uses in areas of the County. In areas of high Landscape sensitivity, the design and the choice of location of proposed development in the landscape will also be critical considerations.*

The five Landscape Sensitivity classes are Low, Moderate, High, Special and Unique. Map LCM2 of the CDP shows that the areas of County Galway within the LVIA study area are rated as predominantly low sensitivity with narrow strips of moderate and high sensitivity areas along the River Shannon. Landscape value of the county has also been assessed and is shown on Map LCM1 of the CDP. This map shows all areas within the study area to be of low landscape value with a narrow corridor along the River Shannon being classed as of medium value.

Focal Points and Views

Galway County Council have attributed important focal points throughout the county from which views of high scenic quality are possible. The council recognises the importance of these views for amenity, tourism and economic and cultural value.

> ***Objective FPV 1 Development Management*** *Preserve the focal points and views as listed in Map FPV1 from development that in the view of the Planning Authority would negatively impact on said focal points and views. This shall be balanced against the need to develop key infrastructure to meet the strategic aims of the plan and have regard to the zoning objectives of serviced development land within the Galway Metropolitan Area.*

Two focal points fall within the 20km study area, shown on Figure 12.8 and listed in

Table 12.8Table 12.8 in Section 12.5 *Visual Baseline*. Both focal points and views are over 17km from the nearest turbine and are focused away from the direction of the proposed development.

County Galway Wind Energy Strategy

The County Galway Wind Energy Strategy (WES) forms Appendix 4 of the current Galway County Development Plan 2015-2021. A Strategic Environmental Assessment (SEA) and Habitats Directive Assessment (HDA) were undertaken when the WES was first adopted in 2011 and for each subsequent iteration of the County Development Plan. The WES was informed by both the County Galway Development Plan and the Landscape and Landscape Character Assessment for County Galway 2002. Section 2.2.9 of the WES states:

Landscape policies and designations in the GCDP were considered in the strategy and included in the GIS. These include areas designated as landscapes of high value or sensitivity and important focal points / views. In addition, the Landscape and Landscape Character Assessment for Galway County 2002 was used as a baseline to assess capacity for areas to accommodate wind farm developments.

Wind Energy policies and objectives relating to landscape include the following:

> ***Policy WE6 Wind Energy Infrastructure*** *Proposals for the development of infrastructure for the production, storage and distribution of electricity through the harnessing of wind energy will be considered in appropriate sites and locations, subject to relevant legislation and policy, environmental, landscape and amenity considerations, electricity infrastructure, settlement patterns and wind energy potential and the guidance in the WES. This will include, inter alia, requirements and considerations in relation to Natura 2000 sites and the Habitats Directive (in particular Article 6 (3) and (4)), biodiversity and the SEA Directive and the objectives of the WRBD River Basin Management Plan.*
>
> ***Policy WE7 Implementation of Wind Energy Strategy*** *Proposals for Wind Energy development can be considered in all areas subject to meeting the specific requirements outlined in this Wind Energy Strategy. However it is anticipated that most development proposals will be located in the Strategic Areas, Acceptable in Principle Areas and areas Open to Consideration and it is the policy of the Council to maximise Wind Energy development in all three of these areas on a case by case basis subject to meeting the specific requirements of this Wind Energy Strategy and taking account of any guidance contained in the Strategy.*
>
> ***Objective WE6 Wind Energy Development and Guidance*** *Facilitate wind energy developments and necessary support infrastructure in appropriate sites and locations, subject to relevant policy, legislation, environmental, landscape and amenity considerations. This shall include the guidance in this WES and other relevant guidance where applicable, including, inter alia, the Guidelines for Planning Authorities on Wind Energy Development (DoEHLG, 2006) (and any updated document), the Best Practice Guidelines for the Irish Wind Energy Industry (IWEA, 2012), the European Best Practice Guidelines for Wind Energy Development (EWEA, 2002) and the Guidance Document: Wind Energy Developments and Natura 2000 (EC, 2010).*
>
> ***Objective WE7 Wind Energy Development Projects*** *Planning applications for wind energy developments will be guided by, and assessed in accordance with, the wind energy policies and objectives in this section, the landscape capacity considerations in Section 4 and the development management considerations, guidelines and standards outlined in Section 5. Where appropriate, planning applications for wind energy developments will also need to consider the landscape, biodiversity/ecological receptors, environmental and amenity impacts on the areas of adjoining Local Authorities.*

The WES also states that viewshed analysis was undertaken for certain upland areas with strategic potential for wind farms, noting that while these viewsheds are a useful guide, they do not take account of screening offered by vegetation or buildings so should not be considered definitive and do not replace more detailed modelling required for site specific wind farm developments.

The WES used five classifications for wind farm developments in County Galway, with specific objectives pertaining to each. The five classifications are as follows:

- Strategic Areas (SA) – Considered to be most suitable for wind farm development.
- Acceptable in Principle (AP) – Considered suitable for wind farm development.
- Open for Consideration (OC) – Areas to be evaluated on a case-by-case basis.
- Not Normally Permissible – Areas not normally considered suitable for wind farm development.
- Low Wind Speed Areas – Areas generally not considered viable.

The classification zones can be found on Figure 5 and 5a of the County Galway WES. The 20km study zone for the proposed development falls within areas categorised as Not Normally Permissible and Low Wind Speed Areas.

> ***Objective WE4 Not Normally Permissible Areas (NP)*** *These areas are not normally considered suitable for wind farm development due to their overall sensitivity and constraints arising from landscape, ecological, recreational, settlement, infrastructural and/or cultural and built heritage resources. The HDA and SEA process in particular helped to inform the identification of these areas. Future wind farm developments will accordingly only be considered in these areas where project level HDA and EIA can demonstrate to the satisfaction of the planning authority that environmental and other impacts can be successfully avoided, minimised and/or mitigated. The approach taken to the compilation of the Wind Energy Strategy is based on a consistent and robust methodology which was not varied to take account of individual planning permissions which have been fully assessed under Habitats Directive Assessment. However, where any project has been granted planning permission following Habitats Directive Assessment which shows that the project complies with the Habitats Directive and the Birds Directive, it is considered that this project is consistent with and in full compliance with this Wind Energy Strategy.*

> ***Objective WE5 Low Wind Speed Areas (LW)*** *These areas are generally not considered viable for wind farm development and in many cases may not be suitable due to their overall sensitivity and constraints arising primarily from amenity, settlement, infrastructural, recreational and/or cultural and built heritage resources. Any applications received for wind energy developments in these areas will be evaluated on a case by case basis subject to viable wind speeds, environmental resources and constraints and amenity, safety and cumulative impacts.*

However, it should be stressed that these classifications are aimed at assessing the suitability of these areas in County Galway to absorb wind turbines, but not the potential impact of wind turbines being visible in these areas.

12.4.1.4 Summary of Potential Landscape Receptors – Landscape Designations

As outlined above scenic routes and views are assessed as visual receptors in this LVIA, leaving only County Offaly High Amenity Areas and County Tipperary Primary and Secondary Amenity. All landscape receptors within the study area have been listed in Table 12.1 below. It should be noted that '*Eiscir Riada, other eskers*' and '*Mushroom Stones'* High Amenity Areas are not single cohesive areas, but multiple very small areas dotted around the county. Hence assessment of the visual and landscape effects on all these individual locations is beyond the scope of this LVIA study. While it is possible that in some cases there may be limited visibility, the impact is anticipated to be very limited and therefore these two High Amenity Areas will not be included in the landscape receptors.

Table 12.1 Landscape Receptors – Landscape Designations

Description	County	Landscape Designation	Theoretical Visibility (ZTV)	Actual Visibility
up to 5 km				
Lough Boora Parklands	Offaly	Area of High Amenity	Full	Anticipated
Shannon River and Callows	Offaly	Area of High Amenity	Partial	Not anticipated
Grand Canal	Offaly	Area of High Amenity	Full	Very limited
10 to 15 km				
Slieve Bloom Mountains	Offaly	Area of High Amenity	Partial	Very limited
Clonmacnoise Heritage Zone	Offaly	Area of High Amenity	Predominantly no visibility	Not anticipated
Lough Derg & Environs	Tipperary	Primary Amenity Area	Partial	Not anticipated
15 to 20 km				
Clara Bog	Offaly	Area of High Amenity	Predominantly no visibility	Not anticipated
Pallas Lake	Offaly	Area of High Amenity	Predominantly no visibility	Not anticipated

12.4.2 Landscape Character of the Proposed Development Site

12.4.2.1 DoEHLG- 'Draft Revised Wind Energy Development Guidelines' (2019)

These guidelines offer guidance for the siting and design of wind energy developments in various landscape contexts by defining six landscape character types that represent most situations where wind turbines may be proposed. The guidance is intended to be indicative and general and notes that it, represents the 'best fit' solutions to likely situations.

The six landscape character types include 'Mountain Moorland', 'Hilly and Flat Farmland', 'Flat Peatland', Transitional Marginal Land', 'Urban/industrial' and 'Coastal' landscape character types. The guidelines note that where a wind energy development is located in one landscape character type but is visible from another, it will be necessary to decide which might more strongly influence the approach adopted for the assessment.

The proposed development site, the areas surrounding as well as many other areas within the study area can be described as 'flat peatland', however, there are also areas of flat farmland within the study area. Although in some cases the turbines will be viewed from this other landscape type, it is considered that in terms of the siting and design the 'flat peatland' landscape type most strongly influences the siting and design of the proposed development. Further details of this landscape character types are provided below.

1.1.1.1.2 Flat Peatland

Plate 12.1 View showing flat peatland on the proposed development site

The key characteristics of the flat peatland landscape type are:

- Landscapes of this type comprise a vast planar extent of peatland and have significant potential for future wind energy development;
- In their relatively undisturbed and naturalistic state the wet bogs comprise a landcover mostly of heather, wild grasses and bog cotton, as well as patches of coniferous plantation;
- Some of these bogs have been harvested for peat and may comprise long parallel ridges of stacked milled peat and deep drains.;
- Evidence of human habitation is sparse;
- Roads tend to run in straight lines over considerable distances, followed by electricity and/or telephone lines; and
- This landscape type is horizontal, open, extensive and also characterised by a sense of remoteness.

The siting and design guidance given for 'flat peatland' in the DoEHLG guidelines is set out below:

Location

Wind energy developments can be placed almost anywhere in these landscapes from an aesthetic point of view. They are probably best located away from roadsides allowing a reasonable sense of separation. However, the possibility of driving through a wind energy development closely straddling a road could prove an exciting experience.'

Spatial Extent

The vast scale of this landscape type allows for a correspondingly large spatial extent for wind energy developments.

Spacing

Regular spacing is generally preferred, especially in areas of mechanically harvested peat ridges.

Layout

In open expanses, a wind energy development layout with depth, preferably comprising a grid, is more appropriate than a simple linear layout. However, where a wind energy development is located close to feature such as a river, road or escarpment, a linear or staggered linear layout would also be appropriate.

Height

Aesthetically, tall turbines would be most appropriate. In any case, in terms of viability they are likely to be necessary given the relatively low wind speeds available. An even profile would be preferred.

Cumulative Effect

The openness of vista across these landscapes will result in a clear visibility of other wind energy developments in the area. Given that the wind energy developments are likely to be extensive and high, it is important that they are not perceived to crowd and dominate the flat landscape. More than one wind energy development might be acceptable in the distant background provided it was only faintly visible under normal atmospheric conditions.

The proposed development is in accordance with the above guidance in terms of location (turbines located away from roadsides) spatial extent (moderate to large scale of the wind energy development) spacing (regular), layout (clustered grid) height (in keeping with the landscape scale and on an even profile) and cumulative effect (adjacent wind developments will be of a similar design and height and visually read as one wind farm).

12.4.2.2 Site Visit Findings

12.4.2.3 Topography

The local topography of the area is predominantly flat and low lying with very small and gradual variations in levels as seen in Plate 12.2 below. The lowest area is in the far eastern part of the site at approximately 47 metres O.D. (Ordnance Datum) and the highest level is in the south-western part of the site at 65 metres O.D.

Plate 12.2 Image indicating the topography of the proposed development site.

12.4.2.4 Drainage

The topography of the proposed development site is relatively flat with an elevation range of between approximately 53 and 62mOD (metres above Ordnance Datum). Along the majority of the site boundaries, a ~1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within the extraction areas of the overall bogs. There are some areas of higher ground at the centre and southwest of Clongawny bogs and these are covered with conifer forestry.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run north-south also, and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity. Further detail on drainage of the site is included in Chapter 9: Hydrology and Hydrogeology.

12.4.2.5 Landcover

Landcover is the term used to describe the combinations of vegetation and land-use that cover the land surface. It comprises the more detailed constituent parts of the landscape and encompasses both natural and man-made features.

The vast majority of the site, with the exception of small remnant sections of raised bog around the peripheries of the site, comprise of milled peat, as shown in Plate 12.3 below. These areas are dominated by bare peat with little growth of vegetation.

Plate 12.3 Image showing areas of cutover bog with coniferous plantation in the background

Where peat production/extraction has ceased for some time, these areas have begun to revegetate, predominantly by poor fen or birch dominated scrub/woodland as seen in Plate 12.4 below.

Plate 12.4 Image showing an area where the cutover bog is revegetating with heath and scrub

In addition, there were some areas of open water, see Plate 12.5 below, within the study area and were fringed by poor fen and reedbeds

Plate 12.5 Waterbody with coniferous plantation in the background

Other areas included secondary dry heath and wetter heath. The wetter heath covers a broad range of conditions from bare peat and dry but vegetated to much wetter areas that grade into poor fen.

The grasslands that are present within the study area are primarily limited in their extent to the sides of old trackways and railway lines. Many of the tracks and grasslands were surrounded by willow scrub and woodlands making them sheltered.

There are some remnant uncut raised bog habitats at the site of the proposed project. The areas of raised bog recorded within the site are typically small in area, have been historically drained and are relatively dry.

Coniferous plantation forestry on site are also accompanied by a small sections of ash trees in some areas.

Beyond the site boundary the landcover is predominantly pastoral agricultural fields separated by hedgerows and deciduous tree lines.

12.4.2.6 Land Use

The land uses within the proposed development site are a mixture of bare cutover and cutaway peat, re-vegetation of bare peat, commercial forestry, telecommunications (a 30m Mast) and wind measurement (a single 100m anemometry mast on Clongawny Bog). There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to Derrinlough Briquette Factory which is located in the most western part of Drinagh bog.

The surrounding land uses and types comprise a mixture of forestry, agricultural land, a mosaic of active peat extraction, cutover and cutaway peatland, amenity (e.g. Lough Boora Parklands) and wind energy. The operational Meenwaun Wind Farm is located adjacent to the southwestern boundary of the proposed development site.

Plate 12.6 Image indicating the land use of the proposed development site.

12.4.3 Landscape Value and Sensitivity of the Proposed Development Site

To determine the landscape sensitivity and value of the proposed development site the landscape issues pertaining to the site have been summarised in

Table *12.2* below. These in turn were then summed up in a landscape value and landscape sensitivity classification of Low, Moderate and High for the proposed development site.

Table 12.2 Indicators of Landscape Value

Indicator	Description
Landscape Designations	The eastern part of the proposed development site is included in the Lough Boora Parklands Area of High Amenity and as a result this area are classed as of High Landscape Sensitivity. The western part is considered of Moderate Landscape Sensitivity.
Landscape Quality/Condition	The condition of the landscape is generally degraded due to the past peat harvesting operations.
Wildness/naturalness	Due to the visible anthropological influences, such as turf cutting, peat production and briquette factory, within and around the proposed development site, any sense of naturalness or wildness has been greatly diminished.

Indicator	Description
Recreation Value	The majority of the proposed development site has no recreational value, however, some areas to the east are included in the Boora Parklands and may be developed for recreation in the future.

Due to the issues summarised in

Table 12.2above the landscape value of the proposed development site is deemed Low and the landscape sensitivity as Low to Moderate.

12.4.4 Landscape Character of the Study Area

Landscape character refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how people perceive this. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement, and creates the particular sense of place found in different areas.

In the *Tipperary Landscape Character Assessment (2016)* and *Landscape and Landscape Character Assessment for County Galway (2002)* Counties Tipperary and Galway have identified Landscape Character Areas (LCAs) There is no published Landscape Character Assessment for County Offaly, therefore, for the purpose of this Landscape and Visual Impact Assessment, a provisional landscape character assessment for the LVIA study area was carried out by MKO, which is presented below. The LCAs falling within the LVIA study area are described below and shown in Figure 12.7, below.

Figure 12.7 Landscape Character

12.4.4.1 Landscape Sensitivity

The approach to landscape sensitivity differs for the three counties as follows:

- **County Offaly:** Section 7.11 and Map 7.15 of the CDP identify three sensitivity categories:
    - Low
    - Moderate
    - High
- **County Tipperary:** Six classes of sensitivity are identified in the Tipperary Landscape Character Assessment 2016:
    - Class Zero Could be improved by change
    - Class One: Low sensitivity to change
    - Class Two: Moderate sensitivity to change
    - Class Three: High sensitivity to change
    - Class Four: Special Landscape –Very low capacity for change
    - Class Five: Unique –Change would alter the character to the landscape
- **County Galway:** Five landscape sensitivity classes were established and are listed in Chapter 9 of the CDP:
    - Class 1 – Low sensitivity •
    - Class 2 – Moderate sensitivity •
    - Class 3 – High sensitivity •
    - Class 4 – Special •
    - Class 5 – Unique

For the sake of consistency, the respective landscape sensitivity categories of each county were translated into the following four classes as set out in Appendix 12.1:

- Very High
- High
- Moderate
- Low

12.4.4.2 County Offaly Landscape Character Areas (provisionally prepared by MKO)

Offaly County Council has not undertaken a Landscape Character Assessment The provisional LCAs, identified by MKO for the purpose of this Landscape and Visual Impact Assessment, are largely based on the 'Areas of High Amenity' as shown on Map 7.17 and their description in Section 7.8 of the CDP. The landscape sensitivity classification shown on Map 7.9 and their descriptions set out in Tables 7.11.1 to 7.11.4 of the CDP were also taken into consideration. Site visits and aerial photography also informed the process.

12.4.4.3 Central Wetlands

Key characteristics:

- Previously cutaway bogs in the process of transition from industrial uses, after-use revegetation to wetland area
- Landscape pattern not clearly distinct
- Generally characterised by open, expansive vistas with sparse vegetation
- Largely free of buildings and associated installations such as overhead wires

Assigned Landscape Sensitivity: Moderate

12.4.4.4 River Shannon and Callows

Key characteristics:

- Lands liable to flooding
- Water meadows, important breeding grounds for migrant birds
- Local scenic views along the river
- Includes local heritage sites such as Clonmacnoise and the Callows.

Assigned Landscape Sensitivity: High

12.4.4.5 Grand Canal Corridor

Key characteristics:

- Linear landscape character area defined by the waterway and adjacent infrastructure such as towpaths
- Canal corridor mostly enclosed by hedgerow and tree lines often opens up to views across surrounding landscape
- Minimal topographical variation of waterway and ancillary elements, unlike the surrounding landscape
- The canal passes through and links a very wide range of landscape types
- Focus of a wide range of uses, in particular, for recreation and tourism purposes.

Assigned Landscape Sensitivity: High

12.4.4.6 North-western Lowland Farmland and Marginal Peatland

- Lowland area with minor changes in level
- Contrast of large areas of degraded cutover bog and agricultural fields
- Area of eskers to the north

Assigned Landscape Sensitivity: Low

12.4.4.7 Birr Plains

- Generally land gradually/gently rises eastwards towards the Slieve Bloom Mountains
- Series of hills running south-west to north-east parallel to Slieve Bloom Mountains including Kiltubbrid Island, Knockhill and Drinagh, Mountbolus
- Orderly agricultural field patterns predominant
- High degree of tree cover in the form of mature hedgerows
- Few isolated areas of forestry or bog

Assigned Landscape Sensitivity: Low

12.4.4.8 Slieve Bloom Upland Area

Key characteristics:

- Extensive, mountainous uplands (only substantial uplands in County Offaly
- Dramatic contrast to the county's otherwise flat landscape
- Spectacular views, forest and riverside walks
- Unbroken area of upland blanket peat (largest in Ireland) retains sense of isolation
- Extensive areas of coniferous forestry on lower slopes

- Includes Knockbarron to the west
- Very sparsely populated

Assigned Landscape Sensitivity: Very High

12.4.4.9 County Tipperary Landscape Character Areas

The *Landscape Character Assessment of Tipperary* 2016 identified 23 Landscape Character Areas (LCAs). The nearest Co. Tipperary LCA is LCA 11 Shannon Callows, all of which falls within the LVIA study area. The northern third of LCA 7 Borrisokane Lowlands also falls within the study area. The key characteristics, taken from *Landscape Character Assessment of Tipperary* 2016, for LCAs 11 and 7 are outlined below.

12.4.4.9.1 *LCA 11 Shannon Callows*

Key characteristics:

- Strongly rural area much influenced by Rivers Shannon and Brosna.
- Historical importance of River Shannon crossing evidenced by siting of Redwood Castle, where one of the Annals of the Four Masters was written and Donal O'Sullivan Beara crossed the Shannon in 1603.
- Extensive raised bogs, river flood plains and nationally recognised ecological value of Shannon Callows.
- Isolated and rural character with settlement constrained by callows and raised bogs.
- Dispersed settlement with limited number of nucleated settlements (the villages of Rathcabbin and Riverstown present within the character area.
- Extensive views afforded southwards across flat plains towards Silvermines from regional road.
- Limestone ridges afford good views over to Counties Offaly and Galway and the meandering rivers Shannon and Brosna.

Assigned Landscape Sensitivity: High

12.4.4.9.2 *LCA 7 Borrisokane Lowlands*

Key characteristics:

- Farmed landscape dominated by limestone pasture interspersed with major communication routes to Portumna and Birr in adjoining Counties.
- Occasional farmed ridges and gently undulating areas add landscape diversity to this large area.
- Long settlement history spanning from the Neolithic tombs at Ardcroney, and Dominican priory at Lorrha to the Cromwellian development of Cloughjordan and Borrisokane.
- Very high density of 'Big Houses' with tree lined avenues and cut stone outbuildings.
- Scattered settlement with principal nucleated settlement of Borrisokane located at junctions of major and regional roads.
- Due to generally low-lying landform, long views are afforded from occasional ridges across to Offaly, the western drumlin belt and the Silvermines.

Assigned Landscape Sensitivity: Moderate

12.4.4.10 County Galway Landscape Character Areas

The Landscape and Landscape Character Assessment for County Galway, published by Galway County Council in 2002, divides the county into 25 distinct Landscape Character Areas (LCAs) as well as assigning a landscape value and landscape sensitivity to each LCA.

The nearest to the subject site is LCA 2. Shannon and Suck River Valley between Portumna and Ballinasloe, however a significant proportion of LCA 3. East central Galway (Athenry, Ballinasloe to Portumna) also falls within the study area. Relevant details along with landscape value and sensitivity assigned in the Landscape Character Assessment for both landscape character areas are outlined below.

12.4.4.10.1 *Shannon and Suck River Valley between Portumna and Ballinasloe*

Key characteristics:

- Flat to undulating low-lying grassland with river as main landscape element.
- Some vegetation, including mature trees along the river edge environment.
- Distant views can be gained of the Slieve Aughty Mountains.
- Scenic quality is higher in this area than that found in the flat pastoral areas of the county (areas 1, 3 and 5), due to the unique features such as the rivers Shannon and Suck and the views of the Slieve Aughty Mountains.
- No national monuments to be found in this area.
- Medium Landscape Value in Landscape Character Assessment for County Galway (2002)

Assigned Landscape Sensitivity: High

12.4.4.10.2 *East Central Galway (Athenry, Ballina sloe to Protumna)*

Key characteristics:

- Flat to undulating lowland
- Pastoral landscape of fields bounded by stone walls.
- Scattered patches of bogland containing scrub and scattered mature trees.
- Generally, not noteworthy in terms of scenic value
- Scenic route – R359 between Castleblakeney and Killaan Cross.
- Minor route between Mountbellewbridge and Ballyforan is scenic.
- 15 National monuments are located in this area. Many of these cannot be viewed from a distance and therefore contribute little in terms of wider scenic value. They are of interest at a very local level historically.
- Low Landscape Value assigned in Landscape Character Assessment for County Galway (2002)

Assigned Landscape Sensitivity: Low

12.4.4.11 Summary of Potential Landscape Receptors – Landscape Character Areas

The LCAs falling within the study area have been listed in Table 12.3 below, where theoretical visibility obtained from ZTV mapping as well as actual visibility observed on site are also shown.

Table 12.3 Landscape Receptors – Landscape Character Areas

LCA	County	Theoretical Visibility (ZTV)	Actual Visibility
up to 5 km			
Central Wetlands	Offaly	Full	Partial
Grand Canal Corridor	Offaly	Mainly full	Very limited
River Shannon and Callows	Offaly	Full	Not anticipated
Shannon and Suck River Valley	Galway	Full	Not anticipated
Birr Plains	Offaly	Mainly full	Not anticipated
5 to 10 km			
North-western Lowland Farmland and Marginal Peatland	Offaly	Full with patches of no visibility	Very limited
East Central Galway	Galway	Full with patches of no visibility	Very limited
LCA 11 Shannon Callows	Tipperary	Full with patches of no visibility	Not anticipated
LCA 7 Borrisokane Lowlands	Tipperary	Full with patches of no visibility	Not anticipated
10 to 15 km			
Slieve Bloom Mountains Upland Area	Offaly	Full with patches of no visibility	Very limited

12.4.5 Landscape Receptor Preliminary Assessment

After identifying the landscape receptors in the study area based on landscape designations derived from the respective CDPs and Landscape Character Areas (LCAs) taken from the Tipperary and Galway Character Assessments and compiled for Offaly by MKO, a preliminary assessment will be carried out to screen out landscape receptors that will not or only very marginally impacted by the proposed development.

Using the Zone of Theoretical Visibility mapping shown on Figure 12.8 the landscape receptors that will have no theoretical visibility are screened out as shown in below.

*Table 12.4 Landscape Receptors Screened Out -**No visibility** indicated by ZTV map*

Landscape Receptor Category	County	Landscape Receptor with no visibility shown on ZTV
Landscape Designations	Offaly	Areas of High Amenity - Clonmacnoise Heritage Zone, Clara Bog and Pallas Lake

For the remaining landscape receptors, potential visibility was assessed on site. In the case of the landscape receptors shown in Table 12.5, views towards the turbines were either entirely screened or substantially screened. This along with, in some cases, distance to the proposed development site precluded these locations being selected as viewpoints.

*Table 12.5 Landscape Receptors Screened Out - **No visibility** found on site*

Landscape Receptor Category	County	Visual Receptor with no significant visibility found on site
Landscape Designations	Offaly	Areas of High Amenity - Shannon River and Callows, Slieve Bloom Mountains
	Tipperary	Lough Derg and Environs Primary Amenity Area
Landscape Character Areas	Offaly	Grand Canal Corridor, River Shannon and Callows, Birr Plains
	Tipperary	LCA 11 Shannon Callows, LCA 7 Borrisokane Lowlands
	Galway	Shannon and Suck River Valley

Following the pre-assessment exercise the landscape receptors shown in Table 12.6 below have been selected for assessment due to their significance within the study area and the potential landscape effects they may experience due to the proposed wind energy development.

Table 12.6 Landscape receptors screened in for full assessment

Landscape Receptor Category	County	Landscape Receptor
Landscape Designations	Offaly	Lough Boora Parklands Area of High Amenity
Landscape of Proposed Development Site	Offaly	Landscape of Proposed Development Site
Landscape Character Areas	Offaly	Central Wetlands
		North-western Lowland Farmland and Marginal Peatland
		Slieve Bloom Mountains Upland Area
	Galway	East Central Galway

12.5 Visual Baseline

12.5.1 Visual Receptors

The main purpose of establishing the visual baseline is to identify the key visual receptors that should be considered for viewpoint selection. To this end the following have been identified:

- Designated Scenic Routes and Scenic Views
- Settlements
- Recreational and Tourist Destinations
- Recreational Routes
    - Waymarked Walking Routes
    - Cycle Routes
    - Scenic Drives
    - Tourist Routes (e.g. Wild Atlantic Way)
- Viewing Points (e.g. marked on OS Maps)
- Transport Routes

These visual receptors are listed in tables in the following sections along with theoretical visibility at those locations indicated by the ZTV maps. All visual receptors are shown on Figure 12.8.

Figure 12.8 Visual Baseline and Half-blade ZTV

12.5.1.1 Designated Scenic Routes and Scenic Views

The designated scenic routes and views are separated by counties and were taken from the respective county development plans. In addition to theoretical visibility, whether the focus of the scenic route or view is directed towards the turbines is also indicated in the tables.

12.5.1.1.1 County Offaly

Protected views and scenic routes within the study area designated in the Offaly County Development Plan 2014-2020 are listed in

Table 12.7 below. The table lists the 15 views by number (the two scenic routes are identified by northern and southern scenic route), a description of the location, the focus of the view stated in the CDP, whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by the ZTV map.

Table 12.7 County Offaly Protected Views and Scenic Amenity Routes within 20 km

View No.	Description	Direction	Directed to Site?	Theoretical Visibility
within 5 km				
V5	N52 in the townland of Heath, Bunaterin, Derrydolney, Ballywilliam, Curraghmore, Ballynacard, Bally na Curra.	Slieve Bloom Mountains	No	Partial to Full
V6	R356 and Road No. L-07014 in the townlands of Cushcallow, Park, Mullaghakeeraun and Curralahan.	River Shannon and Boglands	No	None to Full
V11	Regional Road R357 in the townlands of Lumcloon, Bun, Rin, Leabeg and Leamore.	Southwards towards Slieve Bloom Mountains	Partial	Full
V12	Road No. L-07009 in the townland of Stonestown.	Over boglands and Slieve Bloom Mountains	Yes	Full
Northern Scenic Amenity Route	R357 from Blueball to Shannonbridge	Esker landscape, peatlands, undulating agricultural lands, Lough Boora Parklands and the callows area of the River Shannon	Partial	Full
5 km to 10 km				
V10	Road No. L-03004 in the townlands of Skehannagh, Killagally Glebe, Ballyclare	Southwards towards Slieve Bloom Mountains	Yes	Full
V13	Road No. L-03012 in the townlands of Glaster, Ballynasrah, Newtown, Kilmochonna.	Over Little Brosna and Callows	No	Full
V14	R440 in the townlands of Kyle, Cloghanmore, Streamstown, Ballinree, Killaun.	Towards Slieve Bloom Mountains	No	None to Partial

Southern Scenic Amenity Route	R440 and R421 Birr to Kinitty and Ballard to Kinitty	Open countryside, Slieve Bloom Mountains and foothills	Partial	None to Full
10 km to 15 km				
V16	Road No. L-04025in the townlands of Clonee, Cumber Lower	Westward over farmland	Yes	Full
V17	Road No. L-06034 in the townlands of Knockhill and Drinagh.	Towards North East and North West over lowlands	Yes	None to Full
V18	Road No. L-08008 in the townlands of Grange, Belhill, Longford Big and Church Land.	Views towards Seir Keiran Monastic Site	No	Partial to Full
15 km to 20 km				
V2	Road No. L-08003 in the Slieve Bloom Mountains, townlands of Clough, Ballykelly, Coolcreen, Glenletter, Glenregan, Castletown, Forelacka and Glinsk.	Slieve Bloom Mountains, River Shannon northwards over lowlands	Yes	None to Full
V3	Pilgrims Road (Road No. L-07013) in the townlands of Clonmacnoise, Clonascra, Ballyduff and Bloomhill.	Clonmacnoise and River Shannon, Eskers, Mongan Bog and Finlough.	Partial	None to Partial
V4	Road No. R444 in the townlands of Clonmacnoise, Creevagh.	River Shannon and boglands	No	Partial to Full
V15	Road No. L-04006 in the townland of Knock	Slieve Bloom Mountains, Leap Castle	No	None
V19	Road No. L-02011 in the townlands of Rahan Demesne, Newtown.	Churches and Earthworks.	No	None to Partial

12.5.1.1.2 County Galway

The 122 Focal points and Views are shown and listed on Map FPV1 -Focal Points/Views of the Galway CDP. Only two are within 20 kilometres of the proposed turbines and they are listed in Table 12.8 below. The table lists the views by number, a description of the location and direction of the view, whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by the ZTV map.

Table 12.8 County Galway Vocal Points and Views within 20 km

View No.	Description	Directed to Site?	Theoretical Visibility
15 km to 20 km			
4	Townhouse at Junction of R355 and third-class road at Laurencetwon	No	Partial
5	Folly located southwest of Laurencetown	No	No

12.5.1.1.3 County Tipperary

Protected views are listed in Appendix 4 of the County Tipperary CDP and in Appendix 2 of the Landscape Character Assessment of Tipperary 2016. Only one of these falls within the LVIA study area and is listed in Table 12.9 below. The table lists the views by number, a description of the location and direction of the view, whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by the ZTV map.

Table 12.9 County Tipperary Protected Views within 20 km

View No.	Description	Directed to Site?	Theoretical Visibility
10 km to 15 km			
54	Views south on the R489 east of Lorrha marked on map	No	Full

12.5.1.2 Settlements

In order to identify which settlements within the study area should be considered for viewpoint selection the settlement strategies and hierarchies set out in the core strategies of the CDPs of Counties Offaly, Galway and Tipperary were consulted. The settlement hierarchies are presented by county below.

The hierarchy of towns, villages and other centres within Offaly is shown in *Map 1.2 Core Strategy Map* and listed in *Table 1.5 Settlement Hierarchy* of Offaly County Development Plan 2014 - 2020 as follows:

- Midlands Gateway Town
- Key Service Town
- Service Town
- Local Service Town
- Villages

The settlement hierarchy for Galway is listed in section 2.6.1 in the Galway County Development Plan 2015 to 2021 as follows:

- Galway Metropolitan Area
- Hub Town
- County Town
- Key Towns/Other Towns
- Other Villages
- Small Settlements

The settlement hierarchy listed below was taken from Figure 3.2: County Settlement Hierarchy of the North Tipperary County Development Plan 2010:

- Regional Town
- Sub-Regional Towns
- District Towns
- Service Centres
- Local Service Centres

Table 12.10 below lists the settlements identified from the respective CDPs within the LVIA study area also noting their county status within the settlement strategy and whether there is theoretical visibility indicated by the ZTV.

Table 12.10 Significant Settlements within the Study Area

Settlement	County	Settlement Hierarchy	Theoretical Visibility
up to 5 km			
Banagher	Offaly	Local Service Town	Partial
Cloghan	Offaly	Village	Full
Shannon Harbour	Offaly	Village	Full
5 to 10 km			
Belmont	Offaly	Village	Full
Birr	Offaly	Key Service Town	Full
Crinkle	Offaly	Village	Partial
Ferbane	Offaly	Service Town	Full
Kilcormac	Offaly	Local Service Town	Full
Riverstown	Offaly/Tipperary	Village/Local Service Centre	Full
10 to 15 km			
Eyrecourt	Galway	Other Settlement	Full
Kinnitty	Offaly	Village	Full
Pollagh	Offaly	Village	Full
Rathcabbin	Tipperary	Local Service Centre	Partial
Shannonbridge	Offaly	Village	Partial
15 to 20 km			
Ballycumber	Offaly	Village	Full

Settlement	County	Settlement Hierarchy	Theoretical Visibility
Coolderry	Offaly	Village	Partial
Laurencetown	Galway	Other Settlement	Partial
Lorrha	Tipperary	Local Service Centre	Partial

12.5.1.3 Recreational and Tourist Destinations

Recreation and tourist destinations were identified after consulting the Tourism Strategy for County Offaly 2017-2022 as well as checking the most popular destinations in counties Offaly, Galway and Tipperary on Tripadvisor.ie. All are shown on Figure 12.8 and listed in Table 12.11 below, however, none are located within 5 kilometres of the proposed development

Table 12.11 Recreational and Tourist Destinations in the Study Area

Destination	County	County	Theoretical Visibility
5 to 10 km			
Birr Castle	Castle grounds and gardens open to the public	Offaly	Full
Lough Boora Discovery Park	Outdoor recreation and sculpture park	Offaly	Full
15 to 20 km			
Clonmacnoise	Sixth century monastic site	Offaly	None

12.5.1.4 Recreational Routes

Waymarked walking routes, cycle routes, scenic and drives were identified within the study area. The routes are shown on Figure 12.8 and are listed in Table 12.12 below along with theoretical visibility shown on ZTV mapping for the routes.

Table 12.12 Recreational Routes in the Study Area

Route Name	Description	Theoretical Visibility
Up to 5 km		
Lough Boora Walking and Cycling Trails	Various Walking Loops	Full theoretical visibility
Grand Canal and Way	Waterway and adjacent Waymarked Walking Route	Predominantly full theoretical visibility
5 to 10 km		
The Offaly Way	Waymarked Walking Route	Predominantly full theoretical visibility

Route Name	Description	Theoretical Visibility
10 to 15 km		
Knockbarron Eco Trail	Walking Loop	None
15 to 20 km		
Slieve Bloom Way	Waymarked Walking Route	Mainly no visibility, some patches of full theoretical visibility

12.5.1.5 Viewing Points

Within the LVIA study area four 'Viewing Points' are marked OSi Map in the Slieve Bloom Mountains, while they are not named or numbered, numbers have been assigned to them for the purpose of this study, which are shown on Figure 12.8 and used in Table 12.13 below. These viewing points also double as picnic areas, hence visual receptors are likely to be able to enjoy the view at their leisure.

Table 12.13 Viewing Points marked on OSI point in the study area

Location	County	Directed to Site?	Theoretical Visibility
15 to 20 km			
Viewing Point 1	Offaly	Partially	Partial
Viewing Point 2	Offaly	Partially	None
Viewing Point 3	Offaly	Yes	Partial
Viewing Point 4	Offaly	Yes	Full

12.5.1.6 Major Transport Routes

For the purpose of viewpoint selection national primary and secondary roads were assessed in detail. Preference was given to viewpoint selection on regional routes in cases where they passed through settlement areas or coincided with scenic routes to increase the number of visual receptors. Transport routes within 5 kilometres of the site were also assessed as part of the route screening analysis.

Table 12.14 Significant transport routes within the study area

Transport Route	Description	Theoretical Visibility
Up to 5 km		
N62		Full
N52		Full
15 to 20 km		
N65		None to Partial

12.5.2 Visual Receptor Preliminary Assessment

After identifying the visual receptors in the study area based on designated scenic routes and scenic views, settlements, recreational and tourist destinations, recreational routes, OSi viewing points and transport routes a preliminary assessment was carried out to screen out visual receptors that will not be impacted by the proposed development.

Using the Zone of Theoretical Visibility mapping shown on Figure 12.8 the visual receptors that will have no theoretical visibility are screened out as shown in Table 12.15.

*Table 12.15 Visual Receptors Screened Out -**No visibility** indicated by ZTV map*

Visual Receptor Category	County	Visual Receptor with no visibility shown on ZTV
Designated Scenic Routes and Scenic Views	Offaly	V3, V14, V15, V19
	Galway	View 5
Recreational and Tourist Destinations	Offaly	Clonmacnoise
Recreational Routes	Offaly/ Laois	Slieve Bloom Way, Knockbarron Eco Trail
OSi Viewing Points	Offaly	Viewing Point 2
Transport Routes	Tipperary	N65

Directions have been indicated for viewpoints shown on OSi maps and designated scenic views and scenic routes by either written text or on accompanying maps in the respective CDPs. Therefore, the viewing points, protected views and scenic routes within the study area, listed in Table 12.16, that are not directed towards the proposed turbines have been screened out from further assessment.

Table 12.16 Designated Scenic Views, Scenic Routes and Viewing Points Screened Out - Direction of View

Visual Receptor Category	County	Views, Scenic Routes and Viewing Points Screened Out
Designated Scenic Routes and Scenic Views	Offaly	V4, V5, V6, V13, V18
	Galway	View 4
	Tipperary	View 54

For the remaining visual receptors visibility was assessed on site. In the case of the visual receptors shown in Table 12.17 below views towards the turbines were either entirely screened or substantial screened. This along with in some cases distance to the proposed development site precluded these locations being selected as viewpoints.

Table 12.17 Visual Receptors Screened Out -no visibility found on site

Visual Receptor Category	County	Visual Receptor with no significant visibility found on site
Designated Scenic Routes and Scenic Views	Offaly	V2

Visual Receptor Category	County	Visual Receptor with no significant visibility found on site
Settlements	Offaly	Ballycumber, Belmont, Birr, Cloghan, Coolderry, Crinkle, Kilcormac, Kinnitty, Riverstown, Pollagh, Shannonbridge, Shannon Harbour
	Galway	Eyrecourt, Laurencetown
	Tipperary	Lorrha, Rathcabbin
Recreational and Tourist Destinations	Offaly	Birr Castle
Recreational Routes	Offaly	Grand Canal and Way
OSi Viewing Points	Offaly	Viewing Points 1, 3 and 4

Following the pre-assessment exercise the visual receptors shown in

Table 12.18 below have been selected as viewpoints due to their significance within the study area and the potential visual effects they may experience due to the proposed development.

Table 12.18 Visual receptors screened in and selected as viewpoints

Visual Receptor Category	Description	Viewpoint
Designated Scenic Routes and Scenic Views	V10	VP3
	V11	VP4
	V12	VP2
	V16	VP9
	V17	VP6
	Northern Scenic Amenity Route	VP4, VP16
	Southern Scenic Amenity Route	VP7
Settlements	Banagher	VP13
	Ferbane	VP3
Recreational and Tourist Destinations	Lough Boora Discovery Park	(VP5 and VP4)
Recreational Routes	Lough Boora Walking and Cycling Trails	(VP5 and VP4)
	The Offaly Way	VP4
Transport Routes	N62	VP1, VP10 and P11
	N52	VP8

Furthermore, in addition to the viewpoints listed above, which were selected according to the key visual receptors identified in the visual baseline additional viewpoints were selected within 5 km to assess the visual effects closer to the proposed development from various directions (Viewpoints VP12 and P15). One viewpoint on a section of the R356, where traffic travelling eastwards will have a clear view of part of the proposed development site (Viewpoint VP14) was also selected to provide an assessment of the visual effects within County Galway. Despite the ZTV map showing widespread visibility in County Tipperary, no locations with both clear visibility of the proposed development and significant visual receptors could be found.

12.6 Cumulative Baseline

In terms of cumulative landscape and visual effects only other wind energy projects have been considered, as only these would be described as very tall vertical elements in the landscape and therefore give rise to significant cumulative effects. Other wind energy developments, within 20km of the proposed development, were identified by searching past planning applications lodged through the various Planning Authorities (Offaly County Council, Tipperary County Council, Galway County Council, Roscommon County Council, Westmeath County Council, Laois County Council and An Bord Pleanála) online planning portals. The information identified in the initial planning search was then used to verify, by means of a desk-based study and ground-truthing, whether the permitted wind energy developments had been constructed. The list of existing and permitted wind turbines present within the study area are listed in Table 12.19 below.

Table 12.19 Existing and Permitted Wind Farms within 20 kilometres

Wind Farm	Status	No of Turbines	Blade Tip Height (m)
Co. Offaly			
Meenwaun	Existing	4	169
Meenwaun	Permitted	1	169
Cloghan*	Permitted/ Proposed	9	150/169
Leabeg	Existing	2	124
Co. Tipperary			
Carrig	Existing	3	91
Skehanagh	Existing	5	91

** The developer has applied for consent to increase the height of the permitted Cloghan, which have not been constructed to date, from 150 m to 169 m*

The proposed Derrinlough turbines will be assessed alongside the above turbines to separately determine the cumulative landscape and visual effects.

12.7 Likely or Significant Landscape and Visual Effects

12.7.1 'Do-Nothing' Scenario

In the Do-Nothing scenario, the proposed development of a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to existing land-use practices. If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The rail lines that supply peat to Derrinlough Briquette Factory would continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required). It is anticipated that the proposed development site would not change significantly from its present state from a landscape and visual perspective.

In implementing the 'Do-Nothing' alternative, however, the opportunity to capture a significant part of County Offaly's renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, a development contribution, rates and investment would also be lost. Also, the proposed amenity access points and associated carpark would not be constructed as part of the rehabilitation and therefore this recreational opportunity would be lost as well as the potential connectivity with Lough Boora Parklands. On the basis of the positive environmental effects arising from the project, the do–nothing scenario was not the chosen option.

12.7.2 Construction Phase Effects

It is estimated that the construction phase of the proposed development will last between approximately 24-30 months. This stage of the development will involve temporary construction compounds and the construction of site roads, electricity substation and onsite grid connection as well as the movement of construction and turbine transport vehicles into and out of the site, to allow the construction of the turbines and associated elements.

12.7.2.1 Landscape Effects

It is considered that this is a Short-term, Imperceptible, Negative effect in terms of landscape effects.

12.7.2.2 Visual Effects

During the construction phase, the ancillary project elements will give rise to a Short-term Slight, Negative visual effect.

For more details on the visual effects of the ancillary project elements see 'Ancillary Project Elements' in Section 12.7.3 Operational Phase Effects

12.7.3 Operational Phase Effects

12.7.3.1 Landscape Effects

11.1.1.1.1 *Landscape Designations*

The only landscape designation brought forward as a landscape receptor likely to experience landscape effects is Lough Boora Parklands Area of High Amenity. Here the ZTV mapping shows widespread full theoretical visibility.

However, the examination of the landscape character of the site showed that this area is being allowed to revegetate. While at present there is sparse and generally low vegetation, in time this will make a greater contribution in screening the proposed turbines.

Areas of High Amenity and Landscape Sensitivity

The eastern portion of the site falls within the Lough Boora Parklands High Amenity Area as illustrated on Map 7.17 of the CDP. Areas of High Amenity are classed as 'High Sensitivity' areas as shown on Map 7.15 of the CDP. Hence, different sensitivity classifications apply to the two land parcels. The western Clongawny land area is marked as moderate sensitivity and the eastern Drinagh site is marked as a high sensitivity area.

However, during the site visit very little difference in landscape character and elements could be found between these two areas other than revegetation of the cutover bog was at a slightly more progressed in the Drinagh land parcel. Hence the description provided in Table 7.11.1 of the CDP for 'Moderate Sensitivity' as '*generally 'open' in character with intrinsic quality and moderate capacity to absorb new development'* seems more apt to both areas than having *'identified features or areas of natural beauty or interest'*, which is how areas of 'High Sensitivity' are described as in the same table. Hence, it could be argued that both areas could be approached in a similar manner and that the Moderate Sensitivity rating may be more appropriate.

This modification to the landscape sensitivity classification of the Drinagh land parcel in relation to wind energy is also supported by:

- Section 2.11.5 *Peatlands* of the CDP, where it is stated that promotion of the existing Lough Boora facilities '*and their expansion and also that any development of wind energy on cutaway bog should provide increased access and education'* will be an objective.
- Various areas of the 'Lough Boora Parklands' including '*Turraun Wetlands, Finnamore Lakes Area and Loch Clochan Wetlands*' are singled out for specific mention in Table 7.11.4 under 'C' Wetlands', however, the parts of the proposed development site are not referenced.
- In Section 3.5 of the CDP it is stated that '*the characteristics of cutaway bog appear to be particularly suitable for wind development'*, as they are '*generally large, uninterrupted by hedgerows, streams and natural features'*. Furthermore, they are '*already connected to each other via corridors i.e. bog railway routes, which will allow for transmission infrastructure and roadways to be built between sites, avoiding impacts on the public road in terms of traffic or visual impact'*. Their suitability is further underlined by their being '*the least densely populated areas of the county'*.
- Section 2.3.2 Peatlands of the CDP states that peatlands '*could potentially accommodate large scale energy production in the form of wind farms*' and adds further that *'the Council will encourage the sustainable and appropriate use of the peatlands for employment generating uses when all other planning and environmental considerations are met*'.

In the description of Moderate Sensitivity in Table 7.11.3 of the CDP it is conceded that *'some of these cutaway bogs may be appropriate for other sensitively designed and located developments including renewable energy (wind farms, biomass crops) and/or industrial use'.*

Further support for wind energy development in the proposed development site can be found in the *Wind Energy Strategy for County Offaly Methodology Statement* (WESO)

In Figure 3 of the WESO all the areas of the proposed development site are marked as 'Cutaway Peat', which is described in the document as '*areas generally having visually degraded landscape character, very low levels of residential settlement and large landholdings which give them a high potential for the development of windfarms – while avoiding conflicts with neighbours or scenery*'

In Table 1 the '*Area South of Cloghan'* (i.e. the Clongawny land area) is listed as one of the 12 main areas having wind energy development potential and is in fact deemed suitable for *'large scale wind farms'* due to its having '*low levels of adjacent dwellings, reasonable access to grid, proximity to access and areas of cut-over bog'.*

Map 3.2 showing *'Wind Energy Development Areas'* in the CDP is arrived at through 'sieve mapping' analysis shown in the WESO. In this map the only significant high amenity area included is the *Wind Energy Development Areas'* is the Drinagh land parcel other than some small areas of eskers and a section of the Grand Canal, as seen in Figure 12.4, where the *'Wind Energy Development Areas'* have been overlaid onto the Co. Offaly designated high amenity areas. This again suggests that the landscape value of this part of the Lough Boora Wetlands may not be considered as highly as other high amenity areas.

1.1.1.1.3 Landscape Character of the Proposed Development Site

The landscape character of the proposed development site will undergo a change in character by the introduction of vertical structures in a flat landscape. There will also be a minor localised change around the ancillary project infrastructure.

1.1.1.1.4 Landscape Character Areas

An assessment of the effects on landscape character was undertaken for the four LCAs within the study area that were identified as having significant visibility in the Landscape Receptor Preliminary Assessment above and listed in Table 12.6 of the same section. The individual assessments for each LCA are summarised in Table 12.20 below and included in detail in Appendix 12.2 Landscape Character Assessment Tables.

Table 12.20 Landscape character assessment summary

Landscape Character Area (LCA)	County	LCA Sensitivity to Wind Farm Development	Magnitude of Change	Significance of Landscape Character Effect
Central Wetlands	Offaly	Moderate	Moderate	Moderate
North-western Lowland Farmland and Marginal Peatland	Offaly	Low	Slight	Not Significant
Slieve Bloom Mountains Upland Area	Offaly	Very High	Negligible	Moderate
East Central Galway	Galway	Low	Negligible	Imperceptible

The greatest landscape effects ("Moderate") will be experienced in the provisional LCA for Offaly *Central Wetlands*, where the turbines will be located. However, these potential effects are mitigated by partial, intermittent and generally reduced visibility of the project due to the design of the project and the characteristics of the site and surrounds as described in the LCA assessment included in Appendix 12.2.

Moderate landscape effects are predicted to occur in the Co. Offaly Provisional LCA *Slieve Bloom Mountains Upland Area*. However, this result is arrived at due to the sensitivity of the landscape receptor, as shown in Table 12.20 above, and not due to changes anticipated to the landscape character.

In the other two LCAs, i.e. North-western Lowland Farmland and Marginal Peatland and East Central Galway, the landscape effects are Not Significant and Imperceptible, respectively.

12.7.3.2 Cumulative Landscape Effects

After identifying the cumulative baseline and cumulative status for each LCA it was assessed whether the additional proposed turbines would change the status of the individual LCAs. Although, it was found that the proposed turbines would add to the cumulative landscape status in all LCAs, only in the LCA within which the proposed turbines will be located will the cumulative landscape status change.

Therefore, the cumulative landscape effects are considered Low in three of the LCAs brought forward for assessment and Moderate in the provisional Offaly LCA Central Wetlands in which the proposed turbines are to be located.

12.7.3.3 Visual Effects

12.7.3.3.1 *Summary of Viewpoint Assessment*

An assessment of the visual effects of the proposed turbines was undertaken from the 16 viewpoint locations identified in Section 12.5.2 above using the assessment methodology described in Appendix 12.1. The locations of these viewpoints are shown in Figure 12.9, below. The individual assessments from the 17 viewpoints are presented in Appendix 12.3 and summarised in Table 12.21 below. Appendix 12.3 and Table 12.21 should be read in conjunction with the photomontage booklet forming Volume 2 of the EIAR.

The locations chosen for photomontages follow a detailed and extensive process including review of baseline information, site visits and high-quality photo taking at multiple locations within the LVIA study area. Many locations, which based on a desktop review had the potential for views of the site, had complete intervening screening or were screened to such an extent that the development of photomontages was not considered useful in terms of the assessment process i.e. little or no visibility towards the proposed development. The various locations where very limited or no visibility was observed are shown on Figure 12.9 for information purposes.

In general, flat midland wind farm sites and their surrounds tend to be capable of absorbing suitably designed wind farm projects of scale, due to some key reasons which are outlined below and will be evident in the photomontages:

1. ***The Flat Nature of the Site & its Surrounds***
   The level terrain results in an even overall height of all the wind turbines, this means that visual confusion caused by turbines at various heights does not arise. For Derrinlough, the visual receptors in the surrounding landscape are also at or slightly above the base level of the proposed turbines i.e. the turbines are not situated on elevated lands and so the potential for clear and open views of the project from

receptors at lower elevations does not arise. This topographic feature of the Derrinlough site and surrounds mitigates the potential for overbearing or domineering effects provided sufficient setback from receptors is designed into the project. It also means that separation distances between receptors and turbines becomes important as the turbines appear smaller in scale quickly when viewed in this planar view.

2. ***Presence of Mature Hedgerows, Mature Tree Lines and Commercial Forestry***
The reduced potential for clear and open views and the associated potential domineering effects described in Point 1 above is subsequently compounded by the presence of mature hedgerows, mature tree lines and stands of commercial forestry which are a feature of this site and surrounds. This screening, located between visual receptors and the proposed turbines has the effect of either removing views altogether, obscuring large numbers of turbines (including the existing & permitted turbines) or making those views of the turbines intermittent in nature. The effect of this screening is amplified for turbines in flat landscapes in terms of impeding views of the turbines. The ZTV does not take into account this screening and hence ZTV mapping can only be considered accurate where no visibility is indicated. In areas where theoretical visibility is indicated this is very often not borne out by actual visibility on the ground, in particular for sites of flat topography such as Derrinlough.

3. ***The Derrinlough Sites Wide Expanse***
The Derrinlough lands are vast in scale. The traditional pattern of rural development comprising scattered one-off housing and ribbon development has not encroached onto the site. The majority of the turbines are therefore at significant distance from visual or residential receptors. The centre of the bogs are being developed for wind energy and larger turbines require greater separation distances from each other and so fewer turbines are being brought forward for consent and as part of the design. The effect of this is reduced spatial extent and cluttering of the view. For example, receptors to the south west of the Drinagh cluster (See Photomontage P23) will only ever perceive 4 to 5 No. turbines. The remaining turbines (including the existing and permitted) will not form part of their perception of the wind farm as these turbines are many kilometres away, at the same ground level as the receptor and are screened by multiple layers of vegetative screening.

Combined, these factors mean that significant visibility of the proposed Derrinlough turbines is limited at relatively short distances away from the project. This has meant that the majority of photomontages have been taken from within the 5km buffer area.

The visual effect of the proposed wind turbines was assessed from each viewpoint in terms of the sensitivity of the visual receptors, along with the magnitude of change, as recommended in the GLVIA (2013) guidelines. This, in conjunction with a detailed review of the photomontages themselves and the ZTV maps, informed the visual effects assessment.

Visualisations such as photomontages are tools that can represent the likely effect of a development and are used to inform the reader's prediction of how that development will appear in the landscape. In terms of the predicted visual quality of the proposed turbines however, i.e. whether a visual effect is deemed to be positive, negative or neutral, this involves a degree of subjectivity. What appears to be a positive effect to one viewer could be deemed to be a negative effect by another viewer. All predicted visual effects of the viewpoints below are Long Term and Direct effects.

Figure 12.9 Viewpoint Locations

Table 12.21 Viewpoint assessment summary

VP No	Description	Grid Ref.	Approx. distance & direction to nearest turbine	Visual Sensitivity of Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effect
1	View from the N62 national road in the townland of Stonestown.	E 207,683 N 217,765	2.17 km NW	Low	Moderate	Slight
2	View from the No. L-07009 local road in the townland of Stonestown, designated as County Offaly scenic view V12.	E 209,529 N 218,300	1.27 km NW	High	Moderate	Moderate
3	View from Chapel Lane on the outskirts of Ferbane Town in the townland of Ballyclare, designated as County Offaly scenic view V10.	E 209,889 N 224,339	7.28 km N	Medium	Moderate	Slight
4	View from the R357 regional road in the townland of Lea Beg, designated as County Offaly scenic view V16 and on Northern Scenic Amenity Route (R357 from Blueball to Shannonbridge).	E 217,829 N 220,500	8.7 km NE	Medium	No Effect	No Effect
5	View from the R437 in the townland of Broughal, on the western edge of Lough Boora Parklands.	E 214,590 N 216,796	4.5 km E	Low	Slight	Not significant
6	View from the No. L-06034 local road in the townland of Kilgolan Upper, designated as County Offaly scenic view V17.	E 220,753 N 212,875	10.0 km E	High	Slight	Slight
7	View from the R421 regional road in the townland of Coolacrease, on County Offaly Southern Scenic Amenity Route (R440 and R421 Birr to Kinitty and Ballard to Kinitty).	E 223,504 N 209,335	13.57 km SE	High	Slight	Slight
8	View from the N52 national road in the townland of Glenamony Glebe.	E 212,198 N 212,123	2.6 km SE	Low	Slight	Not Significant

VP No	Description	Grid Ref.	Approx. distance & direction to nearest turbine	Visual Sensitivity of Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effect
9	View from the L-04025 local road in the townland of Cumber Lower, designated as County Offaly scenic view V16.	E 218,120 N 203,371	14.53 km SE	**High**	**Slight**	**Slight**
10	View from the N62 national road in the townland of Galros East.	E 207,688 N 210,542	2.35 km S	**Low**	**Slight**	**Not Significant**
11 East	View from the N62 national road in the townland of Derrinlough.	E 208,152 N 214,386	1.5 km W	**Medium**	**Moderate**	**Moderate**
11 West	View from the N62 national road in the townland of Derrinlough.	E 208,152 N 214,386	0.96 km SE	**Medium**	**Substantial**	**Moderate**
12	View from the R438 regional road in the townland of Glaster.	E 202,080 N 210,133	4.95 km SW	**Low**	**Substantial**	**Moderate**
13	View from the junction of Birr Road, Cluain Rynagh and the L7016 local road adjacent to the Banagher church of Ireland in the townland of Feeghs in Banagher Town.	E 201,396 N 214,812	3.75 km W	**High**	**Negligible**	**Slight**
14	View from the R356 regional road in the townland of Gortaloughane.	194,058 217,315	11.4 km W	**Low**	**Slight**	**Not Significant**
15	View from the L3010 local road in the townland of Coolfin.	E 203,202 N 215,944	2.4 km NW	**Medium**	**Slight**	**Slight**
16	View from the R357 regional road in the townland of Lecarrow.	E 199,848 N 224,017	10.4 km NW	**Medium**	**Negligible**	**Not Significant**

The assessment of visual effects determined the residual significance of the visual effects to range from 'imperceptible' to 'moderate', with the number at findings at each level of significance listed in Table 12.22, below. It should be noted that in the case of Viewpoint 11 the two residual visual effect assessments for east and west have been counted as one value here.

Table 12.22 Summary of Viewpoint Impact Assessment Results

Significance of Residual Visual Effect	Description	No. of Viewpoints
Profound	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment	0
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment	0
Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment	0
Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends	3
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities	7
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.	5
Imperceptible	An effect capable of measurement but without significant consequences	0

The significance of the residual visual effect was not considered to be "Profound", "Very Significant" or "Significant" at any of the 16 viewpoint locations. A residual visual effect of "Moderate" was deemed to arise at three of the 16 viewpoint locations. All other viewpoints were assessed as resulting in Slight (7) and Not Significant (5) residual visual effects. The proposed turbines will not be visible from Viewpoint 12, hence 'No Effect' was recorded for this location.

The viewpoint assessment results will be discussed in more detail in the following sections.

12.7.3.3.2 Assessments of other alternative turbine designs

This LVIA also assessed whether different turbine designs may give rise to visual effects. For the purpose, Viewpoint 12 was chosen as a representative viewpoint and an additional photomontage was prepared using different turbine dimensions, e.g. lower hub height with longer rotor diameter. This additional photomontage is shown at the end of the photomontage booklet. The two different turbine designs shown from this viewpoint were compared to see if a different turbine design would change the assessment of visual effects of the proposed development.

The alternative photomontage prepared for Viewpoint 12 shows that the using an alternate turbine design would have an imperceptible visual impact.

12.7.3.3.3 *Visual Effects in the overall study area*

Generally overall visual effects are strongly guided by ZTV mapping (based purely on topography, in this case 10-meter contour data) as an indication of areas that will have no visibility of proposed turbines and areas that will have theoretical visibility. The level of certainty for areas where no visibility is indicated by ZTV is very high. On the contrary, in areas where the ZTV mapping shows theoretical visibility this will not have taken account of local variations in ground levels not represented by the 10 metre contour data and more importantly vertical objects such as vegetation, buildings and other structures that will block views of the proposed turbines.

The ZTV map for Derrinlough shows widespread theoretical visibility being greatest nearest to the proposed development with pockets of no visibility increasing in size and frequency as distance from the proposed turbines increases. This is to be expected in a LVIA study area with very little variation in levels and few upland areas. However, due the nature of the flat terrain elements in the landscape such as hedgerows and treelines will be more effective in screening even if they are positioned further away from the viewer.

One example is the southern County Offaly Scenic Route (R440 and R421 Birr to Kinitty and Ballard to Kinitty) where the ZTV maps shows full theoretical visibility for approximately half of the stretch between Birr and Kinitty and full theoretical visibility throughout nearly all of the remaining sections of the scenic route within the study area. However, when surveying the route during the site visit it was found that visibility towards the proposed development was blocked along the entirety of the route by intervening vegetation and local topography, save for an elevated stretch of the road north-west of Cadamstown, where Viewpoint 7 was taken from.

12.7.3.3.4 *Visual effects within five kilometres of the site*

Route Screening Analysis

In order to comprehensively demonstrate the varying characteristics of the roads and to record the actual visibility in comparison to the theoretical visibility, a methodology was developed termed Route Screening Analysis, and this was undertaken from all roads within a five-kilometre radius of the proposed turbines. The full methodology is outlined in Appendix 12.1 and the categories recorded were as follows:

- Little/no screening – mainly open and with some very light vegetation (see Plate 12.7)
- Intermittent/Partial Screening – light deciduous roadside vegetation and vegetation with short gaps which would allow intermittent or partial views (see Plate 12.8)
- Dense Screening – vegetation which is dense enough to block views e.g. coniferous forestry (see Plate 12.9)

Plate 12.7 Example of 'little/no screening' along the N62 between turbine clusters

Plate 12.8 Example of "intermittent/partial screening' along the N62 between both turbine clusters

Plate 12.9 Example of Route Screening category – dense screening; marked as point 316 in Figure 12.10 on an unnamed local road south-of the site

Figure 12.10 below outlines the route screening within a five-kilometre radius of the proposed turbines. This figure indicates that the majority of the roads within 5 kilometres of the site have intermittent/partial screening. Therefore, the full theoretical visibility indicated by the ZTV for these roads will be substantially reduced by screening. The presence of roadside screening is particularly important in contexts such as the proposed development site, where the site is at the same elevation or slightly lower to the surrounding roads.

Figure 12.10 Route Screening Analysis

Roads around the proposed development site within 1 kilometre are mainly local roads. Figure 12.10 shows that the dominant screening type is ‘intermittent/partial screening’ with some ‘little/no screening’ within 1 kilometre of the optimised turbines. The R438, passing to the west of the site, has ‘intermittent/partial screening’ towards the site. The N62, passing between the two proposed turbine clusters, is a mosaic of ‘little/no screening’ and ‘intermittent/partial screening’ as shown in Plate 12.7 and Plate 12.8 above. There are also stretches of this national road with open views across harvested peatland towards the site. Offaly protected view V12 is included within this area with ‘intermittent/partial screening’ effects from hedgerows obscuring views the site shown in Plate 12.10.

Plate 12.10 Example of ‘intermittent/partial screening’ along the V12 scenic view route looking eastwards

Within 1-3 kilometres of the site, ‘intermittent/partial screening’ remains the dominant category alongside some areas of ‘little/no screening’. Roads through the village of Cloghan to the north are included in this area and the ‘intermittent/partial screening’ of the village centre is shown in Plate 12.11. The part of the N52 which passes within 3 km of the proposed turbines to the southeast is a mixture of ‘little/no screening’ and ‘intermittent/partial screening’ as shown in Plate 12.12. All the regional roads are predominantly covered by ‘intermittent/partial screening’ with short stretches of ‘little/no screening’.

Plate 12.11 Example of 'intermittent/partial screening' within the village of Cloghan

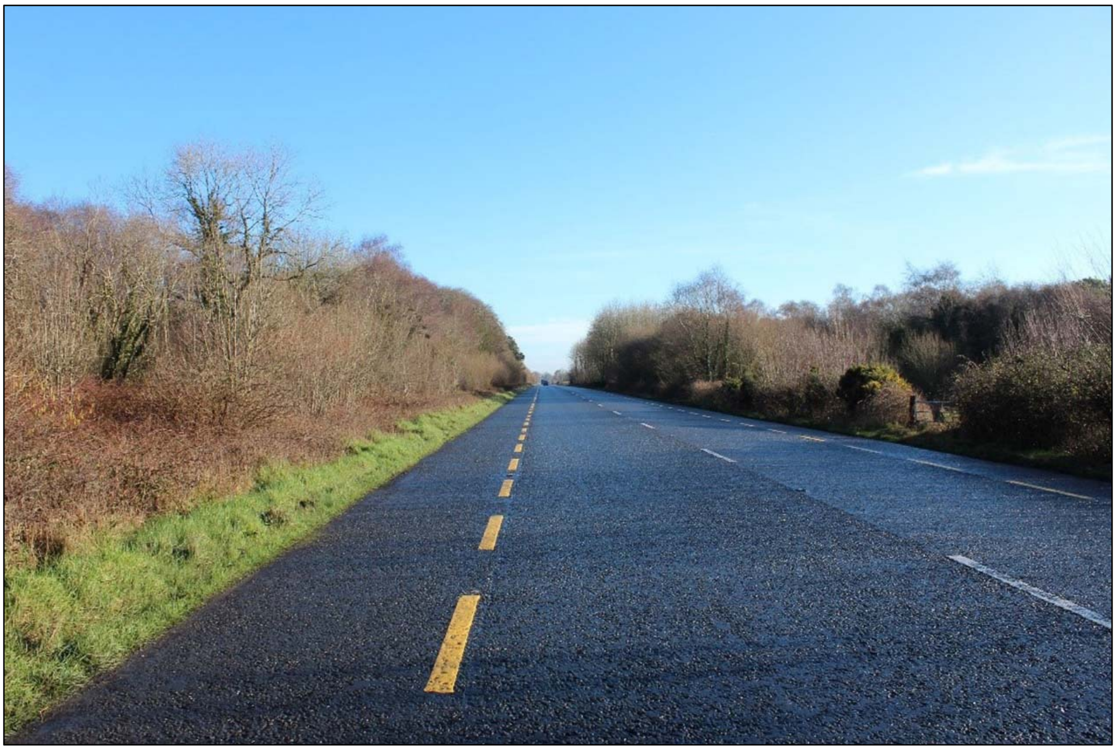

Plate 12.12 The N52 with 'intermittent/partial screening' along its length linking Kilcormac and Birr

Between 3 and 5 kilometres, 'intermittent/partial screening' remains the dominant category. Within this area is the town of Banagher and Shannon Harbour Village. The R356 and R439 regional roads entering and leaving the town of Banagher as well as its outskirts have 'intermittent/partial screening' with the centre of the village having a section of 'dense screening'. Plate 12.13 illustrates clearly the effect of 'dense screening' by buildings in Banagher Town and Plate 12.14 illustrates the 'intermittent/partial screening' of the outskirts. The local road entering and leaving the village of

Shannon Harbour mostly consists of 'intermittent/partial screening' as seen in Plate 12.15. The N52, and N62 national roads within this area are covered by the same level of screening as described above.

Plate 12.13 Example of dense screening within Banagher Town

Plate 12.14 Example of 'intermittent/partial screening' on the outskirts of Banagher Town

Plate 12.15 Example of 'intermittent/partial screening' on roads into Shannon Harbour

County Offaly scenic view V11, which is also part of the Northern Amenity Route is included within this area with 'intermittent/partial screening' effects from hedgerows obscuring views the site shown in Plate 12.16 below.

Plate 12.16 Representative example of 'intermittent/partial screening' along the Northern Amenity Route and V11 scenic view route

Viewpoints (within 5km of the site)

Ten of the selected viewpoints fall within five kilometres of the proposed turbines. Of these, Viewpoint P32/38 is located on Co. Offaly designated protected view V12, Viewpoints 33/35 and 28 are in Cloghan and Banagher and Viewpoints 16, 40, 20 and 23 are located on the N62 and N52. Hence, these viewpoints will be discussed under the respective parts of Section 12.7.3.3.5 *Visual Effects on Specific Visual Receptors'.*

The three remaining viewpoints, P14, P4 and P39, were assigned residual visual effects of Moderate, Slight and Not Significant, respectively.

Ancillary Project Elements

For the purposes of this LVIA, a number of individual elements of the proposed development, ancillary to the proposed wind turbines, have been grouped together for the assessment of effects, given the similar nature of the works required. These operational project elements include the proposed roads and turbine hardstand areas, anemometry masts and the electricity substation compound (and ancillary elements thereto) may all give rise to potentially similar landscape and visual effects.

Due to the topography of the proposed development site and surrounding areas the lower ancillary project elements will be visible in their immediate surroundings, hence, any visual effects will be localised and predominantly confined to within the proposed development site.

Visual effects arising from the proposed ancillary project elements will be slight, localised and long-term where seen, but will remain largely unseen from within and outside the site.

Electricity Substation
The electricity substation is to be located in the northern most corner of the eastern Drinagh. Plate 12.17 below shows while there is currently very little vegetation in the immediate environs of the proposed substation there are hedgerows, scrub and treelines on the site boundary that will partially or fully screen the substation from local visual receptors. Hence, the visual impact of the proposed electricity substation will be very localised, long-term, but only slight in significance.

Plate 12.17 Image taken from approximate position of proposed electricity substation looking northwards to the nearest road

Road Construction and Turbine Hardstands
Every use will be made of the existing machine access tracks on site, however approximately 29 kilometres of new internal roads will need to be constructed. Some vegetation clearance will occur as a result of this construction. Details of the required works are contained in Chapter 4. The visual impact of these hard surfaces will be localised. The visual effect of this road construction is considered long-term, localised, but only slight in significance.

Anemometry Masts
The two proposed permanent anemometry mast will be a slender structure up to 120 metres in height, and in itself will not be imposing structures in terms of visual impact. The landscape impact will primarily constitute vegetation clearance around the base of the mast. The visual effect of the proposed anemometry masts is considered to be long term but Not Significant, in that it will be significantly less visible than any turbine given its slender lattice form and will fade from view at a distance of anything more than a few kilometres.

12.7.3.3.5 *Visual Effects on Specific Visual Receptors*

Designated Scenic Routes and Scenic Views

The Offaly CDP designates protected views along stretches of road in one or consecutive townlands. Hence, views are not limited to one location, but stretch over up to several kilometres of road. Of the 15 County Offaly protected views identified in the study area four were screened out as the ZTV mapping showed that intervening landform will screen views. Another five were excluded as the focus of the protected view was directed away from the proposed development and in the case of one view, no views towards the proposed turbines could be established during the site visit due to the presence of extensive adjacent forestry. The remaining five protected views, V10, V11, V12, V16 and V17, were brought forward for viewpoint assessment. Offaly CDP also has two scenic amenity routes, which were also assessed for visual effects.

County Offaly protected view V10 is along a stretch of road from Ferbane village westwards. The ribbon development alongside hedgerows and treelines mainly precluded views to the proposed development. Actual visibility could only be found from elevated parts of this protected view such as selected Viewpoint 4. In this view, the stated main focus of the view *'southwards towards Slieve Bloom Mountains'* are located to the left (barely visible in the 120-angle view), away from the proposed turbines. Due to screening by intervening vegetation and Cloghan Hill the residual visual effect was considered Slight.

Protected view V11 along the R357 and covering a stretch of road spanning five townlands, also included the northern Co. Offaly Amenity Route, is generally bordered by consistent roadside vegetation as shown in the Route Screening Analysis for the western part of V11. A viewpoint (Viewpoint 4) was selected in the eastern part of this view with an apparently open view towards the turbines, but subsequent preparation of the photomontage showed that all proposed turbines will be screened from this viewpoint.

V12 is approximately 1.27 km from the nearest turbine and therefore, the closest designated view to the proposed development. The Route Screening Analysis shows that roadside vegetation is intermittent along the length of protected view V12 and hence views towards the turbines will be either partial or only along short sections of the road. The viewpoint selected was along the section of the road with the highest elevation and most open views over the proposed development thus representing the 'worst case scenario' with a residual visual effect of 'Moderate'.

V16 in the townland of Lower Cumber is along an infrequently travelled local road with views 'westward over farmland' while the proposed turbines are at a north-westerly direction from this location. Distance in particular was a mitigating factor, resulting in a residual visual effect of 'Slight' for selected Viewpoint 9.

In the case of V17 the view is described as being in 'Road No. L-06034 in the townlands of Knockhill and Drinagh'. This area falls into an area shown as having no visibility on the ZTV mapping, hence the viewpoint was chosen as close to the designated view as possible, but not actually at the protected view. Therefore, it could be concluded that V17 will not be impacted by the proposed development. Furthermore, due to a variety of mitigating factors nearby Viewpoint 6 was found to have a 'Slight' residual visual effect.

In addition to Viewpoint 4, discussed above for V11, another viewpoint (VP16) was selected to assess visual effects for the northern Co. Offaly Scenic Amenity Route. Here, residual visual effects were deemed 'Not significant' as most of the proposed wind farm will be screened by intervening vegetation.

As discussed in Section 12.7.3.3.3direct views towards the proposed development on the County Offaly Southern Scenic Amenity Route (R440 and R421 Birr to Kinitty and Ballard to Kinitty) were difficult to find during the site visit due screening by roadside vegetation. Plate 12.18 shows a rare open view in the direction of the proposed turbines taken along this road. However, it was found that mature trees at the end of the fields would screen most if not all of the proposed wind farm. The only location where a clear view of the proposed turbines could be confirmed was at Viewpoint 7, on the most elevated section of this Scenic Amenity Route. Here the residual visual effect is considered 'Slight'.

Plate 12.18 View from the Southern Amenity Route towards the proposed development site

Settlements

Of the 18 settlements identified in the study area, 15 were screened out in the 'Visual Receptor Preliminary Assessment', as no visibility of the proposed development could be established on site. Hence, viewpoints were selected for the remaining three settlements Cloghan, Banagher and Ferbane.

A location in the southern part of Cloghan was considered for inclusion in the viewpoint assessment, the photomontage prepared is shown in Plate 12.19 below. . The image was taken on the N62 between the Breachach housing estate and adjacent sports grounds. Due to the limited visibility of the proposed turbines it was not included as a viewpoint in the accompanying booklet for the overall assessment. Nonetheless, it, along with the Route Screening Analysis illustrates the minor visual effects that will be experienced in some of the southern parts of Cloghan.

Plate 12.19 Photomontage showing proposed view of Proposed turbines taken in southern part of Cloghan

In Banagher ZTV mapping shows mainly partial visibility with pockets of no visibility to the north-east and south. Furthermore, local buildings and vegetation screens views in nearly all areas as shown in the Route Screening Analysis. Only in the highest most southern part of Banagher could visibility be established. The viewpoint (VP13) selected in this area is adjacent to the Banagher Church of Ireland and looks down a residential road. Buildings and vegetation along this road screen most of the development. The residual visual effect was deemed 'Slight'.

The ZTV for Ferbane and its surrounds generally shows full theoretical visibility for the village with areas of no or partial visibility along the River Brosna and north of the L-03004. However, on the ground effective screening by buildings and vegetation as well as influence of individual hills, such as Cloghan Hill, obstructs views of the site. Viewpoint 3, taken from Chapel Lane, in an elevated position relative to other areas of Ferbane, presents perhaps the most open view of the site from this general area.

Birr is the largest settlement in the LVIA study area, hence particular attention was given to establishing whether residents would have views of the proposed turbines. No views of the site could be found within the town of Birr. The N52 and R439 in the northern parts of Birr Town leading towards the site were also surveyed and as can be seen in Plate 12.20 and Plate 12.21 extensive screening will preclude views towards the proposed development in both cases.

Plate 12.20 View towards the proposed turbines taken from adjacent the N52 on the northern outskirts of Birr Town

Plate 12.21 View towards the proposed turbines taken from the R439 adjacent to o St. Brendan's Community School in the northern outskirts of Birr Town

Recreational Routes and Destinations

Viewpoint 4 was selected to assess, amongst other visual receptors, the visual effects on the Offaly Way. While the ZTV mapping had shown predominantly full theoretical visibility for this recreation route, it was found that screening by roadside vegetation blocked views for a large part of the route. Viewpoint 4 is relatively open view towards the proposed turbines. However, after preparation of the photomontage it was shown that there would be no view from this location.

For the assessment of Lough Boora Parklands and associated recreation routes, in addition to the nearby Viewpoint 4, Viewpoint 5 was selected. This viewpoint is approximately halfway between the Lough Boora Discovery Park entrance and the nearest turbine. Here, the residual visual effect was found to be Not Significant, due to intervening vegetative screening particularly of the furthest, western turbine group.

Transport Routes

As the N62 runs between the two turbine clusters, three viewpoints were selected along this national road. One each approaching the proposed wind development from the north (Viewpoint 1) and one from the south (Viewpoint 10) as well as one (Viewpoint 11, with two photomontages one to the western and another to the eastern turbines) in between the two groups of turbines. The residual visual effects were Slight from Viewpoint 1, Not Significant from Viewpoint 10 and Moderate from Viewpoint 11, partially due to lower visual receptor sensitivity and mitigation factors such as significant screening by roadside vegetation reducing the residual visual effect.

One viewpoint (Viewpoint 8) was selected along the closest section of the N52. Here, after taking mitigating factors into consideration the residual visual effect was deemed Not Significant.

1.1.1.2 Cumulative Visual Effects

The proposed turbines alongside the existing and permitted turbines Meenwaun and Cloghan turbines are very similar in terms of scale and design. Furthermore, due to their proximity, spacing and layout they visually read as one wind farm or in some cases as two equal clusters of wind turbines with the individual wind energy projects indistinguishable. This is in keeping with the *Draft Revised Wind Energy Development Guidelines December 2019*, where in Section 6.6 *Cumulative Effect 'similarity in the siting and design approach is preferred where a number of wind energy developments are located in the same landscape character area'* and *'different wind energy developments can appear as a single collective unit if located near each other'.* The guidelines propose avoiding visual stacking, where turbines are seen '*one behind another, when viewed from highly sensitive key viewpoints'.* The selected 16 Viewpoints show that through careful design this visual effect has predominantly been avoided.

With the above in mind the proposed wind turbines have been assessed alongside the adjacent existing and permitted turbines as 'one collective unit'. Furthermore, the proposed amendments to Cloghan Wind Farm have been considered and if permitted it is not considered that the cumulative impact of Derrinlough together with the amended Clogan WF result in any change to the cumulative impact of Derrinlough with the existing consented developments outlined above.

A comparative ZTV (Figure 12.11 below) shows that the cumulative visibility over that of the existing and permitted turbines will only increase in a small number of tiny pockets due to the addition of the proposed Derrinlough turbines, and therefore it is considered that the proposed turbines will not have a significant impact on the extent of cumulative visibility within the overall study area.

12.7.4 Decommissioning Phase Effects

The landscape and visual effects during decommissioning are anticipated to be the same as during the construction phase.

Figure 12.11 Comparative ZTV

13. ARCHAEOLOGY AND CULTURAL HERITAGE

13.1 Introduction

This archaeological, architectural, and cultural heritage chapter was prepared by Tobar Archaeological Services. It presents the results of an archaeological, architectural and cultural heritage impact assessment for a proposed wind farm at Derrinlough, near Birr, Co. Offaly. The development area predominantly comprises a worked peat bog.

The purpose of this chapter is to assess the potential direct and indirect effects of the proposed development on the surrounding archaeological, architectural and cultural heritage landscape. The assessment is based on both a desktop review of the available cultural heritage and archaeological data and a comprehensive programme of field walking of the study area. The report amalgamates desk-based research and the results of field walking to identify areas of archaeological/architectural/ cultural significance or potential, likely to be impacted either directly or indirectly by the proposed development. An assessment of potential effects, including cumulative effects, is presented, and a number of mitigation measures are recommended where appropriate. The visual effect of the proposed development on any newly discovered monuments/sites of significance as well as known recorded monuments is also assessed.

13.1.1 Proposed Development

The proposed development will include 21 No. wind turbines, a 110kV substation and all associated infrastructure and site works as described in Chapter 4: Description of the Proposed development. All elements of the proposed development are assessed in this chapter.

13.1.2 Statement of Authority

This chapter of the EIAR has been prepared by Miriam Carroll and Annette Quinn of Tobar Archaeological Services. Miriam and Annette both graduated from University College Cork in 1998 with a Masters degree in Methods and Techniques in Irish Archaeology. Both are licensed by the Department of Culture, Heritage and the Gaeltacht to carry out excavations and are members of the Institute of Archaeologists of Ireland. Annette Quinn and Miriam Carroll have been working in the field of archaeology since 1994 and have undertaken numerous projects for both the private and public sectors including excavations, site assessments (EIAR) and surveys. Miriam Carroll and Annette Quinn are directors of Tobar Archaeological Services which has been in operation for 16 years.

13.1.3 Legislation and Guidelines

The chapter has been prepared in compliance with all relevant EIA legislation and guidance (see Chapter 1: Introduction for relevant guidance and legislation).

13.1.3.1 Current Legislation

Archaeological monuments are safeguarded through national and international policy, which is designed to secure the protection of the cultural heritage resource. This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention). This was ratified by Ireland in 1997.

Both the National Monuments Acts 1930 to 2004 and relevant provisions of the Cultural Institutions Act 1997 are the primary means of ensuring protection of archaeological monuments, the latter of which includes all man-made structures of whatever form or date. There are a number of provisions under the National Monuments Acts which ensure protection of the archaeological resource. These include the Register of Historic Monuments (1997 Act) which means that any interference to a monument is illegal under that Act. All registered monuments are included on the Record of Monuments and Places (RMP).

The Record of Monuments and Places (RMP) was established under Section 12 (1) of the National Monuments (Amendment) Act 1994 and consists of a list of known archaeological monuments and accompanying maps. The Record of Monuments and Places affords some protection to the monuments entered therein. Section 12 (3) of the 1994 Amendment Act states that any person proposing to carry out work at or in relation to a recorded monument must give notice in writing to the Minister (Environment, Heritage and Local Government) and shall not commence the work for a period of two months after having given the notice. All proposed works, therefore, within or around any archaeological monument are subject to statutory protection and legislation (National Monuments Acts 1930-2004).

The term 'national monument' as defined in Section 2 of the National Monuments Act 1930 means a monument *'the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto'*. National monuments in State care include those which are in the ownership or guardianship of the Minister for Arts, Heritage and the Gaeltacht. Section 5 of the National Monuments Act (1930) allows owners of other national monuments to appoint the Minister for the Arts, Heritage and the Gaeltacht or the relevant local authority as guardian of such monuments, subject to their consent. This means in effect that while the property of such a monument remains vested in the owner, its maintenance and upkeep are the responsibility of the State. Some monuments are also protected by Preservation Orders and are also regarded as National Monuments. National Monuments also includes (but not so as to limit, extend or otherwise influence the construction of the foregoing general definition) every monument in Saorstát Éireann to which the Ancient Monuments Protection Act, 1882, applied immediately before the passing of this Act, and the said expression shall be construed as including, in addition to the monument itself, the site of the monument and the means of access thereto and also such portion of land adjoining such site as may be required to fence, cover in, or otherwise preserve from injury the monument or to preserve the amenities thereof.

Under the Heritage Act (1995) architectural heritage is defined to include *'all structures, buildings, traditional and designed, and groups of buildings including street-scapes and urban vistas, which are of historical, archaeological, artistic, engineering, scientific, social or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents...'*. A heritage building is also defined to include *'any building, or part thereof, which is of significance because of its intrinsic architectural or artistic quality or its setting or because of its association with the commercial, cultural, economic, industrial, military, political, social or religious history of the place where it is situated or of the country or generally'*.

13.1.3.1.1 Granada Convention

The Council of Europe, in Article 2 of the 1985 Convention for the Protection of the Architectural Heritage of Europe (Granada Convention), states that *'for the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member State will undertake to maintain inventories of that architectural heritage'*. The Granada Convention emphasises the importance of inventories in underpinning conservation policies.

The NIAH was established in 1990 to fulfill Ireland's obligations under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architectural heritage of Ireland. Article 1 of the Granada Convention establishes the parameters of this work by defining 'architectural heritage' under three broad categories of Monument, Groups of Buildings, and Sites:

- Monument: all buildings and structures of conspicuous historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;
- Group of buildings: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest, which are sufficiently coherent to form topographically definable units;
- Sites: the combined works of man and nature, being areas which are partially built upon and sufficiently distinctive and homogenous to be topographically definable, and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The Council of Europe's definition of architectural heritage allows for the inclusion of structures, groups of structures and sites which are considered to be of significance in their own right, or which are of significance in their local context and environment. The NIAH believes it is important to consider the architectural heritage as encompassing a wide variety of structures and sites as diverse as post boxes, grand country houses, mill complexes and vernacular farmhouses.

13.1.3.2 Offaly County Development Plan 2014-2020

Offaly County Development Plan (CDP) 2014-2020 outlines a number of policies and objectives relating to archaeology and built heritage as follows:

13.1.3.2.1 *Areas of High Amenity Policies:*

AHAP-01

It is Council policy to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey and surrounding area, the River Shannon, Lough Boora Parklands, Grand Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers. These areas are indicated on Map 7.17 of the County Development plan.

Notwithstanding the location of certain settlements, or parts of, for which there are settlement plans (towns, villages, 'sráids'), within the Areas of High Amenity, it is not the intention of this policy to hinder appropriate sustainable levels of development (as set out in the plans and subject to proper planning). Further, it is policy to facilitate the sustainable extension and expansion of existing visitor, tourist related or other rural enterprises within the Areas of High Amenity, where such development is appropriate and where it can be demonstrated that it gives 'added value' to the extending activity and to the immediate area which is the subject of the 'Area of High Amenity' designation.

AHAP-02

It is Council policy, in both cases above, to ensure that issues of scale, siting, design and overall compatibility (including particular regard to environmental sensitivities) with the site's location within an Area of High Amenity are of paramount importance when assessing any application for planning permission. The merits of each proposal will be examined on a case-by case basis.

13.1.3.2.2 Areas of High Amenity Objectives:

AHAO-01

It is an objective of the Council to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey & surrounding area, the River Shannon, Lough Boora Parklands, Grand Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers.

13.1.3.2.3 Landscape Sensitivity

Archaeological and Historical Landscapes are identified as High Sensitivity Areas in the Offaly County Development Plan. The landscape characteristics and sensitivities of archaeological and historical landscapes are outlined in Section H of Table 7.11.4 of the CDP and are summarised below.

Characteristics:

- County Offaly is rich in landscapes of archaeological and historic interests as is shown in Map 7.16. This ranges from large ecclesiastical sites such as Clonmacnoise and Durrow Abbey to archaeological features such as the Durrow High Cross.
- Section 7.18, Built Heritage of this plan provides further policies and objectives concerning the county's archaeological and historical landscapes. These primarily include Clonmacnoise, Durrow, Killeigh, Leamonaghan and Rahan.

Sensitivities:

- These landscapes are highly sensitive to new developments, which could potentially damage the historical character and the cultural and social importance of the area.
- The Council shall endeavour to ensure that planning applications for development, refurbishment and restoration works etc. within close proximity to these areas are sympathetic to the sensitive nature of the landscape.

13.1.3.2.4 Architectural and Archaeological Heritage Policies:

AAHP-01

It is Council policy to ensure that the alteration or extensions to protected buildings and structures will only be permitted if the proposals are in keeping with the character of the building and preserve the architectural and historic features of the buildings or structures.

AAHP-02

It is Council policy to encourage the retention, sympathetic maintenance, and appropriate re-use of the vernacular buildings, in both the towns and rural areas of the county, including the retention of the original fabric, such as windows, renders, shop fronts, gates, yards, boundary walls and other significant features where possible, to discourage the replacement of good quality vernacular buildings with modern structures;

AAHP-03

It is Council policy to ensure that new build adjoining, and extensions to, vernacular buildings are of an appropriate design and do not detract from the building's character.

AAHP-04

It is Council policy to apply the following principles to the archaeological heritage:

- To facilitate appropriate guidance in relation to the protection of the county's archaeological heritage.
- To promote public awareness of the rich archaeological heritage in this area.
- To protect and enhance archaeological monuments and their settings and Zones of Archaeological Potential.

AAHP–05

It is Council policy that the area comprising the National Monument at Clonmacnoise, enclosing Eskers, Mongans Bog, Clonmacnoise Callows, Fin Lough and the limestone pavement at Clorhane shall retain its nominated status as the "Clonmacnoise Heritage Zone", in accordance with the recommendations of the study of the area carried out by the Environmental Sciences Unit of Trinity College, Dublin and as indicated on Map 7.21.

AAHP-06

It is Council policy that, in the primary control zone around the National Monument, development will be strictly curtailed, so as to preserve and protect the unique character and distinctive quality of this area. The boundaries of the secondary control area correspond with that of the Shannon Area of High Amenity. Within this secondary area the controls applicable to Areas of Special Control will apply together with a further requirement that the Planning Authority must be satisfied that the particular purpose of the proposal justifies the location proposed.

AAHP-07

It is policy of the Council to promote awareness of, and access to, the archaeological inheritance of Offaly.

AAHP-08

It is Council policy to ensure that development in the immediate vicinity of a recorded monument is sensitively sited and designed so that it does not significantly detract from the monument. Where upstanding remains exist, a visual impact assessment may be required.

AAHP-09

It is Council policy to inform and seek guidance from the National Museum of Ireland if an unrecorded archaeological object is discovered, or the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht in the case of the discovery of an unrecorded archaeological site, in accordance with National Monuments legislation.

AAHP-10

It is Council policy to ensure that full consideration is given to the protection of archaeological heritage when undertaking, approving or authorising development in order to avoid unnecessary conflict between development and the protection of the archaeological heritage.

AAHP-11

It is Council policy to ensure that all development proposals affecting sites specified in the Record of Monuments and Places or Zones of Archaeological Potential are referred to the prescribed bodies (as set out in the Planning and Development Act 2000, as amended) and to have regard to the advice and recommendations of the prescribed bodies in relation to undertaking, approving or authorising development.

AAHP-12

It is Council policy to ensure that when an unrecorded archaeological object or site is discovered, any works that threaten the object or site are immediately suspended and that the appropriate Government agency is informed.

AAHP-13

It is Council policy to protect historical burial grounds within Offaly and encourage their maintenance in accordance with conservation principles.

AAHP-14

It is Council policy to facilitate appropriate guidance in relation to the protection of the archaeological heritage in the area covered by the plan.

AAHP-15

It is Council policy that developments, which require vehicular access from public roads that were formerly towpaths or from existing towpaths along the Grand Canal, are very strictly controlled. This is in addition to restrictions relevant to the Canal's designation as a Natural Heritage Area and consequently as an Area of Special Control. It is policy to consider housing applications for established families* only along roads that were formerly towpaths along the Grand Canal and that such developments will be strictly controlled.

*Families for the purpose of this policy are defined as husband, wife and their children, siblings of the husband and wife and their sons and daughters.

AAHP-16

It is Council policy to encourage the protection, promotion and enhancement of heritage gardens and parks in the county and support public awareness, enjoyment of and access to these sites.

AAHP-17

It is Council policy to protect archaeological sites and monuments, underwater archaeology, and archaeological objects, which are listed in the Record of Monuments and Places, and to seek their preservation in situ (or at a minimum, preservation by record) through the planning process. It is Council policy to seek to protect important archaeological landscapes from inappropriate development.

AAHP-18

It is Council policy to encourage and promote the appropriate management and maintenance of the County's archaeological heritage, including historical burial grounds, in accordance with conservation principles and best practice guidelines.

AAHP-19

It is Council policy to continue to develop the Council's advisory/educational role with regard to heritage matters and to promote awareness, understanding, and appreciation of the architectural heritage of Offaly.

AAHP-20

It is Council policy to encourage, where appropriate, the adaptive re-use of existing buildings and sites in a manner compatible with their character and significance.

AAHP-21

It is Council policy to identify places of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest and where appropriate to define them as Architectural Conservation Areas.

AAHP-22

It is Council policy to require that all development proposals within an ACA should be appropriate to the character of the area, inclusive of its general scale and materials, and are appropriately sited and sensitively designed having regard to the advice given in the Statements of Character for each area.

13.1.3.2.5 *Architectural and Archaeological Heritage Objectives:*

AAHO-01

It is an objective of the Council to examine the feasibility of designating Architectural Conservation Areas in the county over the plan period.

AAHO-02

It is an objective of the Council to protect all structures listed in the Record of Protected Structures, that are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest throughout the county.

AAHO-03

It is an objective of the Council to protect the Slí Mór and Slí Dála routes and sign post them where appropriate.

AAHO-04

It is an objective of the Council to secure the protection (i.e. preservation in situ or at a minimum protection by record) of all archaeological monuments included in the Record of Monuments and Places as established under Section 12 of the National Monuments (Amendment) Act 1994, and their setting.

AAHO-05

It is an objective of the Council to protect and preserve archaeological sites and their settings discovered since the publication of the Record of Monuments and Places and the publication of the Urban Archaeology Survey.

AAHO-06

It is an objective of the Council to protect the Zones of Archaeological Potential identified in the Record of Monuments and Places.

AAHO-07

It is an objective of the Council to prohibit the demolition of a structure that positively contributes to the character of an ACA, except in exceptional circumstances. The Council will require such applications to be accompanied by a measured and photographic survey, condition report and architectural heritage assessment of the structure. Where permission for demolition is granted within an ACA, an assessment of the impact of the replacement building on the character of the ACA will be required.

AAHO-08

It is an objective of the Council to ensure that any new development within or contiguous to an ACA is sympathetic to the character of the area and that the design is appropriate in terms of scale, height, plot density, layout, materials and finishes.

AAHO-09

The council acknowledges the nomination by the Government of Ireland, of two Monastic sites, Clonmacnoise and Durrow, on the tentative list for inclusion to the UNESCO World Heritage sites list. It is an objective of the Council to explore potential of further designating the Monastic Sites at Clonmacnoise and Durrow as prospective UNESCO World Heritage Sites.

13.1.3.3 Statutory Consultations

The Development Applications Unit provided a response, to a scoping consultation by MKO, on Archaeology (Ref G Pre00165/2018). The observations were as follows:

'***Archaeology***

An Archaeological assessment should be carried out by a suitably qualified archaeologist.

The following should be included in the Archaeological survey methodology and guidelines outlined in the EIA scoping document.

Archaeological assessment should be carried out as follows:

- *All previous surveys of the bog should be examined.*
- *A new survey of the bog should be carried out. This survey should include cleaning the drains and walking the bog. It might be necessary to have drains re-cut to facilitate examination.*
- *Survey work should be carried out by an archaeologist working under the terms of an excavation licence granted by this Department. This will facilitate sampling for species identification and dating.*
- *The proposed site layout should be considered in the light of the surveys.*
- *Having identified areas of archaeological importance, buffer areas where no ground disturbance will take place should be established, in order to facilitate preservation in situ of archaeological features.*
- *Archaeological mitigation should be suggested, to take place in advance of and/or during groundworks.*

- *It is likely, that where material is to be preserved in situ, empirical measurement into the future of hydrology of the site will be required e.g. by means of the use of dipwells (piezometers).'*

The issues raised in the consultation response were considered, where possible as part of this assessment as outlined in the following paragraphs.

All available bog surveys were consulted as part of the assessment. Clongawny Bog was archaeologically surveyed in 1997 by the (Irish Archaeological Wetland Unit) IAWU as part of the Archaeological Survey of Ireland Peatland Survey. Drinagh Bog was also archaeologically surveyed in 1997 by the IAWU as part of the Archaeological Survey of Ireland Peatland Survey.

A re-assessment survey was carried out by Archaeological Development Services Ltd on behalf of Bord na Móna in 2009 (Rohan 2009). A summary of the previous surveys is presented in Section 13.3.1.6.1.

An archaeological assessment by way of a detailed and extensive walkover survey of the proposed development site was undertaken by Tobar Archaeological Services in 2019 and 2020. Licensed archaeological monitoring of Engineering site investigations was also undertaken in 2019 and a report is presented as Appendix 13.2 of the EIAR.

The site in general was largely covered in dense vegetation during the 2019/2020 assessment conducted as part of the EIAR. Many areas were also flooded with some drains water-filled.

Inspection of all drains was carried out aside from those that were flooded or overgrown. To alleviate potential impacts and to address the limitations with the assessment (due to vegetation, overgrowth and flooding) a series of detailed mitigation measures have been proposed.

The proposed site layout has taken the known archaeological constraints (RMPs) into consideration taking the 'mitigation by avoidance' approach.

A number of mitigation measures will be implemented both at the pre-construction and construction stage of the proposed development.

13.1.4 Location and Topography

The site of the proposed development is situated c. 74km north of Birr in west county Offaly and at its nearest point c. 2km south of Cloghan (See Chapter 1, Figure 1.1). It is located in cut-over peat bog which is centred around an existing peat briquette factory at Derrinlough. The eastern portion of the proposed development site comprises Drinagh Bog which is 75% cutaway bog. It is separated from the western portion of the proposed development site by the N62. The west side of the site comprises Clongawny bog which is located at the south-western extent of the Boora Group. The site has a total area of 2360ha. The cutaway areas are densely vegetated. Many areas of the Clongawny and Drinagh bogs are tree covered and overgrown and Drinagh bog is flooded in many areas. The proposed development site is almost entirely comprised of raised peat bog which has been commercially worked by Bord na Móna since circa 1960.

13.2 Assessment Methodology

The assessment of the archaeology, architecture and cultural heritage of the proposed development area included GIS mapping and desk-based research followed by field inspection. A desk-based study of the proposed development site was initially undertaken in order to assess the archaeological, architectural and cultural heritage potential of the area and to identify constraints or features of archaeological/cultural heritage significance within or near to the proposed development site.

13.2.1 Geographical Information Systems

GIS is a computer database which captures, stores, analyses, manages and presents data that is linked to location. GIS is geographic information systems which includes mapping software and its application with remote sensing, land surveying, aerial photography, mathematics, photogrammetry, geography and tools that can be implemented with GIS software. A geographic information system (GIS) was used to manage the datasets relevant to the archaeological and architectural heritage assessment and for the creation of all the maps in this section of the report. This involved the overlaying of the relevant archaeological and architectural datasets on georeferenced aerial photographs and road maps (ESRI), where available. The integration of this spatial information allows for the accurate measurement of distances of a proposed development from archaeological and cultural heritage sites and the extraction of information on 'monument types' from the datasets. Areas of archaeological or architectural sensitivity may then be highlighted in order to mitigate the potential negative effects of a development on archaeological, architectural and cultural heritage.

ArcGIS online viewshed analysis was also used to assess effects on setting of archaeological monuments. The Viewshed tool uses the ESRI Elevation Analysis service to determine which areas are visible from specified observer points (the observer points being the monuments). Visibility settings are used to set the height of the observer (1.75m standard), the height, for example of the observed features (e.g. turbines), and the maximum viewing distance of the observer. This tool was utilised to ascertain the potential/theoretical visual effects on Cultural Heritage Assets. The results show the worst-case scenario since the model does not take trees or vegetation into consideration. The results are outlined in Section 13.3.

13.2.2 Desktop Assessment

The following sources were consulted as part of the desktop assessment for the proposed development:

- The Record of Monuments and Places (RMP)
- The Sites and Monuments Record (SMR)
- National Monuments in State Care County Offaly
- The Topographical Files of the National Museum of Ireland
- First edition Ordnance Survey maps (OSI)
- Second edition Ordnance Survey maps (OSI)
- Third edition Ordnance Survey Map (Record of Monuments and Places)
- Down Survey maps (www.downsurvey.tcd.ie)
- Aerial photographs (copyright of Ordnance Survey Ireland (OSI)
- Excavations Database
- National Inventory of Architectural Heritage (NIAH)
- Record of Protected Structures (Offaly County Development Plan)
- Previous archaeological surveys and assessments carried out on or near to the proposed development site (various)
- Archaeological inventory of County Offaly (1997)

Each of these are discussed in the following sections.

13.2.2.1 Record of Monuments and Places, Sites and Monuments Record and National Monuments

A primary cartographic source and base-line data for the assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for County Offaly. All known recorded archaeological monuments are indicated on 6-inch Ordnance Survey (OS) maps and are listed in these records. The SMR/RMP is not a complete record of all monuments as newly discovered sites may not appear in the list or accompanying maps. In conjunction with the consultation of the SMR and RMP the electronic database of recorded monuments and SMRs which may be accessed at www.webgis.archaeology.ie/historicenvironment.

A review of all National Monuments in State Care and those subject to Preservation Orders was undertaken as part of the assessment in order to ascertain any potential impacts on their setting as a result of the proposed development.

13.2.2.2 Cartographic Sources and Aerial Photography

The 1st (1840s) and 2nd (1900s) edition OS maps for the area were consulted, where available, as was OSI aerial photography.

13.2.2.3 Topographical Files - National Museum of Ireland

Details relating to finds of archaeological material and monuments in numerous townlands in the country are contained in the topographical files held in the National Museum of Ireland. In order to establish if any new or previously unrecorded finds had been recovered from the study area these files were consulted for every townland within and adjacent to the same. The bogs database, also held in the National Museum of Ireland was also consulted for finds or items recovered from the proposed development site.

13.2.2.4 Archaeological Inventory Series

Further information on archaeological sites may be obtained in the published County Archaeological Inventory series prepared by the Department of Culture, Heritage and the Gaeltacht. The archaeological inventories present summarised information on sites listed in the SMR/RMP and include detail such as the size and location of particular monuments as well as any associated folklore or local information pertaining to each site. The inventories, however, do not account for all sites or items of cultural heritage interest which are undiscovered at the time of their publication. Many sites have been discovered since the publication of the Inventory Series which have now been added to the Sites and Monuments Record.

13.2.2.5 Record of Protected Structures

The Record of Protected Structures for County Offaly was consulted for the schedule of buildings and items of cultural, historical or archaeological interest which may be affected by the Proposed Development. The development plan also outlines policies and objectives relating to the protection of the archaeological, historical and architectural heritage landscape of Offaly. The digital dataset for Protected Structures was downloaded from ArcGIS online and added to the project GIS mapping (Section 13.2.1 above) used for the creation of Figures in this chapter.

13.2.2.6 Excavations Database

The Excavations Database is an annual account of all excavations carried out under license. The database is available on line at www.excavations.ie and includes excavations from 1985 to 2019. This database was consulted as part of the desktop research for this assessment to establish if any archaeological excavations had been carried out within or near to the proposed development area.

13.2.2.7 National Inventory of Architectural Heritage (NIAH)

This source lists some of the architecturally significant buildings and items of cultural heritage and is compiled on a county by county basis by the Department of Culture, Heritage and the Gaeltacht. The NIAH database was consulted for all townlands within and adjacent to the study area. The NIAH survey for Offaly has been published and was downloaded on to the base mapping for the proposed development (www.buildingsofireland.ie). The National Inventory of Architectural Heritage (NIAH) is a state initiative under the administration of the Department of Culture, Heritage and the Gaeltacht and established on a statutory basis under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999.

The purpose of the NIAH is to identify, record, and evaluate the post-1700 architectural heritage of Ireland, uniformly and consistently as an aid in the protection and conservation of the built heritage. NIAH surveys provide the basis for the recommendations of the Minister for the Environment, Heritage and Local Government to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS). The published surveys are a source of information on the selected structures for relevant planning authorities. They are also a research and educational resource. It is hoped that the work of the NIAH will increase public awareness and appreciation of Ireland's architectural heritage.

13.2.2.8 Previous Surveys and Assessments

A number of archaeological surveys were previously carried out within these bogs during the lifetime of production works by Bord na Móna. A summary of the available results of such surveys and/or any reassessment surveys is presented below. These are discussed in Section 13.3.1.6 below.

13.2.3 Field Inspection

An intensive programme of field inspection was undertaken over a number of days in November and December 2019 and January 2020 in good, clear weather conditions. The proposed development site and its surrounds were inspected by Annette Quinn and Miriam Carroll of Tobar Archaeological Services in November and December 2019 and January 2020. The inspection consisted of a walk-over examination of the proposed development site, an assessment of any recorded monuments, architectural, built or cultural heritage items within the site and the potential direct and indirect impacts on those monuments. Any newly discovered archaeological monuments, items of built heritage or cultural heritage value within the study area were also recorded during the field inspection. A full photographic record of the site was made and is attached in Appendix 13.1.

13.2.3.1 Limitations Associated with Fieldwork

The site in general was largely covered in dense vegetation during the 2019/2020 assessment conducted as part of the EIAR. Many areas were also flooded with some drains water-filled.

Inspection of all drains was carried out aside from those that were flooded or overgrown. To alleviate potential impacts and to address the limitations with the assessment (due to vegetation, overgrowth and flooding) a series of detailed mitigation measures have been proposed.

This limitation is dealt with by the implementation of appropriate mitigation measures (Pre-construction and construction stage).

13.2.4 Assessment of Likely Significant Effects

The likely effects on the existing archaeological, architectural and cultural heritage environment are assessed using the criteria as set out in the draft *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (EPA, 2017) and as outlined in Section 1.8.1 of Chapter 1. The following terminology is used when describing the likely effects of the proposed development from a Cultural Heritage perspective.

13.2.4.1 Types of Impact

- Direct impacts arise where an archaeological heritage feature or site is physically located within the footprint of the development whereby the removal of part, or all of the feature or site is thus required.
- Indirect impacts may arise as a result of subsurface works undertaken outside the footprint of the development, secondary environmental change such as a reduction in water levels and visual impacts.
- Cumulative Impacts arise when the addition of many impacts create a larger, more significant impact.
- Residual Impacts are the degree of environmental changes that will occur after the proposed mitigation measures have been implemented.

13.2.4.1.1 *Magnitude of Effects (Significance)*

- Profound: Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological site is completely and irreversibly destroyed.
- Very Significant: An effect which by its character, magnitude, duration or intensity significantly alters most of the sensitive aspect of the environment.
- Significant: An effect which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. An effect like this would be where part of a site would be permanently impacted upon, leading to a loss of character, integrity and data about an archaeological site.
- Moderate: A moderate effect arises where a change to an archaeological site is proposed which though noticeable, is not such that the integrity of the site is compromised and which is reversible. This arises where an archaeological site can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.
- Slight: An effect which causes changes in the character of the environment which are not high or very high and do not directly impact or affect an archaeological site.
- Not Significant: An effect which causes noticeable changes in the character of the environment but without significant consequences.
- Imperceptible: An effect on an archaeological site capable of measurement but without noticeable consequences.

13.2.5 Methodology for the assessment of impacts on visual setting (indirect effects)

A standardised approach was utilised for the assessment of impacts of visual setting (indirect effects) according to types of monuments and cultural heritage assets which may have varying degrees of sensitivity. This assessment does not include visits to each and every site as this is considered to be beyond the scope of the EIAR as they are mainly located on private lands. The assessment of impacts on visual setting was undertaken using both the Zone of Theoretical Visibility (ZTV) map in the Landscape and Visual Impact Assessment (LVIA), as presented in Chapter 11 of this EIAR, and also viewshed analysis from specific cultural heritage assets (viewshed analysis is described in Section 13.2.1 above). The viewshed analysis used in the assessment of potential impacts on the visual setting of cultural heritage assets in the wider landscape of 10km and 20km considers the effects of the proposed turbines only. Other lower visibility infrastructure such as roads, grid connection, sub-station etc. are not included in the viewshed analysis. All other infrastructure (proposed roads, grid connection, sub-station, compounds etc) are assessed without the use of viewshed analysis.

While direct physical impacts to a site or monument can easily be assessed in quantitative terms, the assessment of impacts on setting can be subjective and as such is a matter of qualitative, professional judgement and experience. The distances below used in the assessment of impacts on setting are regarded as appropriate and are based on professional judgement.

Table 13.1: Cultural Heritage Assets considered according to sensitivity

Cultural Heritage Asset	Distance Considered
UNESCO World Heritage Sites (including tentative sites)	20km
National Monuments (State Ownership and Preservation Order Sites)	10km
Recorded Monuments, RPS	5km
NIAH structures	5km
Undesignated sites, if relevant	500m from proposed development

13.3 Existing Environment

13.3.1 Archaeological Heritage

Archaeological Heritage includes World Heritage Sites, National Monuments, sites which are subject to a preservation order, sites listed in the RMP/SMR and newly discovered archaeological sites. Each of these are addressed in the following sections.

13.3.1.1 UNESCO World Heritage Sites (and those on tentative List)

Offaly County Council have acknowledged the nomination by the Government of Ireland, of two Monastic sites, Clonmacnoise and Durrow Abbey, on the tentative list for inclusion to the UNESCO World Heritage sites list. It is an objective of the Council to explore the potential of further designating the Monastic Sites at Clonmacnoise and Durrow as prospective UNESCO World Heritage Sites.

All UNESCO sites (including those on the Tentative list) within 20km of the proposed development were assessed.

Clonmacnoise is situated c. 15km to the north-west. Durrow Abbey is located outside the 20km visual assessment study zone at 23km to the north-east of the proposed development site (**Error! Reference source not found.**). Given the intervening distance, the immediate visual setting of these archaeological sites will not be impacted by the proposed development.

13.3.1.1.1 *Clonmacnoise*

The Zone of Theoretical Visibility (ZTV) (Figure 11.1 of the Landscape and Visual Assessment Chapter 11) was utilised as part of the assessment of impacts on visual setting and this shows that Clonmacnoise has limited to no visibility in the direction of the proposed development. A viewshed analysis was also undertaken in ArcGIS from the south side of Clonmacnoise graveyard enclosure. The viewshed included the 20km visual assessment study zone. The results (Figure 13.2) show that there are potentially no instances where any component of the proposed turbines would be visible from the monument (See Section 13.2.5 for ZTV and Viewshed methodology).

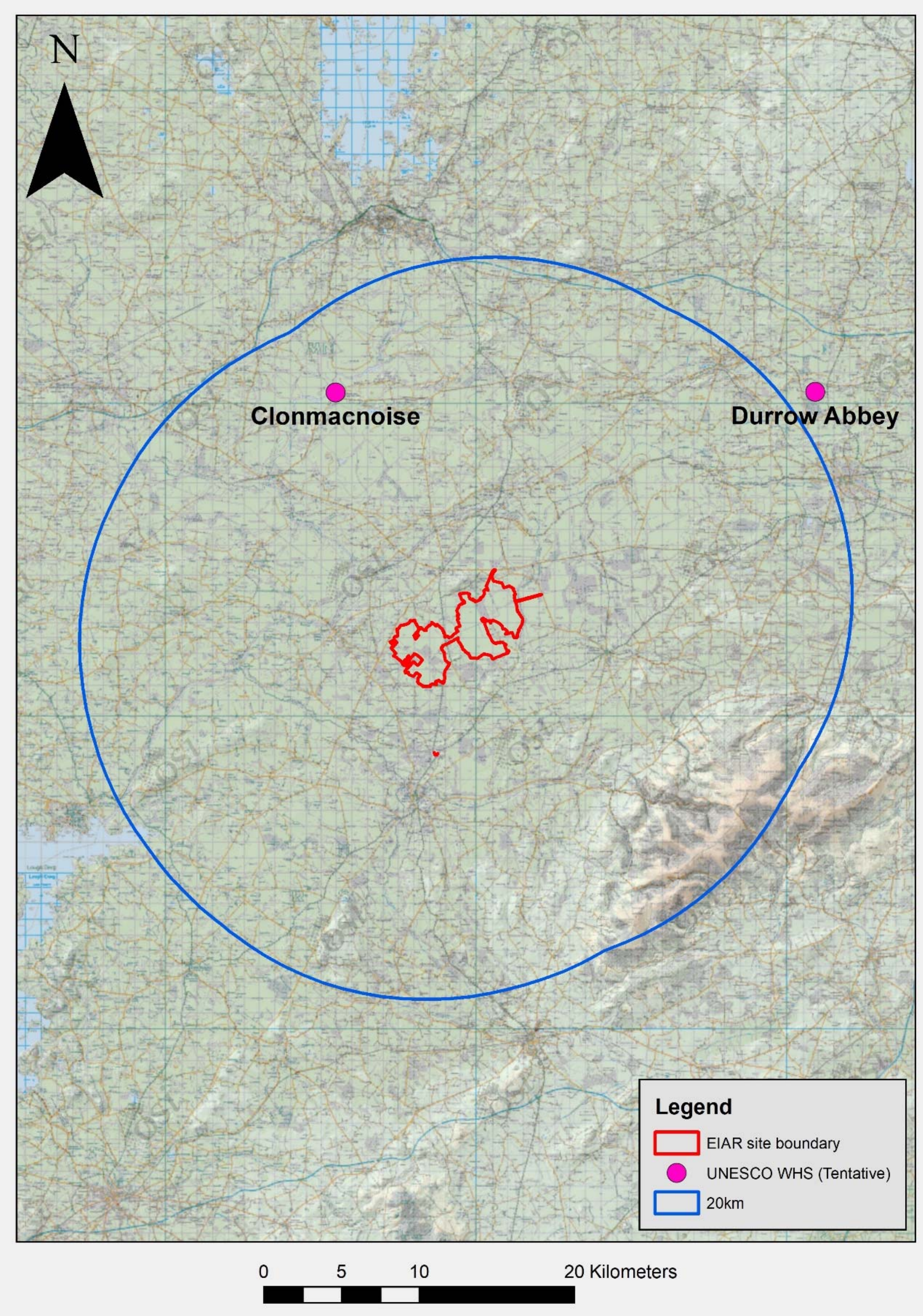

Figure 13.1: UNESCO WHS Tentative list sites at Clonmacnoise and Durrow in relation to the proposed development site.

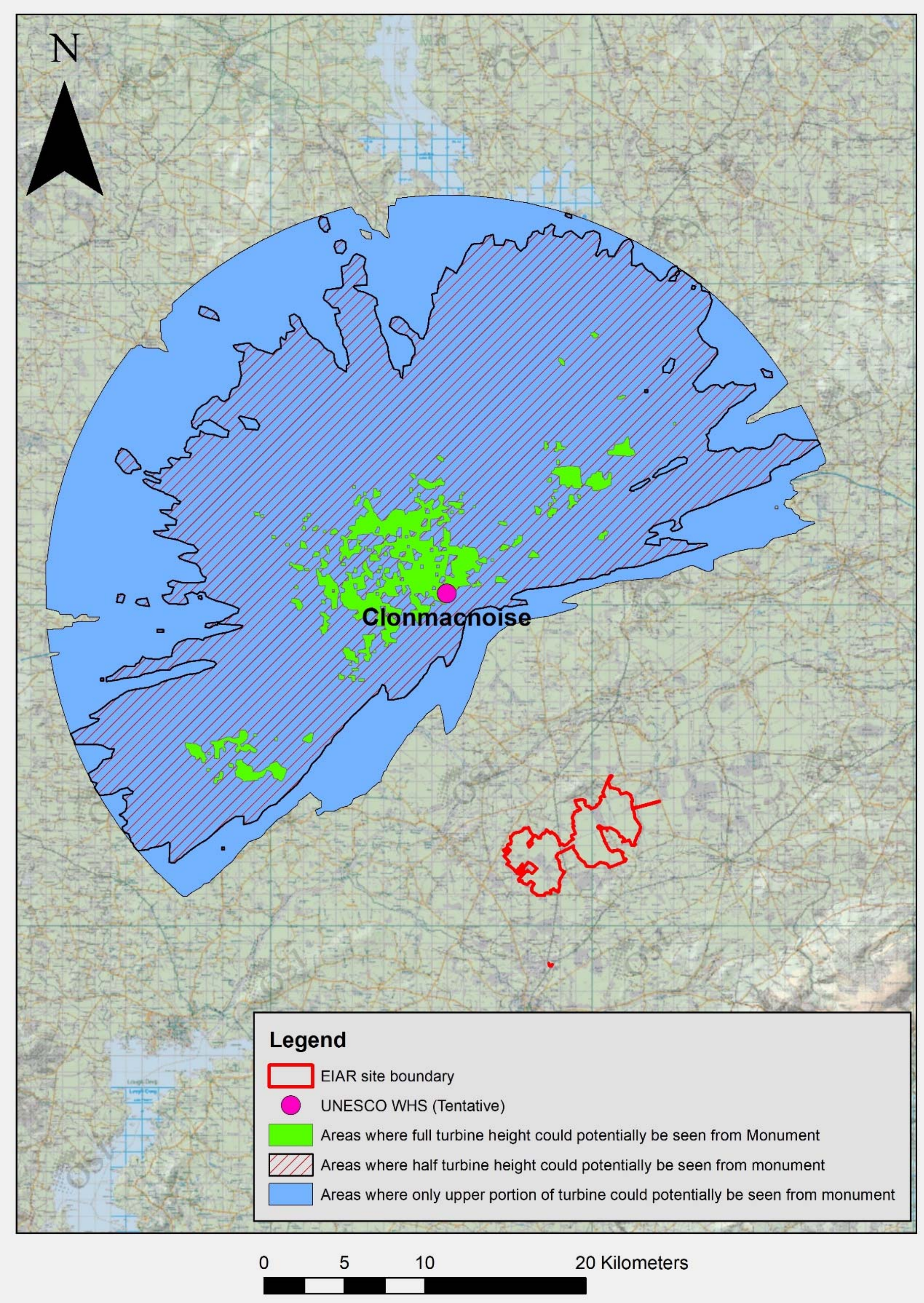

Figure 13.2: Viewshed analysis from Clonmacnoise WH tentative site.

13.3.1.2 National Monuments

National Monuments are those recorded monuments which are in the ownership / guardianship of the Minister for Culture, Heritage and the Gaeltacht (DCHG). They are frequently referred to as being in 'State Care'.

An assessment of all National Monuments in State Care and those subject to Preservation Orders within 10km of the proposed turbines was undertaken to ascertain any potential impacts on their visual setting (See Section 13.2.5 for methodology of assessment). No National Monuments or those subject to a Preservation Order are located within the proposed development site and none are located within close proximity to same.
The nearest National Monument, Gallen Abbey (NM No. 504) is located c. 6.8km to the north-east of the nearest turbine. Three monuments subject to Preservation Orders are located within 10km of the proposed turbines (

Table 13.2 and Figure 13.3).

Table 13.2: National Monuments and those subject to Preservation Orders within 10km of nearest proposed turbine

Nm No.	Rmp No.	Name	Description	ITM E	ITM N	Townland	Wtg Id	Distance (M)
49	OF015-017	Coole Castle	Coole Castle	613367	722763	Kilcolgan	21	6725
86	OF022-008001	Clonony Castle	Clonony Castle	605154	720611	Clonony More	8	5052
Jun-56	OF023-010	Ringfort	Ringfort	616681	715671	Broughal	15	6013
504	OF014-029001	Gallen Abbey	Church & Slabs	611790	723591	Gallen	21	6814

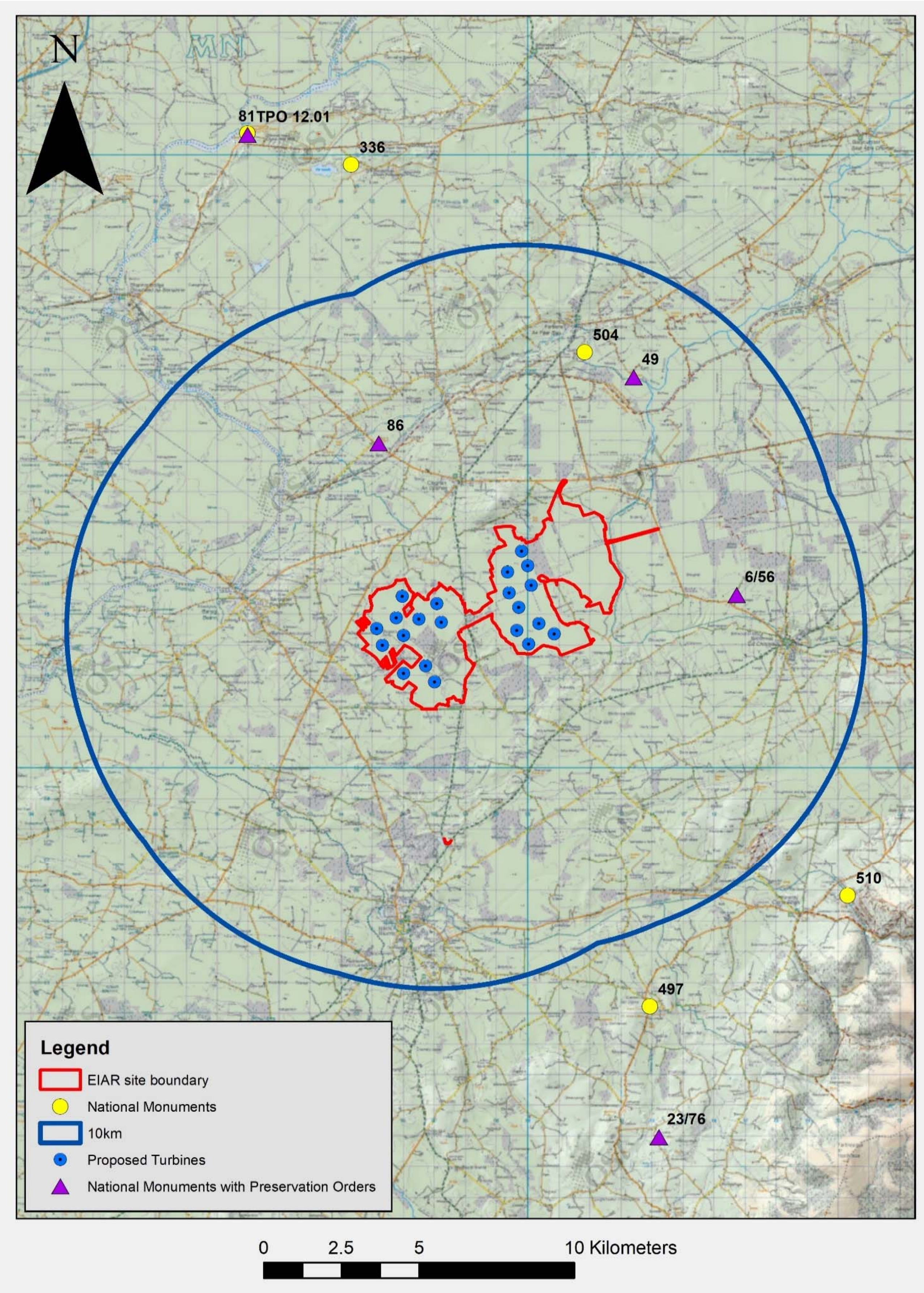

Figure 13.3: National Monuments within 10km of the nearest proposed turbine

Visibility from National Monuments

National Monument Preservation Order 49 (OF015-017, Coole Castle)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. Figure 13.4 shows that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m). It shows that potentially, 15 of the 21 turbines could be seen from mid-shaft upwards (red hatched areas) and it shows that the upper portion of all of the turbines (blue areas) could potentially be seen from the monument.

Description of Coole Castle:

Situated on flat well drained land with river Brosna to the S. Well-preserved rectangular four storey tower house (ext. dims. 8.7m N-S; 10.4m E-W; wall T 2m) built with roughly coursed limestone rubble with slight base batter evident. Access is through a flat headed doorway in E wall with murder hole above, guard room in the NE angle and spiral stairs in the SE angle. Lobby area has a series of small rooms orientated N-S directly above murder hole which are accessed from the corresponding main chamber at each level except the room at attic level which is accessed from the spiral stairs and from the small room the barrel vaulted attic is accessed. The main ground floor chamber is accessed from the lobby area and is lit by three ogee headed windows set in widely splayed embrasures with wicker centring. Off the spiral stairs at first floor level there is a mural passage running E-W along the S wall leading to a garderobe in the SW angle which has a triple leaf ventilator. Mural passage in the W end of the N wall at first floor level gives access to a garderobe in the NW angle. Access to the murder-hole over the lobby area from the NE angle which has a twin light transomed angle loop and triple ogee headed ventilator. There is a large flat headed fireplace at the W end of the N wall at second floor level with datestone of 1575 directly above mantelpiece. Also at this level there is a mural passage in the S wall at W end leading to a possible garderobe in the SW angle. Barrel vaulted attic over the second floor which is accessed from the barrel vaulted chamber over the lobby area. Above the vaulted attic at wall walk level there is a destroyed third floor with destroyed fireplace with rectangular chimney stack at the NE angle, also visible at this level is the other chimney stack of the second floor fireplace. All of the doorways area of the two centred type with punch dressed jambs and drafted margins with one doorway possessing chamfer stops at the base of its jambs. The windows are mainly of the ogee headed type with decorated spandrels and punch dressing forming decorative patterns similar to the mint in Carlingford, Co. Louth. Flat and round headed windows light the stairs and the mural passages with two of these windows possessing slop stones under their sills. Two musket loops are visible one being circular in shape the other cruciform. Blocked up external opening of garderobe chute at S end of W wall. This monument is subject to a preservation order made under the National Monuments Acts 1930 to 2014 (PO no. 49/1937).

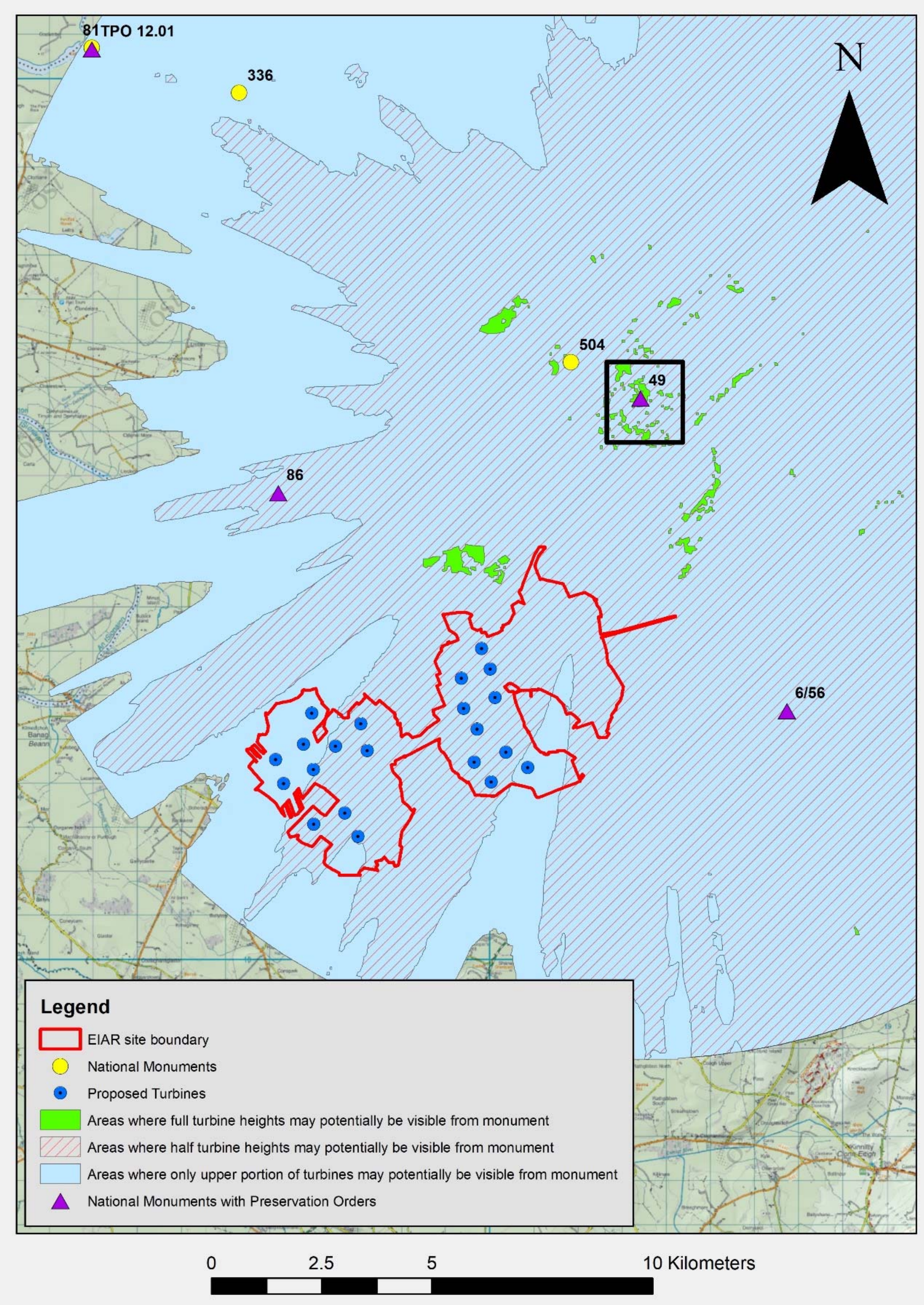

Figure 13.4: Viewshed analysis results from monument OF015-017 NM49 Coole Castle showing varying degrees of visibility depending on height of structures in the landscape (such as turbines).

National Monument Preservation Order 86 (OF022-008001, Clonony Castle)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. The results as shown on Figure 13.5 show that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m). The results also show that potentially, 12 of the 21 turbines could be seen from mid-shaft upwards (red hatched areas) and it shows that the upper portion of 20 of the 21 turbines (blue areas) could potentially be seen from the monument. One turbine (T14) has no visibility from the monument.

Description of Clonony Caslte:

Situated on top of natural rock outcrop in undulating countryside. Three storey tower (10.75m E-W; 8.2m N-S; wall T 2.1m) built with roughly coursed limestone rubble entered through a rebuilt door in the W wall which is protected by a machicolation now destroyed at wall-walk level with a later inserted window directly below. Inside door there is a murder-hole above with an intramural chamber which is accessed from the first floor. Spiral stairs in the SW angle from which all main chambers are accessed. The main chamber at ground floor level is accessed from the lobby area via a two centred pointed door with finely punch dressed jambs. The vaulted first floor gives access to a garderobe chamber in the NE angle and the intramural chamber in the W wall. Access to third floor via the spiral stairs which is now destroyed. Windows mainly consist of ogee heads with some simple flat and round headed windows. The windows at ground floor have been altered considerably as has the rest of the tower especially the inner bawn wall which appears to be a late 18th/19th-century addition. The bawn wall (OF022-008003-) is attached to the NE corner where it blocks the garderobe chute opening, smaller inner bawn structure in front of the main W door which has crenellations with brick infill and a pointed entrance with steps leading up to it. The round arched main entrance with its crenellated wall appear to be a later construction possibly 19th-century. The main entrance on the W wall of the bawn is constructed from worked stones of another structure possibly an earlier entrance. Two square towers at either end of the W wall with original coat of arms plaque over entrance now removed. Bawn is not depicted on Petries 19th-century drawing of Clonony Castle. Inner bawn of probable mid-19th-century date, while the outer bawn has been rebuilt in places during the 19th century. Mac Coghlan castle mentioned in the A.F.M in 1519 (ITA Survey 1942). (Anon 1868-69, 85-7; Cooke 1875, 330-32; O' Flanagan 1933, vol. 1, 85; Harbison 1970, 205)

Archaeological testing under licence no. 03E1292 in advance of the development of a programme of conservation and renovation of Clonony Castle, Clonony More, Co. Offaly, was carried out. The early 16th-century three-storey tower-house, with later 18th/19th-century inner and outer bawn areas, has been acquired by a new owner, who intends to renovate the structure as a private residence. Clonony Castle was one of several tower-houses in the possession of the MacCoughlan family, whose power base was in West Offaly during the 16th century. In the 17th century it came into the possession of Matthew De Renzi as part of the plantation of Delvin MacCoughlan. By the early to mid-19th century the castle had come into the possession of Edmond Maloney, who set about converting it to a more ornate residence. This included the enlarging of many of the original narrow opes of the tower-house and possibly the construction of the inner and outer bawn walls and the ancillary buildings that currently surround the structure on the west, south and east sides. Four trenches were manually excavated at different locations within the structure, to establish the nature and extent of original fabric beneath later adhesions. Trench 1 was located in the south-east corner of the parapeted walkway and measured 1.5m north-south by 1.3m. The trench revealed the presence of a slate cladding applied to the wall-walk, above the original wall fabric, protecting it and the modified wall plate from weathering. This work probably took place as part of the early 19th-century works to the castle and may represent a repeat of the earlier water management of the walkway. Trench 2 was located in the north-eastern corner of the second floor of the castle and measured 1m by 1m. It revealed that the original medieval fill of the vault is largely intact beneath the modern silty sediment, at a depth of 0.2m below the present floor level. The upper part of the vault fill has been partially quarried out with shallow, linear shafts, which acted as bedding for later 19th-century floor joists. Trench 3 was located in the western corner of the ground floor and measured 1.6m north-west/south-east by 1.2m. The earliest surviving clay floor surface of the castle was uncovered at a depth of 0.35m below the present floor level. It was covered with a thick layer of stony rubble, laid down as a make-up layer for the higher 19th-century floor level. Trench 4 was located in the doorway in the south wall of the ground floor, within an enlarged former window embrasure. The trench measured 2m north-south by 1.5m and was excavated to a depth of 0.24m below present ground level. The compacted upper metalled surface of the 19th-century floor was revealed in this trench; it was not removed (Excavations Bulletin 2003).

Test-trenching was carried out under licence no. 04E1042 as part of the planning schedule for a single-house development adjacent to a tower-house (SMR 22:8) at Clonony More, Shannon Harbour. A series of trenches were excavated by mechanical digger at the house site, entrance and percolation area. No features or finds of archaeological significance were revealed (Excavations Bulletin 2004). This monument is subject to a preservation order made under the National Monuments Acts 1930 to 2014 (PO no. 86/1940).

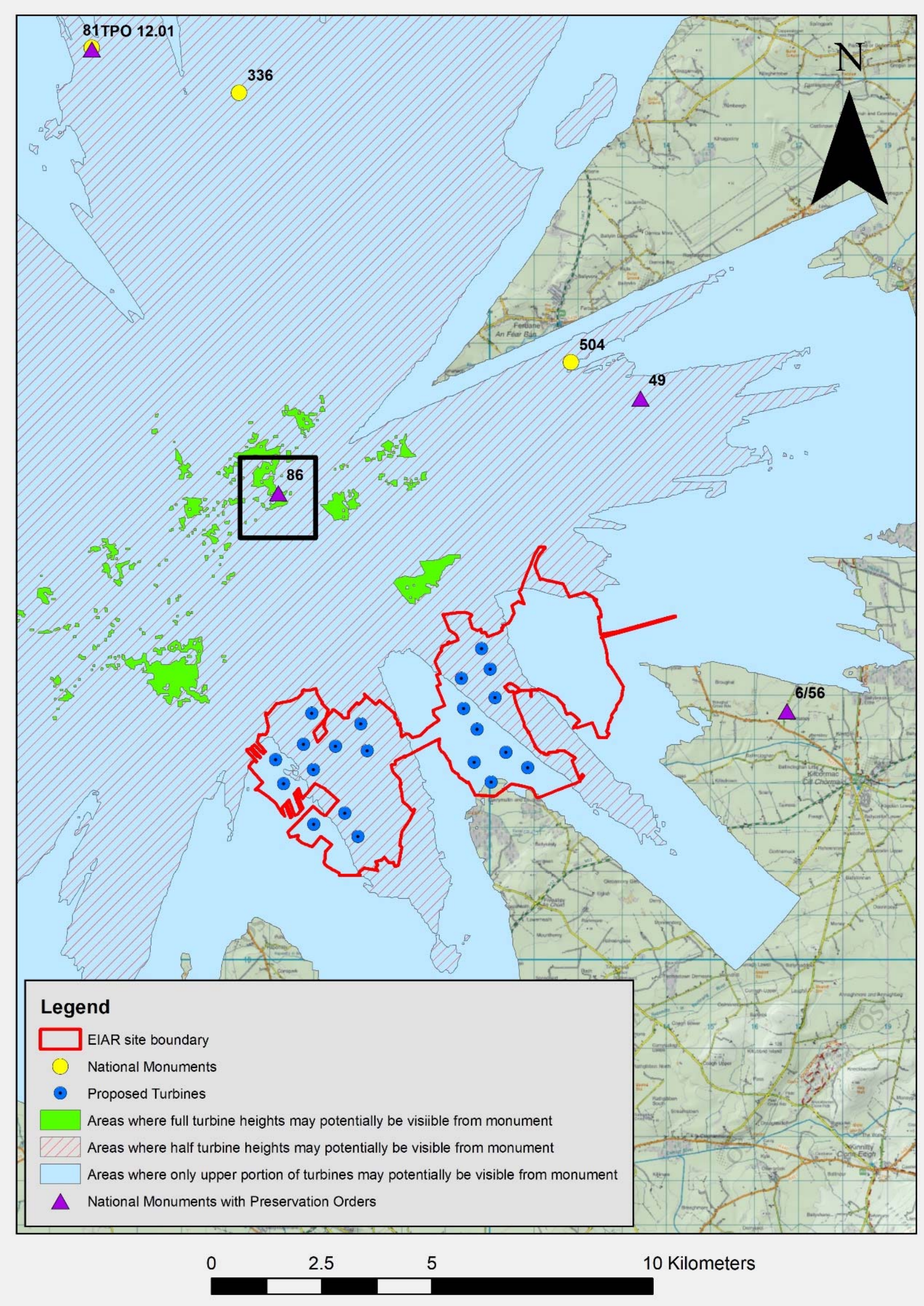

Figure 13.5: Viewshed analysis results from monument OF022-008/001 NM86 showing varying degrees of visibility depending on height of structures in the landscape (such as turbines).

National Monument Preservation Order Jun-56 (OF023-010, Ringfort)

Viewshed analysis results are a worst case scenario since it does not take natural screening such as vegetation, boundaries or buildings into consideration. The results on Figure 13.6 show that there are no instances (green areas) where the full leAngth of the turbines would be visible (i.e. from ground level). The results show that potentially, 11 of the 21 turbines could be seen from mid-shaft upwards (red hatched areas) and that all of the upper portions of the turbines (blue areas) could potentially be seen from the monument.

Description of Ringfort:

Roughly oval shaped area (diam 36m N-S) enclosed by two earthen banks with intervening and external fosse. Inner bank (Wth 6m at base; int. H 1m; ext. H 2m), external bank (Wth 7m at base; int. H 1.8m; ext. H 2m). Intervening fosse (Wth 1.6m) and external fosse (Wth 2.2m; ext. D 1.4m). Possible entrance gap (Wth 3m) at SE. This monument is subject to a preservation order made under the National Monuments Acts 1930 to 2014 (PO no. 9/1956).

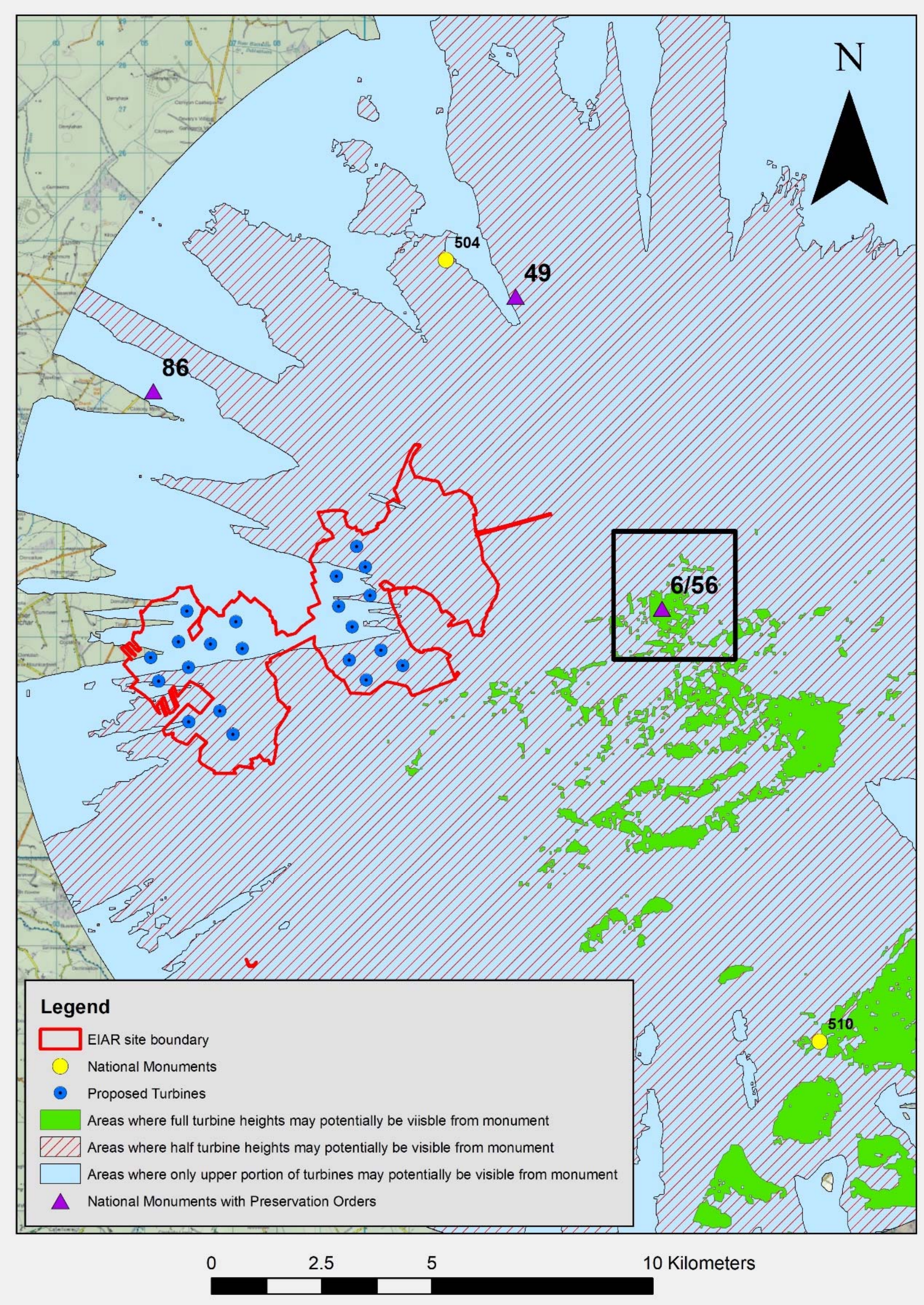

Figure 13.6: Viewshed analysis results from monument 6/56 – OF023-010 showing varying degrees of visibility depending on height of structures in the landscape (such as turbines).

National Monument State Care No 504 (OF014-029001, Gallen Abbey)

Viewshed analysis results are a worst case scenario since it does not take natural screening such as vegetation, boundaries or buildings into consideration. The results on (Figure 13.7) show that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m)). There are also no instances where the turbines would be visible from mid-shaft (red hatched areas). The results show that potentially, the upper portion of 10 of the 21 turbines may be seen from the monument. The remaining turbines at the western portion of the site have no visibility from the monument.

Description of Gallen Abbey:

Situated on a slight rise with river to the E. The ecclesiastical remains consist of a medieval church (OF014-029008-), early Christian cross-slabs (OF014-029003-), graveyard (OF014-029002-) and a bullaun stone (OF014-029005-). The Abbey which was built near the site of an Early Christian monastery founded by St. Canoc in 492 is now in a ruinous condition consisting of a long rectangular church (ext. dims. 23.9m E-W; 8.4m N-S; wall T 0.8m) built with roughly coursed limestone rubble with no architectural features evident. There is a N transept now blocked at the E end of the N wall (int. 7.5m N-S; 4.4m E-W; wall T 0.8m) with a destroyed window in the N gable. The interior of the abbey and sacristy are used as burial plots with a burial vault added to the W end of the S wall. There were several architectural fragments lying in the collapsed rubble along the walls of the church. The date of this church probably belongs to the 15th-century as mentioned by Armstrong (1908) who assigned such a date via the flamboyant E window which was recently destroyed by workers during recent graveyard clean up. The Early Christian cross-slabs are described by Lionard (1961 Vol. 61, 95-169) and are on display in a field to the N of the abbey on the site of a small 11th/13th-century church discovered during excavations by Kendrick in 1934-35. A small graveyard (OF014-029002-) was associated with the long rectangular church (ext. 71ft E-W; 24ft N-S) which had a small rectangular sacristy (int. 7.5ft N-S; 16ft E-W) attached to its NE corner. Most of the cross-slabs (OF014-029003-) which date from the 8th/11th-centuries (Harbison 1970, 206) came from this excavated area. 200 decorated slabs were discovered during this excavation and are described by Kendrick (1939 Vol. 69, 1-20). (Cooke 1875, 340-43; Macalister 1908, 323-27; Crawford 1913, 262-5; Crawford 1918, 178; Fanning and O hEailidhe 1980, 17-19).

Archaeological testing was carried out under licence no. 03E0202 on a proposed development site in the grounds of Gallen Priory Nursing Home, Ferbane, Co. Offaly, on 24-25 February 2003. The north edge of the site is within the area of constraint around ecclesiastical remains. Testing comprised the mechanical excavation of four trenches, varying from 30 to 100m in length. The stratigraphy comprised grey/brown sandy silt topsoil (0.4m deep) overlying yellow/brown and grey/white silty sand subsoil. Areas of grey fine to medium sand and grey coarse sand, gravel and cobbles were encountered across the tested area. A number of relatively modern features, including two sand pits and an old track/road, marked on OS 6-inch maps, were uncovered. Five further shallow features were found to be of probable post-medieval or early modern date. One of these yielded several small red-brick fragments and a potsherd, suggesting a 19th-century date. All are cut into sand, and gravel deposits may be broadly contemporary (Excavations Bulletin 2003).

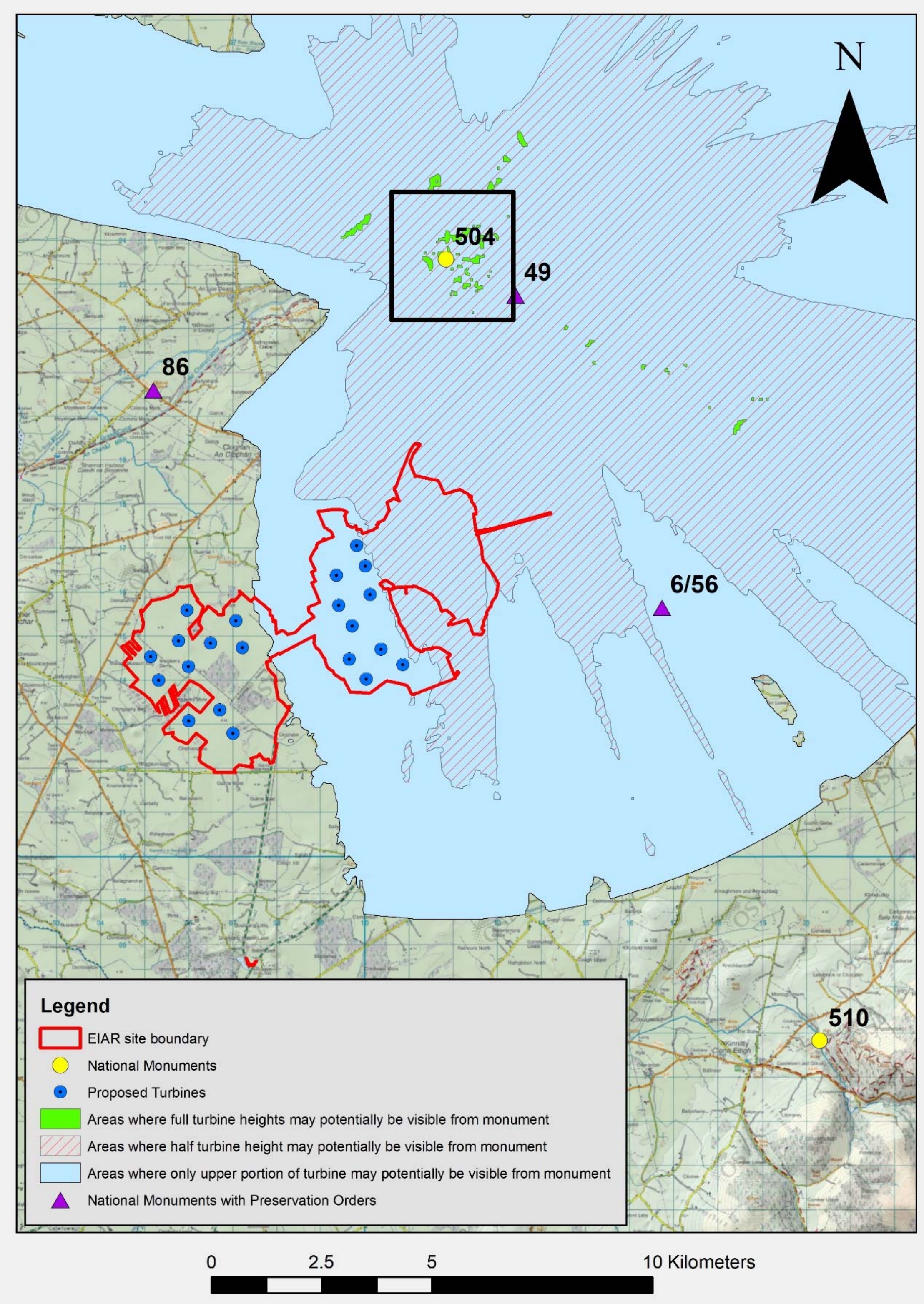

Figure 13.7: Viewshed analysis results from monument NM504, OF014-029/001 showing varying degrees of visibility depending on height of structures in the landscape (such as turbines).

13.3.1.3 Recorded Monuments within the site boundary including grid connection

Twenty-eight monuments subject to statutory protection as defined in the Record of Monuments and Places or Sites and Monument Record are located within the site boundary for the proposed development including the area of the proposed grid connection (also within the proposed development site boundary). The monuments are listed in

Table 13.3 below and described thereafter. Fourteen of the monuments are classified as Redundant Records. Such monuments are classified for one of the following reasons as detailed on the Historic Environment Viewer (www.webgis.archaeology.ie/historicenvironment). 'Records classed as 'Redundant record' are those that fulfil one or more of the following criteria: (1) a record identifying a location where, according to documentary sources (e.g., published reference, cartographic sources) or personal communication, a monument might have existed, but which, on inspection, was found not to be an archaeological monument (e.g. a natural feature); (2) a record classified using a term which is now obsolete (e.g. ecclesiastical remains); (3) a record created in error, a duplicate record or one which has no supporting evidence recorded on file or in the database; (4) an archaeological object (i.e. an artefact), e.g. a quernstone; (5) a record entered as a 'Shipwreck'. Shipwrecks are recorded in a separate database.' The redundant records within the proposed development site are not scheduled for inclusion in the next revision of the RMP.

The remaining monuments within the proposed development site boundary are classified as toghers - Class 1 (1), Class 2 (1) and Class 3 (12) and are depicted on Figure 13.9 to Figure 13.12. None of the proposed turbines or associated infrastructure are proposed to be located on or within close proximity to the Recorded Monument described above. The overgrown nature of the areas around the monuments, whilst a limitation in assessing the presence or otherwise of the monument, has no implications for the proposed development since no impacts to the RMPS will occur as a result of the proposed turbines and other associated infrastructure.

Table 13.3: Recorded monuments within the proposed development site boundary.

RMP NO.	ITM E	ITM N	CLASS	TOWNLAND
OF030-050—	611664	714342	Redundant record	DERRYAD (Eglish By.)
OF030-051—	611672	714347	Redundant record	DERRYAD (Eglish By.)
OF030-052—	611683	714485	Redundant record	DERRYAD (Eglish By.)
OF030-053—	611686	714486	Road - class 3 togher	DERRYAD (Eglish By.)
OF030-054—	611668	714468	Redundant record	DERRYAD (Eglish By.)
OF030-055—	611668	714457	Redundant record	DERRYAD (Eglish By.)
OF030-056—	611622	714427	Redundant record	DERRYAD (Eglish By.)
OF030-057—	611665	714381	Redundant record	DERRYAD (Eglish By.)

RMP NO.	ITM E	ITM N	CLASS	TOWNLAND
OF030-060—	611655	714440	Road - class 1 togher	DERRYAD (Eglish By.),DRINAGH
OF030-061—	611655	714628	Road - class 3 togher	DRINAGH
OF030-062—	611670	714580	Road - class 3 togher	DRINAGH
OF030-063—	611674	714526	Road - class 3 togher	DRINAGH
OF030-064—	611653	714476	Redundant record	DRINAGH
OF030-065—	611667	714631	Redundant record	DRINAGH
OF030-066—	611082	714738	Redundant record	DRINAGH
OF030-067—	611198	714455	Redundant record	DRINAGH
OF030-068—	611653	714486	Redundant record	DRINAGH
OF030-069—	611704	714531	Road - class 3 togher	DRINAGH
OF030-070—	605270	713860	Road - class 3 togher	CLONGAWNY
OF030-071—	605239	713824	Road - class 3 togher	CLONGAWNY
OF030-072—	605158	713674	Redundant record	CLONGAWNY
OF030-073—	605210	713623	Road - class 3 togher	CLONGAWNY
OF030-074—	605322	713663	Road - class 3 togher	CLONGAWNY
OF030-075—	605332	713816	Road - class 3 togher	CLONGAWNY
OF030-076—	605292	713889	Road - class 3 togher	CLONGAWNY

RMP NO.	ITM E	ITM N	CLASS	TOWNLAND
OF030-077—	605310	713900	Road - class 2 togher	CLONGAWNY
OF030-078—	605426	713978	Redundant record	CLONGAWNY
OF030-079—	605329	713674	Road - class 3 togher	CLONGAWNY

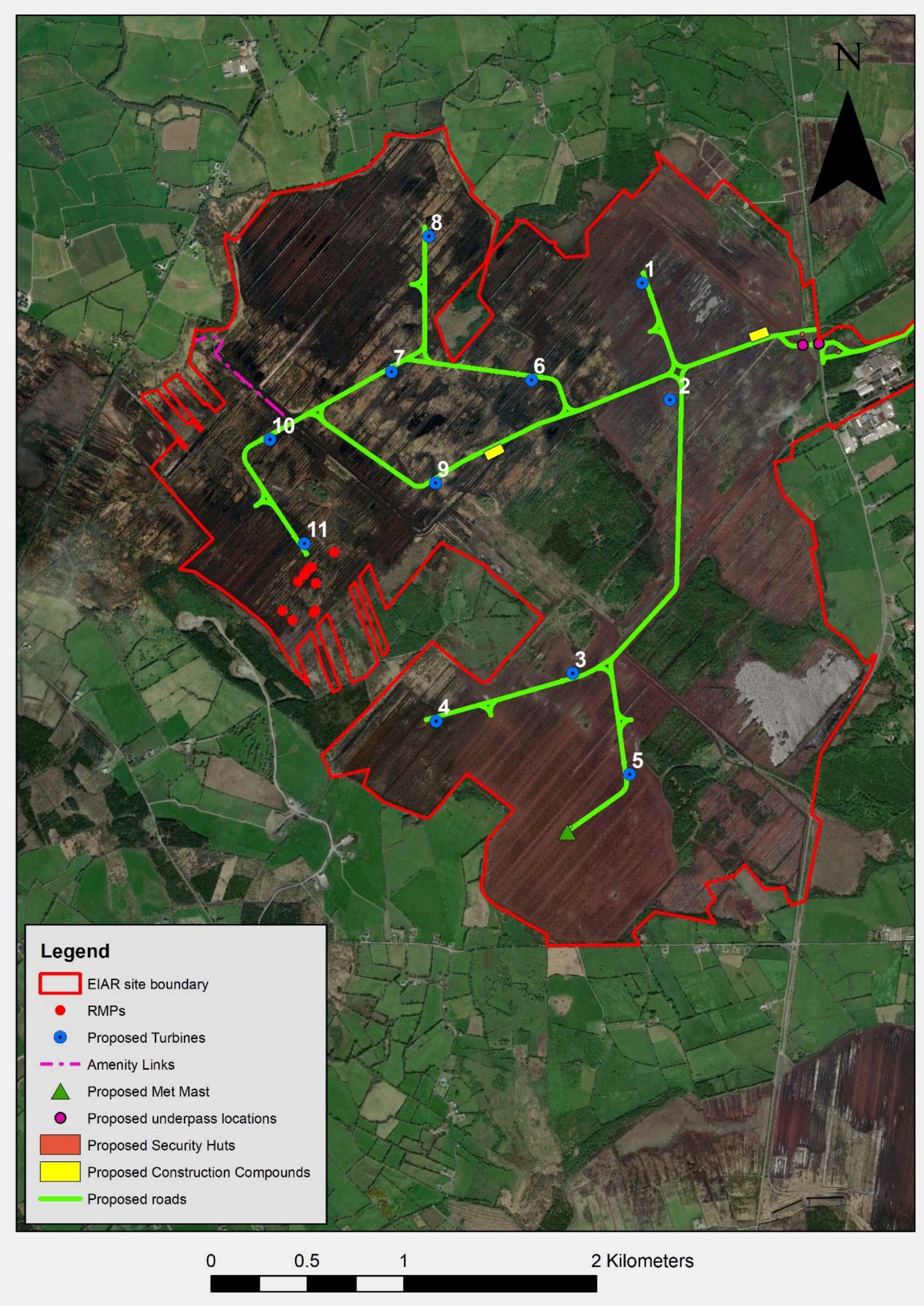

Figure 13.8: West side of proposed development site showing RMPs (some redundant) in south-west corner.

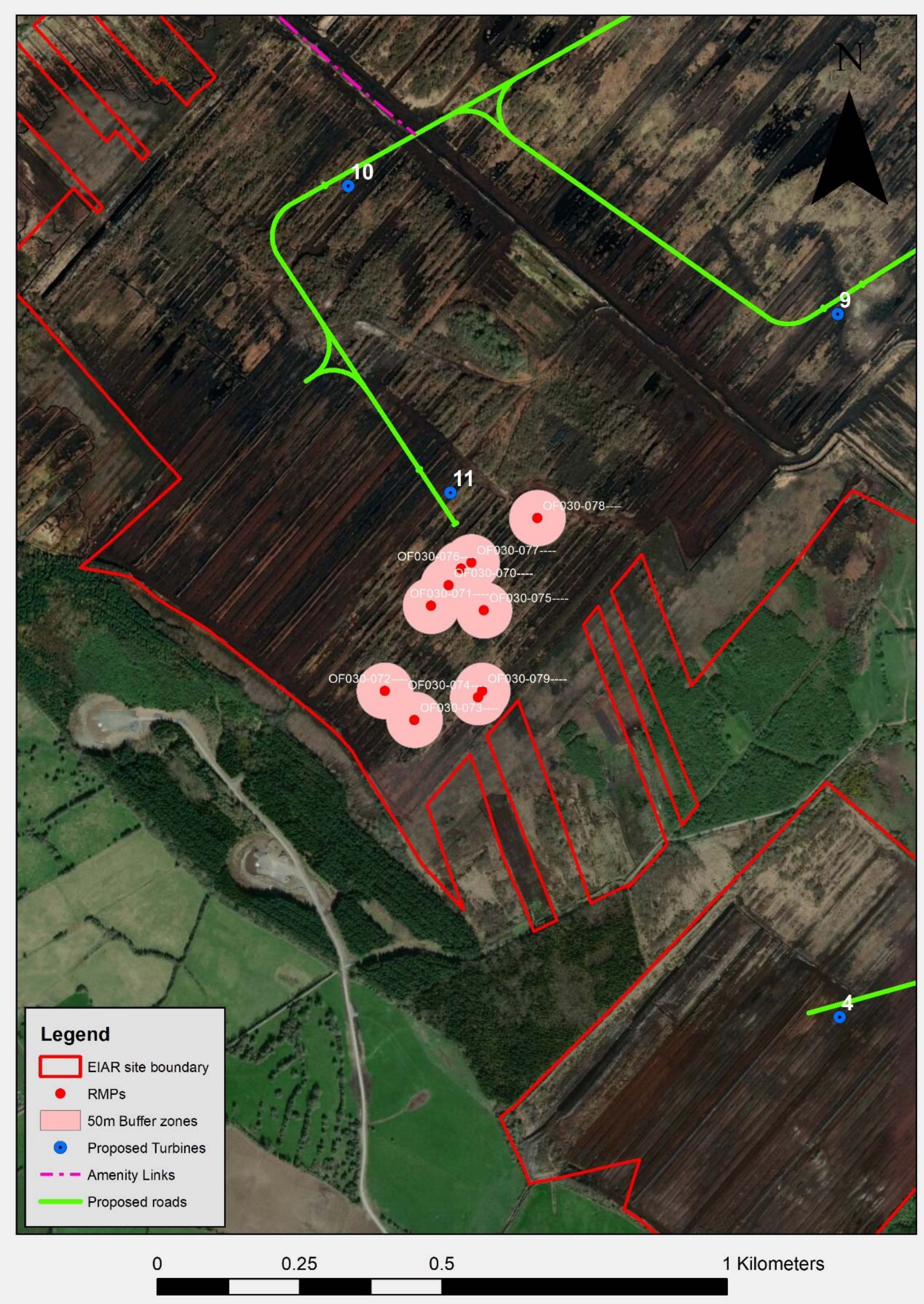

Figure 13.9: RMPs within the site boundary (West side showing detail) with 50m buffer zones around all recorded monuments.

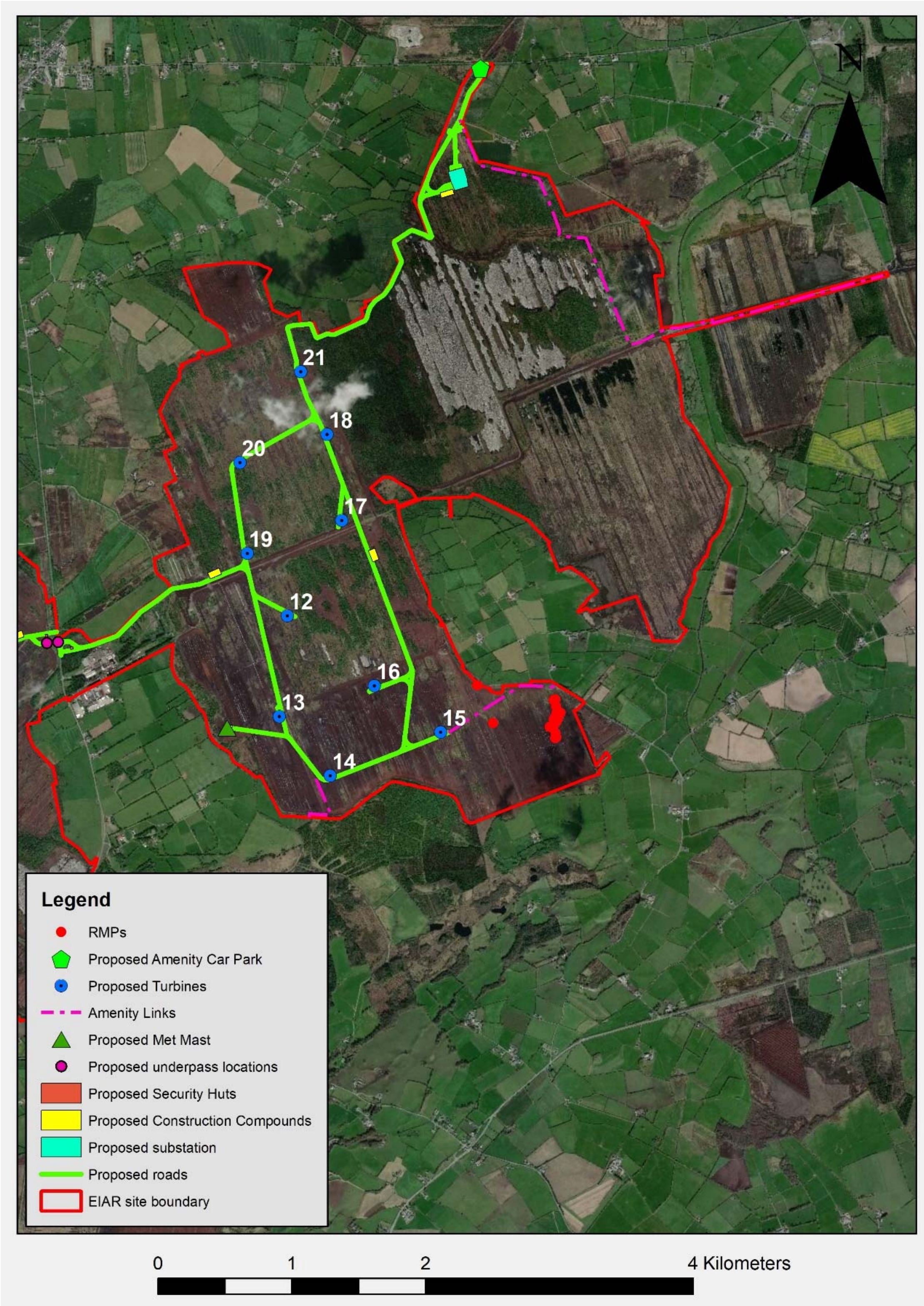

Figure 13.10: East side of proposed development in relation to RMPs in south-east corner.

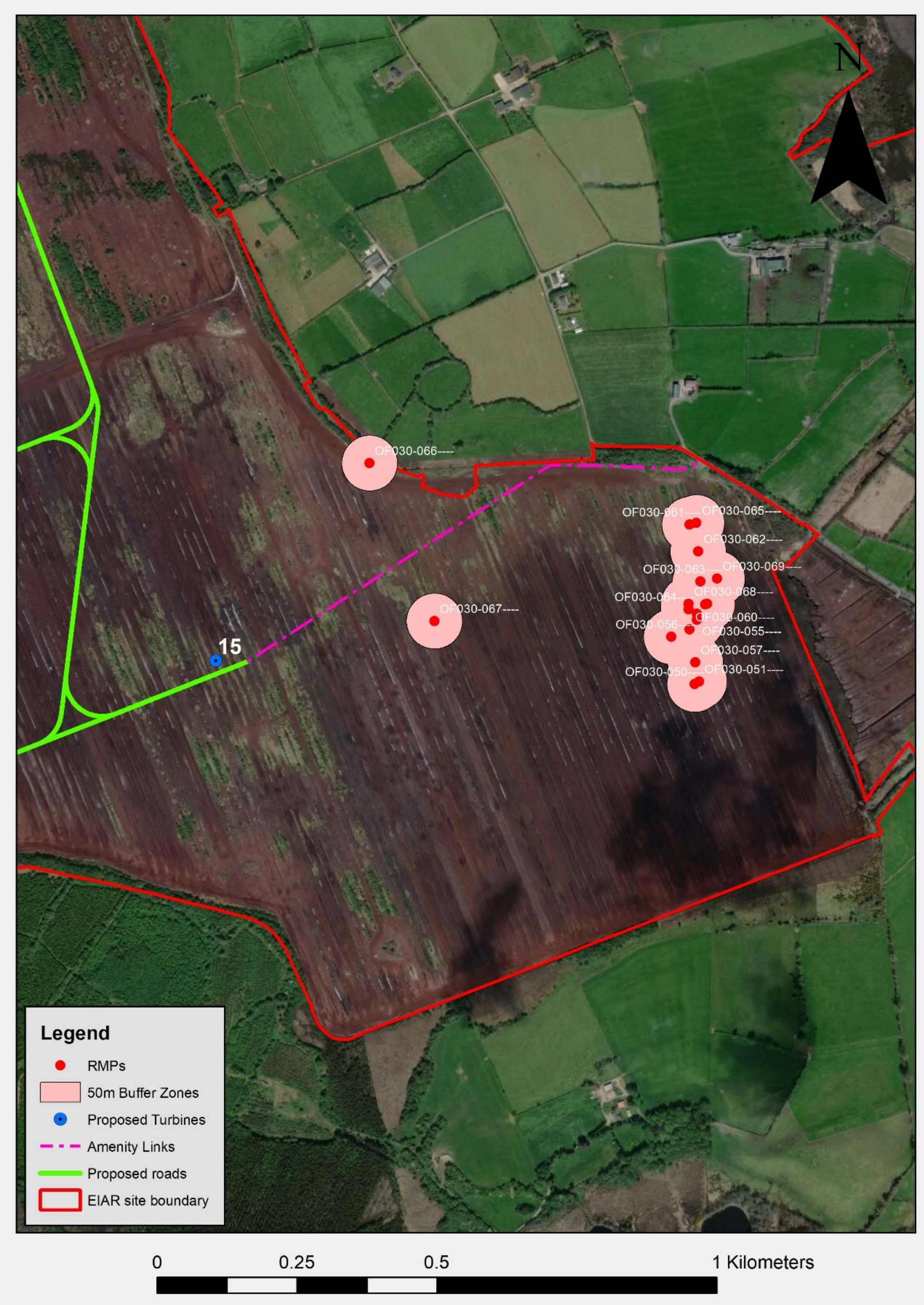

Figure 13.11: Detail of RMPs in southeast corner of East side of site showing 50m buffer zones around RMPs.

13.3.1.3.1 National Monument Service of the Department of Culture, Heritage and the Gaeltacht Classification of Toghers

Road - class 1 togher

A peatland trackway/causeway constructed of wood and intended to traverse a bog which have a known orientation. In most instances, they comprise substantial timber planks and have good structural definition. They may have several phases of construction indicative of long-term use and reuse. These may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Road - class 2 togher

A length of peatland trackway, constructed of wood, believed to be over 15m in length. They have a clear orientation and good structural definition. Class 2 Toghers may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Road - class 3 togher

A short stretch of peatland trackway, constructed of wood, up to 15m in length with a discernible orientation. It may not be possible to trace them beyond a single sighting. They have evidence of deliberate structure and are interpreted as laid down to cross a small area of bog. Such sites may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

13.3.1.3.2 Descriptions of the Toghers within the proposed development site boundary

The descriptions in italics are extracts from the Sites and Monuments Record files on the National Monuments Service public Historic Environment viewer.

OF030-053 Class 3 Togher: '*A deposit of three distinct layers of roundwoods, brushwood and twigs (Wth 1.28m; D 0.34m) in opposing drain faces. The substructure consists of five roundwoods and some brushwood orientated WSW-ENE. The superstructure is composed of two layers. The upper layer consists of densely packed brushwood and beds of twigs orientated WSW-ENE. The lower layer is primarily composed of widely spaced brushwood and beds of twigs orientated NNW-SSE. The site is deepest at its centre, tapering towards the edges, with a number of possible outlying elements above and below the main concentration. The majority of these outliers may constitute separate sites as their association to the site is unclear. A small number of metal-cut toolmarks are present but these are quite degraded. Wood species include birch, hazel, ash and Pyrus/Malus. The site is in poorly humified Sphagnum peat with Eriophorum, Phragmites and ericaceous remains*'.

This site was examined and on the day of survey in January 2020 no surface trace was apparent. Track machines had been utilising the field and this was evident on the surface. A railway had been laid here in the past but had been lifted in recent times (Plate 13.1).


Plate 13.1: Site of OF030-053 Class 3 Togher looking north.

OF030-060 Class 1 Togher: '*The site (L 278.91m; Wth 0.7m; D 0.2m) is orientated N-S on the field and contains two structural layers. The substructure is composed of split timbers, roundwoods and brushwood, laid both longitudinally and transversely. The superstructure is composed of longitudinal planks and roundwoods. Planks (L 6m max.) are the predominant component of the superstructure. Pegs are utilised in places to secure the planks. The planks are both radially and tangentially split with flat and pointed ends. One of the planks has a broken or incomplete mortice. The site is in Sphagnum peat with Eriophorum and ericaceous remains. The site was dendrochronologically dated to 1411-1410 BC (Q9791). At one sighting SMR OF030-064— is 0.3m below the site. Compiled by: Irish Archaeological Wetland Unit (University College Dublin)*'.

This area was examined on the day of survey in January 2020 and no surface trace was apparent either on the surface or within drains (Plate 13.2).

Plate 13.2: OF030-060 Class 1 Togher looking north/northwest along field on which togher was recorded.

OF030-061 Class 3 Togher: '*A deposit of roundwoods, brushwood, occasional twigs and a peg (L 1.1m; Wth 1.07m; D 0.26m) on the field surface. The majority of the elements are closely spaced, orientated NNW-SSE and are longitudinally laid. There is no discernible substructure, the different elements being interspersed to form a layer approximately four pieces deep with the heaviest pieces concentrated towards the centre. Some pieces have been broken and displaced as a result of milling. Metal-cut toolmarks are evident on one piece of brushwood and on one roundwood. The site is in moderately humified Sphagnum peat with Phragmites and many Menyanthes seeds'*.

The area was examined on the day of survey in January 2020 and no surface trace of the togher was apparent. The field surface and drains were overgrown in this area and peat had been reduced significantly (Plate 13.3).

Plate 13.3: Site of OF030-061 Class 3 Togher looking west.

OF030-062 Class 3 Togher: '*A deposit of brushwood, laid 3-4 pieces deep, and occasional twigs (L 1.7m; Wth 1.15m; D 0.11m) which has suffered extensive milling damage. The site may represent two phases of construction or two separate sites. Heavy brushwood dominates the upper layers, with lighter, more uniform brushwood beneath. Some of these lighter elements may have been interwoven. The majority of the pieces are orientated E-W while others are perpendicular. A single metal-cut chisel point was noted. Wood species include hazel, birch, holly and yew. The site is in moderately humified Sphagnum peat with Eriophorum and ericaceous remains*'.

The area was examined on the day of survey in January 2020 and no surface trace of the togher was apparent (Plate 13.4).

Plate 13.4: Site of OF030-062 Class 3 Togher looking east

OF030-063 Class 3 Togher: '*The site (L 9.47m; Wth 1.72m; D 0.19m) is orientated E-W consisting of roundwoods and brushwood with two structural layers evident. The substructure consists of roundwoods and brushwood, longitudinally and transversely laid, three pieces deep. The superstructure consists of roundwoods, two pieces deep, and brushwood (diam. 0.027-0.06m), three pieces deep. The elements are longitudinally laid. The heel of a coppiced piece of brushwood has toolmarks. Wood species include hazel, ash, alder and birch. The site is in poorly to moderately humified Sphagnum peat with Eriophorum. The site was radiocarbon dated to 341 BC-AD 48 (UCD-9943)*'.

The area was examined on the day of survey in January 2020 and no surface trace of the togher was apparent (Plate 13.5).

Plate 13.5: Site of OF030-063 Class 3 Togher in location of decommissioned railway looking north.

OF030-069 Class 4 Togher: '*A deposit of light brushwood, laid five pieces deep, two roundwoods and occasional twigs (Wth 1.4m; D 0.27m). The roundwoods (diam. 0.07m-0.09m) and pieces of brushwood are irregularly laid. Two pieces of brushwood have toolmarks'*.

The area was examined on the day of survey in January 2020 and no surface trace of the togher was apparent (Plate 13.6).

Plate 13.6: View of site of OF030-069 Class 4 Togher looking south along peat field.

OF030-070 Class 3 Togher: '*The site (L 14.21m; Wth 1.25m; D 0.2m) is orientated NNE-SSW and consists of a compact structure of longitudinally laid pieces of brushwood and roundwoods set below a single plank and roundwood. This created a central walking surface (Wth 0.4m). The oak plank was irregularly split. It appears to dive under the central roundwoods to the W. The woodworking is degraded but suggests metal tools. This material is set in poorly-humified fen peat which contained Phragmites, bark fragments and occasional Menyanthes seeds*'.

No trace of this monument was visible during the walk-over survey in December 2019 and the bog has been reduced and milled since its interception by the IAWU in 1997. The peat fields have been reduced to the level of the base of the drains some of which are grown over (Plate 13.7 13.7).

Plate 13.7: Site of OF030-070 looking NNE.

OF030-071 Class 3 Togher '*The site (L 2.94m; Wth 0.44m; D 0.12m), in opposing drain faces, composed predominantly of two parallel roundwoods and a plank. Within a small area examined, the two roundwoods and the plank are orientated NNE-SSW, with two pieces of light brushwood set roughly at right angles. The pieces of light roundwood (and plank are loosely set 0.04-0.19m apart. The plank (L 2.3m; Wth 0.11m) was a tangential outer quarter split and was poorly preserved. The site is located on the field surface within moderately-humified peat which contains Phragmites, Menyanthes seeds and some ericaceous remains'.*

This was originally recorded within the drain faces according to the above description. The peat fields are now reduced to almost the same level as the drain bases which are overgrown. No surface trace of the monument was detected during the recent site walk-over survey in December 2019 (Plate 13.8).

Plate 13.8: Site of OF030-071 looking NNE.

OF030-073 Class 3 Togher: '*Broken pieces of interspersed brushwood and roundwood (L 12m; Wth 0.94m; D 0.07m) traced across the field in a NE-SW direction. Where examined, the site consists of longitudinally laid irregular pieces of brushwood and roundwood (diam. 0.02-0.055m). Two small pegs (diam. 0.02-0.03m), mark the limit of the site to the N. The wood is in poor condition with no wood working evident. The site is located within poorly humified Sphagnum peat, with some traces of Eriophorum, ericaceous remains and Menyanthes seeds, 8.46m N of a deposit of bog iron'*.

No surface trace of this togher was detected during the walkover survey in December 2019 and the area is also vegetated (Plate 13.9Plate 13.9).

Plate 13.9: Site of OF030-073 looking North.

OF030-074 Class 3 Togher: '*The site (L 0.4m min.; Wth 2.11m; D 0.1m) is formed of pieces of brushwood with some twigs and roundwoods orientated roughly E-W, immediately below the field surface. Within the area examined it consists of two deposits of brushwood, twigs and a roundwood set 0.2-0.3m apart. The N deposit is denser and the S side more dispersed and fragmented. A single tool marked roundwood had been worked to a pencil point with a metal tool. This material was located within moderately humified Sphagnum peat with frequent Phragmites and occasional ericaceous remains*'.

This togher was noted on the surface by the IAWU in 1997. No trace of the monument was visible on the day of the walk-over survey in December 2019 (Plate 13.10).

Plate 13.10: Site of OF030-074 togher looking NE.

OF030-075 Class 3 Togher: '*The site (L 10.9m min.; Wth 0.74m; D 0.07m) is orientated NNE-SSW evident at two sightings. At the NE extent the site consists of compactly set, longitudinally laid roundwoods (diam. 0.6m) with some pieces of brushwood (diam. 0.01-0.042m) and twigs used to fill the voids in the structure. Only one degraded tool mark was recorded. The site is within poorly humified Sphagnum with Eriophorum and ericaceous remains and occasional Menyanthes seeds. To the SSW the site was similarly constructed but in poorer condition and disappears toward an area of high bog, located in the centre of this bog*'.

The peat field and the shallow remains of the drains in the area of this monument are re-colonised and overgrown, and no visible remains of the monument were apparent on the day of the walkover survey in December 2019 (Plate 13.11).

Plate 13.11: Site of OF030-075 togher looking NW.

OF030-076 Class 3 Togher: '*Two parallel planks, roundwoods and pieces of brushwood with occasional twigs (L 8.2m; Wth 0.96m; D 0.1m), orientated NE-SW evident at two separate sightings. The site was examined near the NE extent where the components are longitudinally laid and secured in place with two pegs. This material was overlain by a small deposit of branch wood and roundwoods on the SW side of the site. The planks (L 3.5m min.; Wth 10.1-19.7m) are an irregular inner split and an outer tangential split and the pieces of brushwood and roundwoods are mixed. The site is located within poorly humified and laminated peat that contained Phragmites and Menyanthes seeds. This site has been radiocarbon dated to 1734-1440 cal. BC (UCD-9956*)'.

Given the extent of vegetation it was not possible to assess the presence or otherwise of the monument on the day of the walkover survey in December 2019 (Plate 13.12).

Plate 13.12: Site of OF030-076, looking NNE.

OF030-077 Class 2 Togher: '*The site (L 25.24m; Wth 0.63m; D 0.04m) is orientated E-W across the field surface and consists of longitudinally laid brushwood. The wood (diam. 0.02-0.055m) is in fragmented condition has been badly disturbed by machine milling. Some root-like elements are also present in the deposit. Only a single end showed evidence of having been worked to a chisel point. The site is located in moderately humified Sphagnum peat with frequent Eriophorum and occasional ericaceous remains, Menyanthes seeds and a hazelnut shell'.*

No surface trace of the togher was detected during the walkover survey in December 2019 (Plate 13.13).

Plate 13.13: Site of OF030-077 togher looking SE.

OF030-079 Class 3 Togher: '*A concentrated deposit of longitudinally placed pieces of brushwood, twigs and a roundwood (L 6.5m; Wth 0.56m; D 0.12m), orientated in a NE-SW on the field surface. Twigs infilled the small voids between the pieces of roundwood. No evidence of woodworking was recorded as the ends of the pieces were broken and part of the structure may have been removed by peat milling. The site is in moderately-humified Sphagnum peat which contained ericaceous remains and some Menyanthes seeds. The site has been radiocarbon dated to 1734-1449 cal. BC (UCD-9932)*'.

This is now colonised with trees and bushes so an assessment of the field surface was not possible on the day of the walkover survey in December 2019. Such limitations have been addressed by way of mitigation measures.

13.3.1.4 Recorded monuments in the vicinity of new temporary junction bypass at Kennedy's Cross

It is proposed that the turbine components will be delivered via the M6 before turning south onto the N52 at Kilbeggan. The route follows the N52 south, bypassing Tullamore to the east and passing through the settlements of Blue Ball, Kilcormac and Five Alley. Deliveries will turn right onto the N52 (at the junction known as Kennedy's Cross) and will proceed northwards towards Cloghan to the proposed site entrances, immediately north of Derrinlough Briquette Factory. A new section of haul road will be required at Kennedy's cross to allow the turbine delivery vehicles to negotiate this junction. This is the only location where groundworks will be required along the haul route.

The proposed new section of road traverses a green field. The nearest Recorded Monuments are located 150m to the west on the west side of the public road and in a forested area. The monuments are described in the Archaeological Inventory of County Offaly as outlined in the following sections and are depicted in Table 13.4 and on Figure 13.12.

Table 13.4: RMPs within close proximity to proposed new temporary junction bypass at Kennedy's Cross

RMP NO.	DESCRIPTION	ITM E	ITM N	TOWNLAND	DISTANCE to haul road (M)
OF035-002002	Castle – Unclassified	607126	707625	Ballindown	150m
OF035-002001	Deserted Medieval Settlement	607124	707620	Ballindown	150m

13.3.1.4.1 Castle – Unclassified OF035-002002-

Situated on wet marshy land on the W side of a small lake or turlough. Isolated fragments of upstanding walls survive in places which may be the remains of Ballindown Castle, no ground plan or any idea of the shape or size of the castle could be ascertained from the remains. Site of an O' Carroll castle (Cooke 1875, 25-6; O'Flanagan 1933, vol. 1, 98, 101; vol. 2, 9-10).) ('Archaeological Inventory of County Offaly, 1997).

13.3.1.4.2 Deserted Medieval Settlement OF035-002001

Unlocated possible deserted medieval settlement associated with the castle (OF035-002002-) at Ballindown as mentioned in the OS Letters (O'Flanagan 1927, vol. 1, 98, 101; Vol. 2, 9-10).).) ('Archaeological Inventory of County Offaly, 1997).

Direct and Indirect effects are addressed below in Section 13.4 below.

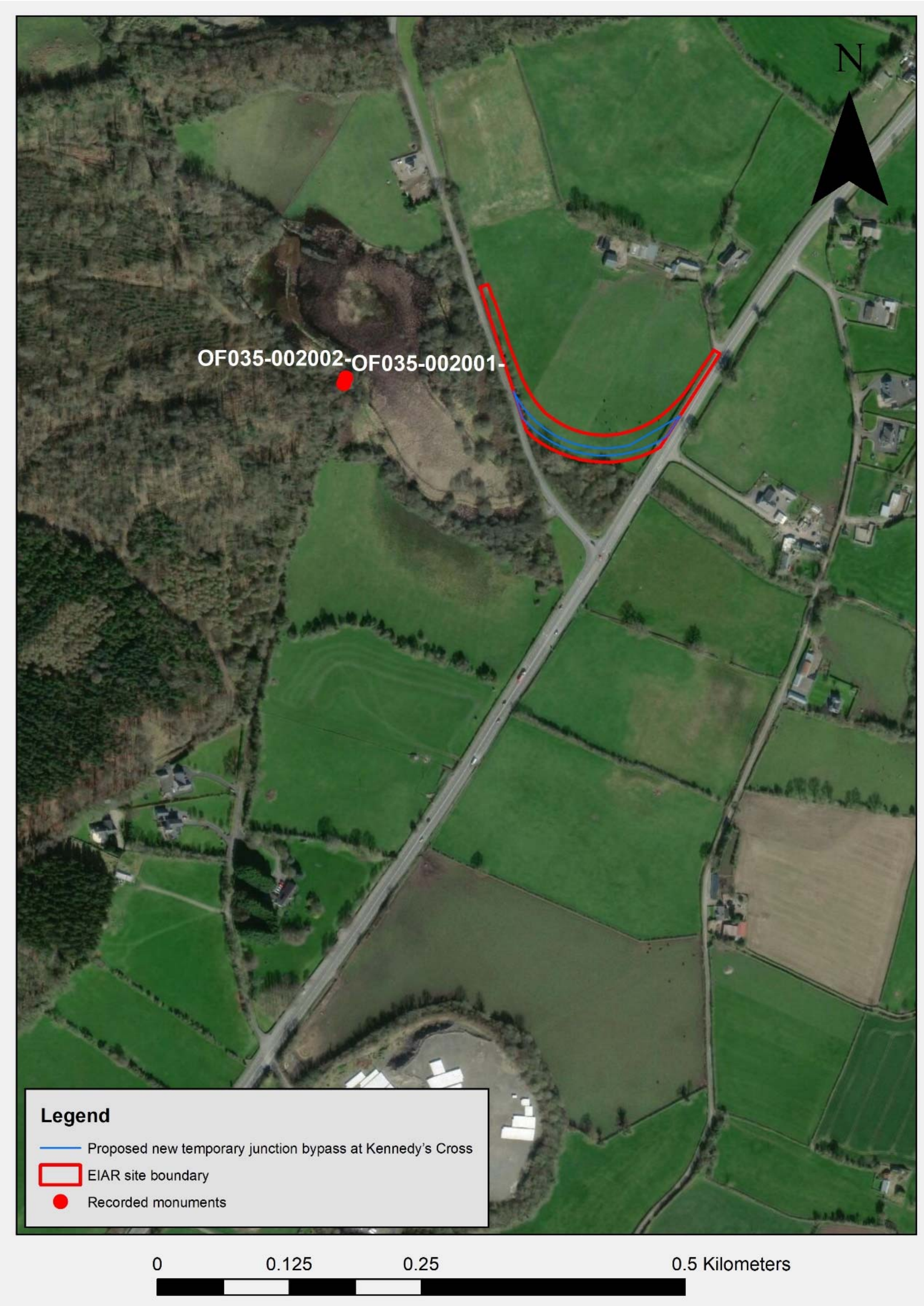

Figure 13.12: Proposed new temporary junction bypass at Kennedy's Cross to facilitate turbine delivery.

13.3.1.5 Recorded Monuments within 5km of the proposed Turbines

One hundred and sixteen (116) monuments are located within 5km of the nearest proposed turbine and these are detailed below in Table 13.5. The distance (5km) criteria methodology is described in Section 13.2.5. The monuments are labelled from 1-116 (Map ID) for ease of reference on Figure 13.13. Monuments within 5 kilometres of the proposed turbines are included here for purposes of assessing potential visual impacts in the wider landscape setting. Seven monuments are located within 1km of the nearest proposed turbines. Thirty-seven monuments are located between 1 and 2km of the nearest proposed turbine. Seven monuments are located between 2 and 3km with 29 monuments located between 3 and 4km. Thirty-six (36) monuments are located between 4 and 5km. A breakdown of the monuments by type is depicted on Figure 13.14. Direct and Indirect effects are addressed below in Section 13.4 below.

Table 13.5: RMPs within 5km of the nearest proposed turbines

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
1	OF022-015	607207	717274	Enclosure	Stonestown	1	1907
2	OF022-021	606853	716803	Graveyard	Kilcamin	1	1438
3	OF022-022	606866	716652	Ritual site - holy well	Carrick (Garrycastle By.),Kilcamin	1	1287
4	OF030-003	605729	712062	Enclosure	Cloonacullina	4	1063
5	OF030-012	602974	709646	Barrow - ring-barrow	Coolaghansglaster	4	4564
6	OF030-014	603959	709239	Mound	Clondallow	4	4348
7	OF035-001	604694	708291	Ringfort - rath	Clondallow	4	4973
8	OF030-006	608729	712272	Enclosure	Whigsborough	5	1852
9	OF030-013	609699	708932	Enclosure	Cloncarban	5	4758
10	OF030-015	609834	709843	Castle - tower house	Eglish	5	4140
11	OF030-016	609895	709823	Church	Eglish	5	4197
12	OF030-017	608539	709385	Ritual site - holy well	Eglish	5	3783
13	OF030-018	609579	708912	Enclosure	Ballynaguilsha	5	4707
14	OF030-019	609884	709119	Enclosure	Cloncarban	5	4719
15	OF030-023	608544	709425	Mass-rock	Ballycollin (Eglish By.)	5	3749
16	OF035-003	607595	708095	Ringfort - rath	Ballindown	5	4771

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
17	OF030-016001	609891	709826	Graveyard	Eglish	5	4192
18	OF030-080	609308	711213	Road - class 3 togher	Coologe	5	2846
19	OF030-081	608065	711085	Redundant record	Galros East	5	2060
20	OF030-082	609095	711627	Redundant record	Whigsborough	5	2446
21	OF030-083	608676	711194	Redundant record	Ballycollin (Eglish By.)	5	2366
22	OF030-015001	609824	709843	Bawn	Eglish	5	4133
23	OF022-014	605267	717328	Ringfort - rath	Attinkee	8	1830
24	OF022-020001	606727	716813	Church	Guernal	8	1443
25	OF022-020002	606709	716811	Bullaun stone	Guernal	8	1431
26	OF021-002	600258	715570	Battery	Kylebeg Or Banagher	10	4940
27	OF021-003	600683	715700	Historic town	Curraghavarna And Portavrolla,Kylebeg Or Banagher	10	4555
28	OF021-001001	602616	716277	Ringfort - rath	Mullaghakaraun	10	3013
29	OF021-001002	602600	716271	Hut site	Mullaghakaraun	10	3023
30	OF021-006	601840	715291	Redundant record	Cuba	10	3335
31	OF021-008	601815	715358	House - 18th/19th century	Cuba	10	3374
32	OF022-019	602926	716287	Castle - tower house	Streamstown (Garrycastle By.)	10	2770
33	OF029-006001	602008	713761	Castle - tower house	Garrycastle	10	3188
34	OF029-006002	602014	713751	Bawn	Garrycastle	10	3185
35	OF029-006003	602003	713742	House - fortified house	Garrycastle	10	3198
36	OF029-006004	602040	713757	Sheela-na-gig	Garrycastle	10	3158

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
37	OF021-003002	600864	715391	Graveyard	Kylebeg Or Banagher	10	4310
38	OF021-003001	600873	715405	Church	Kylebeg Or Banagher	10	4304
39	OF021-003003	600872	715401	Graveslab	Kylebeg Or Banagher	10	4304
40	OF021-003004	600884	715398	Cross - High cross	Kylebeg Or Banagher	10	4292
41	OF021-003005	600925	715384	Ritual site - holy well	Kylebeg Or Banagher	10	4249
42	OF021-003006	600901	715377	Kiln - pottery	Kylebeg Or Banagher	10	4271
43	OF021-003007	600543	715733	Bastioned fort	Kylebeg Or Banagher	10	4699
44	OF021-003008	600602	715664	Town defences	Curraghavarna And Portavrolla,Kylebeg Or Banagher	10	4625
45	OF021-003009	600463	715879	Bridge	Curraghavarna And Portavrolla,Kylebeg Or Banagher	10	4814
46	OF021-001003	602521	716310	Enclosure	Mullaghakaraun	10	3110
47	OF029-027	600680	714950	Burnt mound	Kylebeg Or Banagher	10	4431
48	OF021-009	600258	715562	Architectural fragment	Kylebeg Or Banagher	10	4938
49	OF021-003010	600543	715733	Castle - unclassified	Kylebeg Or Banagher	10	4699
50	OF029-015001	602672	711721	Church	Garrycastle	11	3473
51	OF029-015002	602650	711722	Graveyard	Garrycastle	11	3489
52	OF029-015003	602677	711728	Ritual site - holy tree/bush	Garrycastle	11	3465
53	OF029-015004	602589	711774	Ritual site - holy well	Garrycastle	11	3502
54	OF029-015005	602622	711691	Redundant record	Garrycastle	11	3531

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
55	OF030-002	604690	713301	Enclosure	Clongawny Beg	11	928
56	OF029-015006	602676	711780	Ritual site - holy well	Garrycastle	11	3431
57	OF029-015007	602667	711785	Ritual site - holy well	Garrycastle	11	3435
58	OF029-015008	602592	711765	Ritual site - holy well	Garrycastle	11	3505
59	OF030-004	609645	713541	Enclosure	Derrinlough	14	617
60	OF030-005001	609784	713348	Castle - tower house	Whigsborough	14	737
61	OF030-005002	609762	713349	Mound	Whigsborough	14	742
62	OF030-005003	609769	713331	Bawn	Whigsborough	14	758
63	OF030-007	609911	712865	Ringfort - rath	Whigsborough	14	1195
64	OF030-010	609988	710512	Enclosure	Ballycollin (Eglish By.),Eglish	14	3546
65	OF030-011	610196	710810	Enclosure	Coologe	14	3255
66	OF030-020	610783	709148	Enclosure	Cloncarban	14	4975
67	OF023-007	613587	715482	Ringfort - rath	Broughal	15	2989
68	OF030-001	611208	714871	Enclosure	Drinagh	15	631
69	OF030-008	610933	713599	Redundant record	Derrymullin And Loughderry	15	795
70	OF030-009	611704	712668	Ringfort - rath	Ballykealy	15	1936
71	OF030-021001	612322	709671	Church	Tinnacross	15	4951
72	OF030-021002	612329	709660	Graveyard	Tinnacross	15	4963
73	OF031-001	613538	714711	Enclosure	Broughal	15	2750
74	OF031-002	614639	714075	Enclosure	Clontaglass	15	3844
75	OF031-003	614917	715192	Enclosure	Broughal	15	4189
76	OF031-004	615107	715271	Enclosure	Broughal	15	4390

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
77	OF031-049	614940	714040	Castle - unclassified	Killadrown	15	4147
78	OF030-029	611961	714749	Redundant record	Aghagoogy	15	1210
79	OF030-030	611959	714697	Road - class 3 togher	Aghagoogy	15	1194
80	OF030-031	611958	714405	Redundant record	Aghagoogy	15	1151
81	OF030-032	612000	714352	Redundant record	Aghagoogy	15	1193
82	OF030-033	612009	714336	Redundant record	Aghagoogy	15	1203
83	OF030-034	612014	714336	Road - class 3 togher	Aghagoogy	15	1208
84	OF030-035	612016	714331	Redundant record	Aghagoogy	15	1210
85	OF030-036	612039	714341	Road - class 3 togher	Aghagoogy	15	1233
86	OF030-037	612025	714325	Redundant record	Aghagoogy	15	1219
87	OF030-038	612033	714317	Redundant record	Aghagoogy	15	1228
88	OF030-039	612031	714316	Redundant record	Aghagoogy	15	1226
89	OF030-040	612028	714315	Redundant record	Aghagoogy	15	1223
90	OF030-041	612009	714278	Redundant record	Aghagoogy	15	1207
91	OF030-042	612016	714259	Redundant record	Aghagoogy	15	1215
92	OF030-043	612023	714241	Road - class 3 togher	Aghagoogy	15	1224
93	OF030-044	611942	714419	Redundant record	Aghagoogy	15	1135

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
94	OF030-045	611968	714431	Redundant record	Aghagoogy	15	1162
95	OF030-046	611978	714691	Road - class 3 togher	Aghagoogy	15	1210
96	OF030-047	611918	714591	Road - class 3 togher	Aghagoogy	15	1130
97	OF030-048	612078	714631	Road - class 3 togher	Aghagoogy	15	1295
98	OF030-049	611948	714681	Redundant record	Aghagoogy	15	1179
99	OF030-058	611842	714545	Redundant record	Derryad (Eglish By.)	15	1047
100	OF030-059	611865	714535	Road - class 3 togher	Derryad (Eglish By.)	15	1069
101	OF030-084	611101	712681	Castle - unclassified	Ballykealy	15	1728
102	OF014-047	607989	721690	Kiln - lime	Smithstown	21	4933
103	OF022-009	607179	720350	Enclosure	Ballyloughan	21	4161
104	OF022-010001	608569	721510	Ritual site - holy well	Cush East	21	4581
105	OF022-010002	608569	721520	Redundant record	Cush East	21	4591
106	OF022-011	608579	721390	Graveslab	Smithstown	21	4463
107	OF022-012001	608597	720647	Church	Killowney Beg	21	3746
108	OF022-012002	608591	720624	Graveyard	Killowney Beg	21	3726
109	OF022-012004	608529	720643	Redundant record	Killowney Beg	21	3764
110	OF022-013	607686	719439	Castle - tower house	Cloghan (Garrycastle By.)	21	3137
111	OF022-016	609241	718356	Enclosure	Stonestown	21	1372
112	OF022-017	610023	718159	Ritual site - holy well	Stonestown	21	1104

Map ID	Rmp No.	ITM E	ITM N	Description	Townland	WTG ID	Distance (m)
113	OF022-025	608206	717734	Castle - unclassified	Stonestown	21	1685
114	OF022-012005	608620	720650	Ecclesiastical enclosure	Killowney Beg	21	3742
115	OF022-012006	608623	720543	Fulacht fia	Killowney Beg	21	3639
116	OF022-012007	608675	720542	Fulacht fia	Killowney Beg	21	3622

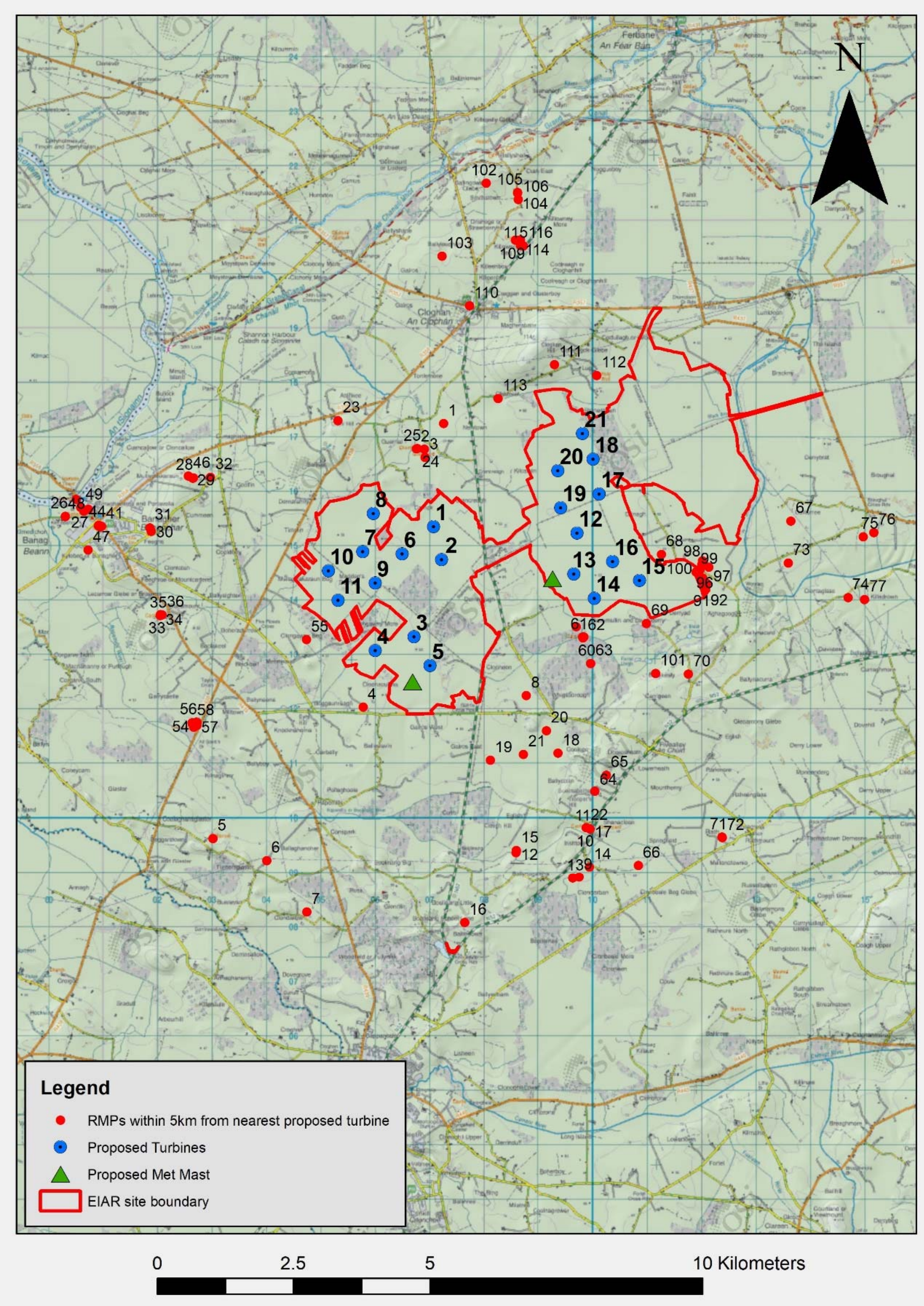

Figure 13.13: RMPs within 5km of the nearest proposed turbine.

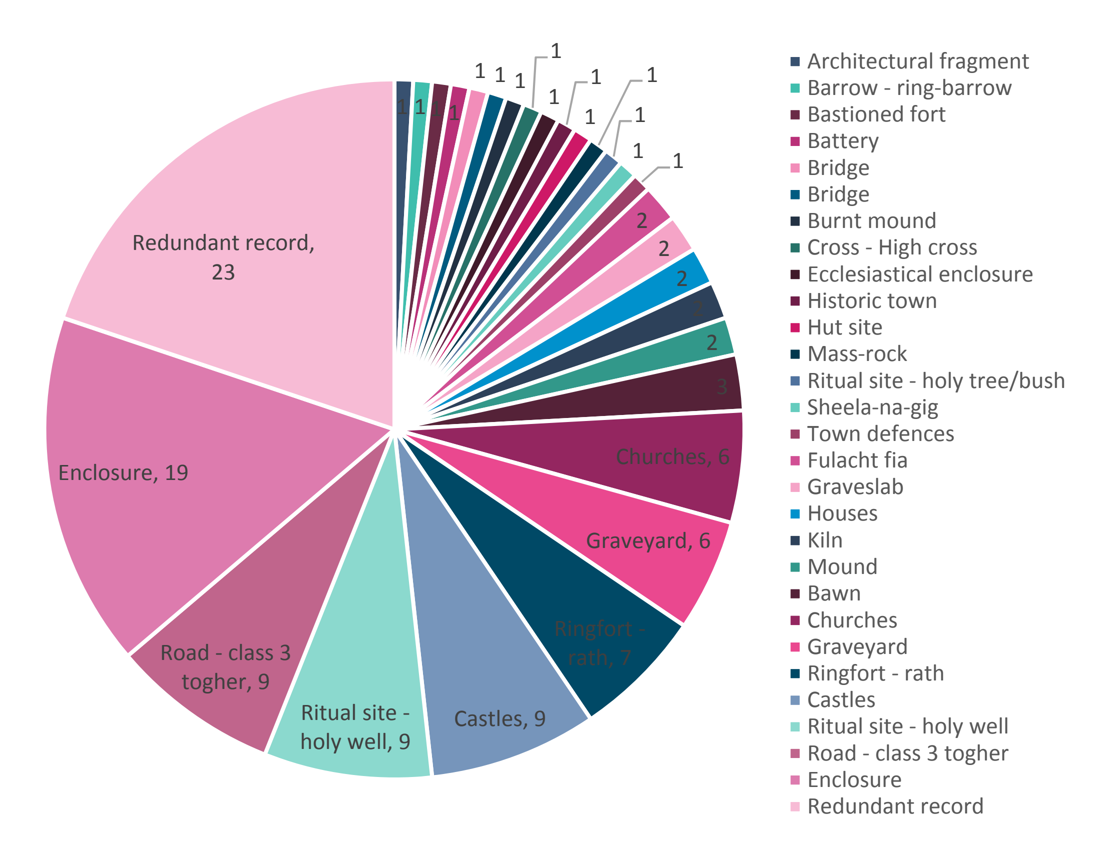

Figure 13.14: Monuments numbers within 5km of the nearest proposed turbine

13.3.1.5.1 *The Prehistoric Period*

The prehistoric period is strongly represented within the proposed development site boundary itself containing a number of toghers typically found in raised bogs. These are likely to be prehistoric in date and are described above in Section 13.3.1.3. The prehistoric period, however, within the wider landscape is represented by burnt mounds, fulachta fia, a hut site, a ring barrow as well as a number of class 3 toghers (trackways).

A number of other monuments may date to the prehistoric period but their dates can span from prehistory through to the Medieval period (Table 13.5, Figure 13.13 and Figure 13.14). One such site type is hut sites one of which is located within 5km of the proposed turbines. The primary function and date of hut sites is slightly ambiguous. Examples of hut sites are known throughout the country, particularly in upland regions, and are frequently associated with the practice of transhumance or booleying. Transhumance refers to the practice of the seasonal movement of people and their livestock typically to higher pastures in the summer and lower valleys in the winter. In Ireland this practice is known as booleying and is believed to date to the early medieval period, although it continued well into the nineteenth and early twentieth century.

Other uses for hillside huts has been noted at Mount Brandon, County Kerry, where it is suggested that they functioned as temporary habitations for seabourne pilgrims. It is also thought that they were used as habitation sites such as booleying huts during the year when pilgrimage was not taking place. An extensive series of pre-bog walls was also noted on the southern slopes of Mount Brandon. It is noted in that instance that although pre-dating the bog, the peat may still have been growing well into the medieval period. In this regard, such walls could be early medieval in date rather than prehistoric (Archaeology Ireland Heritage Guide No. 29). Furthermore, the potentially lengthy chronology of hut sites means that while some may be prehistoric others may date to the early or later medieval period or indeed to more modern times (ibid.).

Burnt mounds and fulachta fia at Kylebeg/Banagher and Killowney Beg also represent the Bronze Age period in general. Again, this monument type may span from the Bronze Age (c. 2400-500 BC) to the early medieval period (5th - 12th century AD. They consist of a circular or irregularly shaped mound of material consisting of burnt stones, ash and charcoal with no surface evidence of a trough or depression. Levelled examples can appear as a spread containing burnt stones.

Toghers in Aghagoogy townland may also date to the prehistoric period although may also span as far as the Medieval period. Toghers consist of a peatland trackway/causeway constructed of wood and intended to traverse a bog. Some have known orientations and some have substantial timber planks and have good structural definition. They may have several phases of construction indicative of long-term use and reuse. These may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Of note, also, although in excess of 5km from the proposed turbines is the Lough Boora Mesolithic habitation site (OF023-005). This is located 3.7km from the proposed development site boundary and in excess of 6.4km from the nearest turbines. Lough Boora (RMP OF023- 005) is the only Early Mesolithic site identified to date from Ireland's midlands. The site dates from a period before the formation of the raised bog in this area. At that time the site was located on the shores of a large post-glacial lake and evidence from excavations suggests that hunter-gatherers were using fireplaces, working chert, shale and limestone and trapping pig, hare, birds, eels and trout in the area around the site (O'Sullivan 2007, 159). The area was subsequently covered by peat which masked the post-glacial topography and archaeological remains. Given that the extensive peatlands in Offaly were in the process of forming in the early prehistoric period it can be argued that sites of a similar nature remain to be identified (McDermot 1998, 11).

It is described in the Archaeological Inventory as follows:

'*Mesolithic habitation site discovered on the bed of Lough Boora in 1977 and excavated by the National Museum under the direction of Dr. Michael Ryan (Ryan 1978). The site appears to have been located on a fossil lake shore formerly sealed by peat and subsequently inundated by the modern lake. The excavation revealed a number of hearths which were rich in charcoal, which included the burnt bones of mammal, bird and fish. Other evidence included the waste debris associated with the manufacture of bone tools. Over 400 objects were recovered including three polished stone axe heads, almost 200 microliths along with blades and scrapers of chert. Radiocarbon dating provided a range of dates from 7000-6500 BC*'.

13.3.1.5.2 The Early Medieval Period

The majority of monuments consist of those which may be definitively attributed to the Early Medieval period and ringforts and enclosures dominate the archaeological landscape within the 5km study area. Ringforts comprise earthen monuments while cashels take a similar form to the latter but are constructed using stone. Enclosures may represent the remains of ringforts or cashels but may not retain enough features to classify them as such or fall outside the acceptable size range for these monuments. Ringforts consist of a circular or roughly circular area enclosed by an earthen bank formed by material thrown up from the digging of a concentric ditch on its outside. Ringforts are usually enclosed by a single bank (univallate) while bivallate or trivallate ringforts i.e. those enclosed by double or triple rings of banks are less common. The number of banks and ditches enclosing these monuments are considered to reflect the status of the site, rather than the strengthening of its defences. Archaeological excavation has shown that the majority of ringforts functioned as enclosed farmsteads, built during the Early Christian period (5th – 9th century A.D.). Excavation within the interior of the monuments has traced the remains of circular and rectangular dwelling houses as well as smaller huts probably used to stall animals. The enclosing earthworks would also have protected domestic livestock from natural predators such as wolves and foxes. Souterrains are frequently associated with ringforts, cashels and enclosures. Souterrains derive their name from the French sous terrain meaning 'underground' and comprise an underground structure consisting of one or more chambers connected by narrow passages or creepways, usually constructed of drystone-walling with a lintelled roof over the passages and a corbelled roof over the chambers. Most souterrains appear to have been built in the early medieval period by ringfort inhabitants (c. 500 - 1000 AD) as a defensive feature and/or for storage.

Within 5km of the proposed development a number of enclosures are located at Derrinlough, Drinagh, Clongawny Beg, Cloonacullina, Stonestown, Whigsborough, Stonestown, Broughal, Mullaghakaraun, Coologe Ballycollin (Eglish By.), Eglish, Clontaglass, Ballyloughan, Ballynaguilsha and Cloncarban townlands. Ringforts are located in numerous townlands including Whigsborough, Attinkee, Ballykealy, Broughal, Mullaghakaraun, Ballindown and Clondallow thus also representing a wide geographic area for settlement.

13.3.1.5.3 *Sites with religious or ritual association*

Numerous holy wells are located in the vicinity at Garrycastle, Stonestown, Carrick (Garrycastle By.), Kilcamin, Eglish, Kylebeg/Banagher and Cush East. Holy wells may have their origins in prehistory but are associated with devotions from the medieval period (5th-16th centuries AD) onwards.

A bullaun stone OF022-020002 is located at Guernal. It is situated on the floodplains of the Little river in undulating countryside with graveyard (OF022-021) to the E and holy well (OF022-022) to the S. Only the grass covered wall footings of a small church survive (OF022-020001-) with evidence of large limestone boulders used in the wall construction. Unable to locate any traces of a bullaun stone in the vicinity of the church that was shown to the SMR office fieldworkers by a local landowner in 1988. The term 'bullaun' (from the Irish word 'bullán', which means a round hollow in a stone, or a bowl) is applied to boulders of stone or bedrock with hemispherical hollows or basin-like depressions, which may have functioned as mortars. They are frequently associated with ecclesiastical sites and holy wells and so may have been used for religious purposes. Other examples which do not appear to have ecclesiastical associations can be found in bedrock or outcrop in upland contexts, often under blanket bog, and are known as bedrock mortars. They date from the prehistoric period to the early medieval period (5th-12th centuries AD).

An Ecclesiastical Enclosure is located at Killowney Beg and consists of a curving arc of townland boundary c. 100m to N and NE of church (OF022-012001-) and graveyard (OF022-012002-) along with curving arc of field boundaries to SW of graveyard may indicate possible remains of an ecclesiastical enclosure of Early Christian date (Fitzpatrick 1998, 121). The partial remains of an enclosing bank which may have formed part of an inner enclosure visible on aerial photographs (GSI June 1973 N. 521/520) was levelled in the early 1990s. This enclosing bank was located in the field to the E of Killowney church (OF022-012001-) and graveyard (OF022-012002-) and was levelled by a machine driver when the graveyard was being extended c. 1990 (SMR file 1997). The circular curving field banks indicated on the current edition of the OS 6-inch maps 150m to the SSW of the church (OF022-012001-) may be the remains of the original ecclesiastical enclosure (int. diam. c. 290m) associated with an Early Christian monastery at Killowney. This field boundary no longer survives but a portion of an upstanding curving field boundary located 100m to the N of the church (OF022-012001-) may be the only surviving surface remains of the possible ecclesiastical enclosure. This upstanding section of the ecclesiastical enclosure acts as the townland boundary between Killowney Beg and Killowney More. The curving shape of the 19th century graveyard wall may suggest the presence of an inner enclosure with the graveyard wall following the curve of the earlier inner enclosure.

13.3.1.5.4 *Miscellaneous Monuments*

A number of other site types within various periods are also represented and seem to occur in isolation with only one of each monument type represented (see Figure 13.14).

13.3.1.6 Archaeological Investigations undertaken within the proposed development site and adjacent to same

As outlined above, the proposed development site incorporates both Drinagh and Clongawny bogs. A number of archaeological surveys were previously carried out within these bogs during the lifetime of production works within same by Bord na Móna. A summary of the available results of such surveys and/or any reassessment surveys is presented below.

13.3.1.6.1 *Irish Archaeological Wetland Unit Peatland Surveys*

Clongawny Bog was archaeologically surveyed in 1997 by the (Irish Archaeological Wetland Unit) IAWU as part of the Archaeological Survey of Ireland Peatland Survey. At that time ten sites were recorded, which consisted of a Road-Class 2 Togher (OF030-077), seven Road-Class 3 Toghers (OF030-070, 071, 073, 074, 075, 076 & 079) and two now 'redundant' records (OF030-072 & 078). Two of the Road-Class 3 Toghers were subsequently dated (OF030-076 and OF030-079) and returned middle Bronze Age dates. In 2009 ADS Ltd carried out a re-assessment survey of the bog, which at that time was 75% cutaway. All areas of Clongawny Bog that were in production at the time of survey were subject to fieldwalking. This area included the north-east extent of the bog, in proximity to the Briquette Factory at Derrinlough, part of the north-west extent of the bog and the southern extent of the bog. The area in which the previously recorded sites were identified was re-walked and a handheld GPS was used to locate the find spots. This area was covered with scrub and trees and the drains were also overgrown with reeds, however, where the central portion of the field surface remained visible these areas were subject to inspection. The previously recorded archaeological sites were no longer visible. Two small, previously unrecorded sites, including a possible platform and a deposit of archaeological wood, were identified in an area to the west which remained in production in 2009 (Whitaker, 2018).

Drinagh Bog was archaeologically surveyed in 1997 by the IAWU as part of the Archaeological Survey of Ireland Peatland Survey. A total of 41 sites were submitted to the records of the Archaeological Survey of Ireland. Of these sites, 18 were concentrated in Derryad and Drinagh townlands along the western extent of Drinagh dryland island. The remainder were located in private turbury plots to the east of the limit of the BnM boundary in Aghagoogy and Derryad townlands.

A re-assessment survey was carried out by ADS Ltd on behalf of BnM in 2009 (Rohan 2009). As noted above, over 75% of the bog is now cutaway with large areas of the bog milled out, overgrown or flooded. The northern and the central sections of the bog were largely covered with dense vegetation and some areas were underwater. It was not possible therefore to field walk these areas. The drains in the south-eastern extent of the bog did not have much vegetation. Fourteen previously unrecorded sites including 13 sightings of archaeological wood and a possible togher and were recorded during the re-assessment survey. One of the sightings of archaeological wood was located in isolation, at the southern end of the bog while the remaining sites were recorded in proximity to the south-eastern limit of the bog. A previously recorded plank trackway (OF030-060) and a platform (OF030-063) were reidentified. The private turbury plots where the IAWU identified several sites was not re-inspected (Whitaker 2018).

13.3.1.6.2 *Licensed archaeological Monitoring of Derrinlough Windfarm Engineering Site Investigations (19E0095)*

Archaeological monitoring of site investigation trial pits within the proposed development site was carried out by Tobar Archaeological Services over a number of months in 2019 under excavation licence 19E0095 (See Appendix 13.2 for Archaeological Report). No timbers or potentially archaeological wood was observed in the majority of the trial pits excavated. Timbers were noted within three trial pits excavated at Compound 2, 3 and 6, respectively. Compounds 2 and 3 were located in Clongawny Bog, while Compound 6 was located in Drinagh Bog (proposed compound in Drinagh has now been moved further east).

At Compound 3 (now proposed security hut in Clongawny) a single isolated timber was identified within the trial pit, however, no other potentially associated timbers or structure were noted. No definitive archaeological structure was noted at Compound 3.

At Compound 2 (TP CC2, Archaeological Monitoring Report, Appendix 13.2) two east-west running timbers were identified at a depth of 0.38m below the present ground level. A definitive archaeological structure was not identified within the limits of the trench and no other potentially associated timbers or structure were identified. Mitigation measures are required, and are outlined in Section 13.4, as further investigation is warranted in this location.

At what was previously referred to as Compound 6 during site investigations (now TPCC4) four horizontal timbers were observed within the trial pit at a depth of 0.65m. Two of the longer timbers were exposed for a distance of 2.4m and 1.2m (NE/SW) and had widths of 0.31m and 0.25m respectively and were 0.80m apart. Between the aforementioned timbers two shorter pieces of wood were noted and measured 0.5m and 0.7m in length NW/SE. While it was not possible to discern a definitive archaeological structure from the timbers observed within the limits of the trial pit, it is possible that they have some archaeological potential. The proposed compound and adjacent site road are now located c. 60m to the east of where the trial pit containing the timbers was excavated. No direct impact to the timbers is therefore anticipated. It does, however, highlight the potential for uncovering potential sub-surface archaeological sites and features during the construction stage of the development (see section 13.4.2 below).

13.3.1.7 Excavations Database

This database contains details regarding licensed excavations undertaken both within and adjacent to the proposed development. The first two examples are summaries of the Peatland Surveys described above in Section 13.3.1.6. Of significance in terms of overall archaeological potential of peatland sites is the discovery, in 2017, of early Bronze Age activity and a Neolithic Stone axe in the Meenwaun windfarm just to the south-west of the proposed Derrinlough windfarm site (see **2017:299** below). Furthermore, monitoring of site investigations associated with the permitted Cloghan windfarm (within Derrinlough townland) did not reveal any archaeological features (See **2018:543** below).

1998:App1 - IRISH ARCHAEOLOGICAL WETLAND UNIT (IAWU) FIELDWORK 1998–COUNTIES OFFALY
County: Offaly Site name: IRISH ARCHAEOLOGICAL WETLAND UNIT (IAWU) FIELDWORK 1998–COUNTIES OFFALY
Sites and Monuments Record No.: N/A
Licence number: –
Author: Conor McDermott, Nóra Bermingham, Ellen O'Carroll and Jane Whitaker, Irish Archaeological Wetland Unit, Department of Archaeology, UCD.
Site type: –
ITM: E 511244m, N 799206m
During the summer of 1998 the Irish Archaeological Wetland Unit (IAWU) spent eight weeks completing the survey of the Boora group of bogs in County Offaly. Boora Works comprises a series of bogs north and south of the road between Tullamore and Cloghan in County Offaly. The survey of the Boora Works began in 1997, when over 31 sites had been recorded. The 1998 survey concentrated on ten Bord na Móna bogs in the Boora region (over 6849ha in area). Clowngawney More, Drinagh West, Drinagh East, Tumduff, Boora East, Boora West, Derrybrat and Monettia are bogs that produce milled peat. Derrinboy and Killaun bogs had only recently been ditched, and there had been no milling in these bogs. One of the main objectives of this survey was to complete all the bogs west of Tullamore in County Offaly so that all the sites could be included in the Sites and Monuments Record. This work led to the completion of the Boora Group of bogs in West Offaly. In addition to these projects a week was spent reinstating a crannog in Frenchgrove, Co. Mayo (No. 488 above), and a preliminary field survey was undertaken in Oweninny, Co. Mayo.

In working in these bogs a standard IAWU survey strategy was used. This involved walking every second of the parallel drainage ditches, which gives an interval of c. 30m. On the first walk sites are identified, and then these are revisited and recorded on a standard IAWU record sheet. Sixty-one sites were recorded in six of the Bord na Móna-owned bogs, and seventeen other sites were recorded in a privately owned bog near Drinagh. Although no sites were recorded in four of the bogs, this does not preclude the finding of sites in the future as peat extraction continues. This brings the total of archaeological sites surveyed and recorded by the IAWU in Boora to over 92. The locations of all the archaeological sites were recorded and transferred onto appropriate maps. A record was also compiled of the threats facing each bog surveyed by the IAWU in 1998. The locational information of each site, the accompanying maps and the bog threats have been submitted to the NMHPS for inclusion in its Sites and Monuments Record.

Clowngawney More: This is the most westerly of the bogs in the Boora area. It lies west of the road from Birr to Cloghan, and its total area is 1018ha. Much of the central axis of the bog has been planted in coniferous forestry. Ten archaeological sites were identified. They lie to the south of Madden's Derry bog island, on the eastern side of Clowngawney bog. Most of the sites are brushwood toghers situated close to the surface of the bog.

Drinagh West: Drinagh bog lies east of the road from Birr to Cloghan and has been divided into east and west for production purposes. The total area of the two bogs is 1568ha. The survey of Drinagh West revealed nineteen sites in the spur off the south-eastern side of the bog. Sites included a large, single-plank walkway, roundwood and brushwood toghers, worked wood in situ and some puddle toghers. A single-piece vessel and a woven basket with associated leather were also recorded. A further seventeen sites were recorded in an area of private peat cutting to the east of the main concentration of archaeology.

Drinagh East: There were no archaeological sites recorded during the 1998 IAWU survey in this bog.

2009:673 - BALLIVER/CARRICK/CLONGAWNY MORE/CLOONACULLINA/CLOONEEN/
CRANCREAGH/DERNAFANNY/DERRINLOUGH/ GALROS EAST/GALROS
WEST/GUERNAL/TIMOLIN, CLONGAWNY BOG, Offaly
County: Offaly
Site name: BALLIVER/CARRICK/CLONGAWNY MORE/CLOONACULLINA/CLOONEEN/
CRANCREAGH/DERNAFANNY/DERRINLOUGH/ GALROS EAST/GALROS
WEST/GUERNAL/TIMOLIN, CLONGAWNY BOG
Sites and Monuments Record No.: N/A
Licence number: 09E0411
Author: Nicola Rohan, Archaeological Development Services Ltd, Unit D, Kells Business Park, Cavan Road, Kells, Co. Meath.
Site type: Peatland survey
ITM: E 619212m, N 720628m
The Re-assessment Survey 2009 included Bellair North and South, Killaranny, East Boora, Clongawny, Oughter (Roscore), West Drinagh and Galros Bogs, which are part of the Bord na Móna (BnM) Boora group of bogs. The Boora group of bogs was initially surveyed by the IAWU in 1994, 1997 and 1998. The objective of the Re-assessment Survey was to re-identify any surviving previously recorded sites, identify new sites and subsequently record all archaeological sites identified during the course of survey.
Clongawny Bog is located 3.3km south of Cloghan, Co. Offaly. It is located at the south-west edge of the BnM Boora group of bogs directly northwest of Galros Bog. It has a total area of 901ha, 75% of which is cutaway.
A total of ten archaeological sites, which were identified during the first-round survey of Clongawny Bog in 1994, were lodged in the records of the Archaeological Survey of Ireland. The sites were located within a cluster in the south-west corner of the bog.
As outlined above, c. 75% of Clongawny Bog is cutaway, with much of these areas covered in dense vegetation, forestry, dense scrub and open water. The location of the previously recorded sites was overgrown and as a result the sites were no longer visible but some may survive below the vegetation.

Immediately west of this area remained in production and two previously unrecorded sites, including a possible platform and a deposit of archaeological wood, were noted.

2009:670 - AGHAGOOGY/CRANCREAGH/DERRINLOUGH/ DERRYAD/DERRYMULLIN AND LOUGHDERRY/DRINAGH/KILCAMIN/STONESTOWN, WEST DRINAGH BOG, Offaly
County: Offaly Site name: AGHAGOOGY/CRANCREAGH/DERRINLOUGH/ DERRYAD/DERRYMULLIN AND LOUGHDERRY/DRINAGH/KILCAMIN/STONESTOWN, WEST DRINAGH BOG
Sites and Monuments Record No.: OF030–060, OF030–063
Licence number: 09E0413
Author: Nicola Rohan, Archaeological Development Services Ltd, Unit D, Kells Business Park, Cavan Road, Kells, Co. Meath.
Site type: Peatland survey
ITM: E 619212m, N 720628m
The Re-assessment Survey 2009 included Bellair North and South, Killaranny, East Boora, Clongawny, Oughter (Roscore), West Drinagh and Galros Bogs, which are part of the Bord na Móna Boora group of bogs. The Boora group of bogs was initially surveyed by the IAWU in 1994, 1997 and 1998. The objective of the Re-assessment Survey was to re-identify any surviving previously recorded sites, identify new sites and subsequently record all archaeological sites identified during the course of survey. West Drinagh Bog is located to the rear of Derrinlough Briquette Factory, c. 2.2km south-east of Cloghan, Co. Offaly. Drinagh Bog has a total area of 1923ha, of which c. 75% is now cutaway, with the remaining 25% in production at the time of survey.

A total of 41 sites, previously recorded during the first-round survey of West Drinagh Bog in 1998, were lodged in the records of the Archaeological Survey of Ireland.

At the time of the Re-assessment Survey much of the bog was cutaway, with large areas of the bog milled out, overgrown or underwater. Fourteen previously unrecorded sites, including thirteen sightings of archaeological wood and a possible togher, were recorded during the Re-assessment Survey. A previously recorded plank trackway (OF030–060) and a platform (OF030–063) were reidentified during survey. One of the sightings of archaeological wood was located in isolation, at the southern end of the bog, while the remaining sites were recorded in proximity to the south-eastern limit of the bog.

2011:510 - DERRINLOUGH, Offaly
County: Offaly Site name: DERRINLOUGH
Sites and Monuments Record No.: N/A   Licence number: 11E322
Author: Orlaith Egan
Site type: Post-medieval limekiln
ITM: E 608285m, N 713555m
Testing was undertaken across two areas along the N62 Birr to Athlone Realignment Scheme at Derrinlough. The works were carried out between 7 and 9 September 2011 on behalf of Offaly County Council. Approximately 948 linear metres of test trenches were excavated. A single clamp limekiln was identified and fully excavated.
The limekiln consisted of an oval pit/bowl measuring 1.8m north–south x 1.18m x 0.45m deep and was partially encircled by a shallow trench with possible flues in the east-south-east and the west. The pit/bowl of the kiln was mainly filled with a mid-grey-brown, gritty mortar limestone deposit with a compact gritty grey residue on the base and sides. The shallow trench encircling the pit/bowl measured 0.22–0.26m in width x 0.05m in depth and had evidence of in situ burning. It was filled with charcoal-rich silty clay with a high fibrous humic content likely to be the remnants of a sod wall of the kiln.
The limekiln cut an irregular-shaped pit measuring 1.79m x 1.67m x 0.5m. It appears that the earlier irregular-shaped pit was backfilled in the eastern side of the pit, while the western side of the pit was remodelled and reused for the bowl of the limekiln.
Post-medieval pottery was found at the surface of the kiln.
National Roads Authority, Westmeath NRDO, Culleenbeg, Mullingar, Co. Westmeath

The archaeological potential of the surrounding landscape is evident by the discovery of Early Bronze Age pits and a Neolithic Stone Axe in the now existing Meenwaun Windfarm, just to the south-west of the proposed development site boundary.

2017:299 - Meenwaun windfarm, Offaly
County: Offaly Site name: Meenwaun windfarm
Sites and Monuments Record No.: N/A Licence number: 17E0023
Author: Ros Ó Maoldúin
Site type: Early Bronze Age pits and a stone axe
ITM: E 712955m, N 605120m
Monitoring and testing work was carried out in advance of construction works related to Meenwaun Windfarm near Banagher, Co. Offaly. Archaeological evidence was uncovered at one location. The remains included a Neolithic stone axe, two oval pits filled by burnt mound-like material, several stake-holes and spreads of burnt material, located along the banks of a probable palaeostream (Fig 1). A radiocarbon date from one of the pits returned an Early Bronze Age date of 2040–1890 cal BC (2 Sigma). The remains were fully excavated and were the subject of an Archaeology Ireland article (Ó Maoldúin & Danaher 2018). Reference: Ó Maoldúin, R. & Danaher, E. 2018. The Biography of an Axe. Archaeology Ireland. 31 (1), 17-20. Laghtagoona House, Gort Road, Corofin.

2018:543 - Derrinlough, Offaly
County: Offaly Site name: Derrinlough
Sites and Monuments Record No.: N/A Licence number: Unlicensed monitoring
Author: Dermot Nelis
Site type: No archaeology found
ITM: E 608115m, N 715290m
The development site is located approximately 10km south-west of Ferbane and 4km south of Cloghan, and involved the mechanical excavation of two site investigation test pits to facilitate construction of a wind farm.
A 12 tonne machine fitted with a toothless grading bucket was used to excavate the test pits, which on average measured 3m long x 0.5m wide x 1.5m deep. Excavation of both test pits revealed topsoil sealing a peat layer which directly sealed undisturbed natural geology.

No archaeological features or artefacts were revealed as a result of carrying out the monitoring.

13.3.1.8 Townlands and administrative boundaries

Townlands and administrative boundaries may indicate the presence of archaeological features within a development site. Administrative counties are subdivisions of pre-established counties which were formed for administrative purposes in the nineteenth and twentieth centuries. Baronies are administrative units larger than civil parishes and originally established as the primary subdivision of counties by the British administration in Ireland. Irish baronies which were formed at the time of the Norman conquest were usually named either after Irish territories, or from places which had been of importance in pre-Norman times. Irish baronies came into existence at different periods. The division of Ireland into counties and baronies was a process which continued down to the reign of James I. The original baronies in Ireland were the domains of the Norman barons; in the final stage of development they were divisions of counties created merely for greater convenience of administration. The word barony is of feudal origin, and was applied to a tenure of a baron, that is, of one who held his land by military service, either directly from the king, or from a superior feudal lord who exercised royal privileges. The origin of the Irish barony (a division of land corresponding to the English hundred) is to be found in the grants of lands which were made to the barons of Leinster and the barons of Meath (Liam Price, 'Ráith Oinn', Éigse VII, lch. 186-7). Civil parishes are administrative units larger than townlands and based on medieval ecclesiastical parishes. Civil parishes, modern Catholic parishes and Church of Ireland parishes may differ in extent and in nomenclature. Counties are administrative units larger than baronies and originally established by the British administration in Ireland between the twelfth and the seventeenth centuries. Some of these were subsequently subdivided into smaller administrative county units.

Townlands are the smallest land units which were determined and established in the Irish administrative system in the first half of the nineteenth century. Many of the townlands were in existence prior to that. Townland names are a valuable source of information, not only on the topography, land ownership and land use within the landscape, but also on its history, archaeological monuments and folklore. Logainm.ie was utilised to ascertain the origin of the townland names.

Table 13.6: Townlands in the vicinity and within the proposed development

Townland Name	Meaning
Balliver (Baile Íomhair) -	The town of Íomhar
Ballyeighter (An Baile Íochtarach	The lower town
Carrick (An Charraig)	The rock
Clongawny Beg (Cluain Gamhna Beag)	Small calf meadow
Clongawny More (Cluain Gamhna Mór)	Big calf meadow
Cloonacullina – (Cluain Cuillionn)	Meadow of Holly
Clooneen (An Cluainín)	Little meadow
Coolderry (Cúldoire)	Black derry or oak wood
Crancreagh (Crann Critheach)	Trembling Tree
Dernafanny (Doire Fuaran) -	Oak Spring
Derrinlough (Doirín an Locha)	Little oak wood lake
Galros East/ West (Gall Ros)	Wood of Foreigners
Guernal (Guairnéal)	Whirlpool
Timolin (Tuaim Eolaing)	tomb/burial place
Aghagoogy (Ard Guaige)	High Guaige
Cortullagh or Grove (Cor Thulach)	Round Hill
Derryad (Doire Fhada)	Long oak grove
Derrymullin and Loughderry Doire an Mhuilinn agus Loch an Doire	Mill oakwood and oakwood lake
Drinagh (Droighneach)	A place producing blackthorns
Stonestown (Baile na Cloiche)	

13.3.1.9 Topographical Museum Files

Some of the locational information for stray finds can be gleaned from Heritage Maps (heritage maps.ie) where the National Museum have provided such data. Some more recent finds, however, are not marked on this resource. In general, however the following is a summary of the stray finds from both bogs:

Clongawny Bog

There are nine stray finds that may be attributable to Clongawny Bog. Five of these are from Carrick townland and consist of an oval stone macehead (1937:2953) with a central perforation; a large upper stone of a rotary quern (1966:151); a roughout for a wooden goblet (1980:32); a notched wooden timber (1980:33) and a 'cut log' (1980:34).

Drinagh Bog

There are 19 records of finds recorded as having been found in Drinagh townland. These are a wooden jug (1954:71); a wooden vessel (1954:72); a socketed bronze dagger or knife (1960:647); several lumps of bog butter with traces of bark wrapping (1977:2176); six fragments of a wooden tray (1977:2178 & 2179); half of a circular base of a wooden vessel (1977:2180); a possible wooden paddle (1977:2181); a stone D-shaped saddle quern (1979:107); the right femur of a human skeleton (1982:71);a D-shaped wooden object (1988:127) with axe marks that may have been the seat of a chair or stool; a portion of a wooden beetle (1988:128), two wooden board with toolmarks (1988:129 & 130); a thick oak plank with a mortice (2013:323); a wooden beetle (2013:324) and a bog butter in two pieces (2001:71 & 72) with traces of hazel rods from a possible wicker container.

Derrinlough

Four finds are recorded as having been found in Derrinlough townland. These are a Lucas Type 3 leather shoe (1960:607) found 2- 3tf deep in the bog; a Lucas Type 5 leather shoe (2002:54) found on the bog surface and an unfinished wooden bow (2014:152) carved from yew and a hurdle panel with wicker lashing (2014:230). Some of these finds are shown on Figure 13.15 and Figure 13.16.

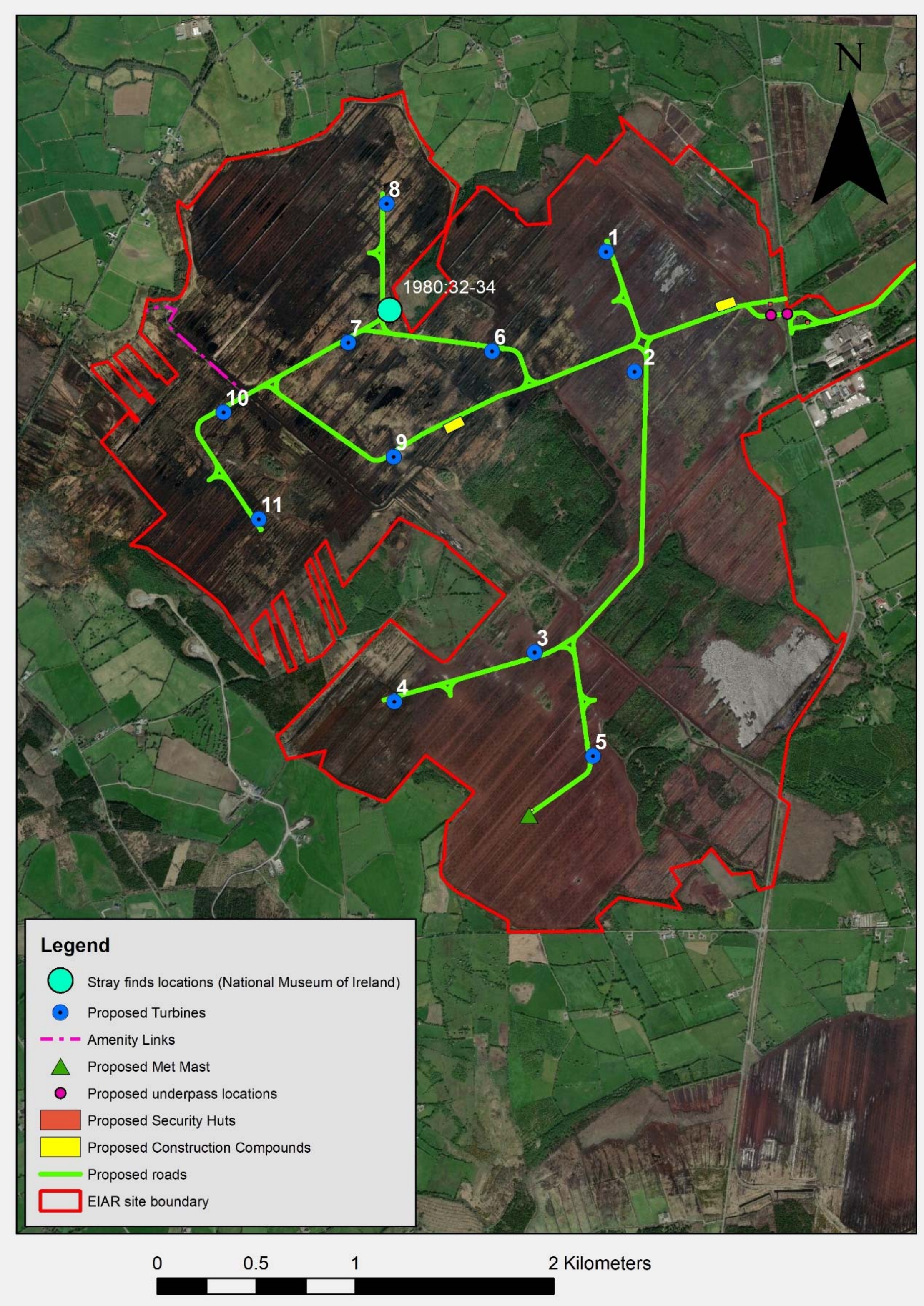

Figure 13.15: Stray finds from Clongawny Bog

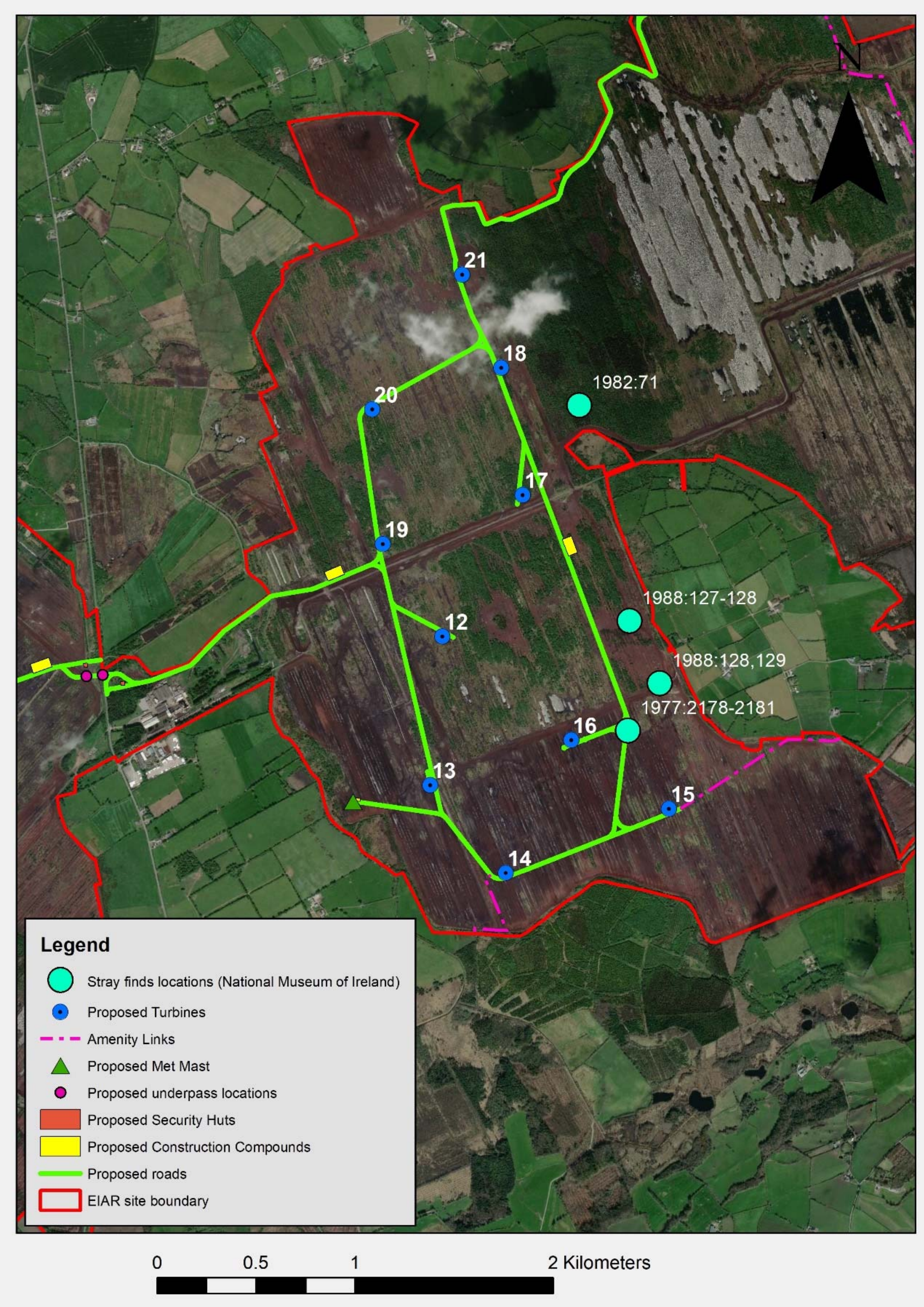

Figure 13.16: Stray finds from Drinagh and Derrinlough townlands

13.3.1.10 Cartographic Evidence

13.3.1.10.1 Down Survey maps

The Down Survey is a mapped survey undertaken in the mid-17th century. Using the Civil Survey as a guide, teams of surveyors, mainly former soldiers, were sent out under Petty's direction to measure every townland to be forfeited to soldiers and adventurers. The resulting maps, made at a scale of 40 perches to one inch (the modern equivalent being 1:50,000), were the first systematic mapping of a large area on such a scale attempted anywhere. The primary purpose of these maps was to record the boundaries of each townland and to calculate their areas with great precision. The maps are also rich in other detail showing churches, roads, rivers, castles, houses and fortifications. Most towns are represented pictorially and the cartouches, the decorative titles, of each map in many cases reflect a specific characteristic of each barony.

The Down Survey map for 'Dryan' and 'Derrinloghan' describes the area as a wood and bog belonging to the Earle of Kildare (Figure 13.17).

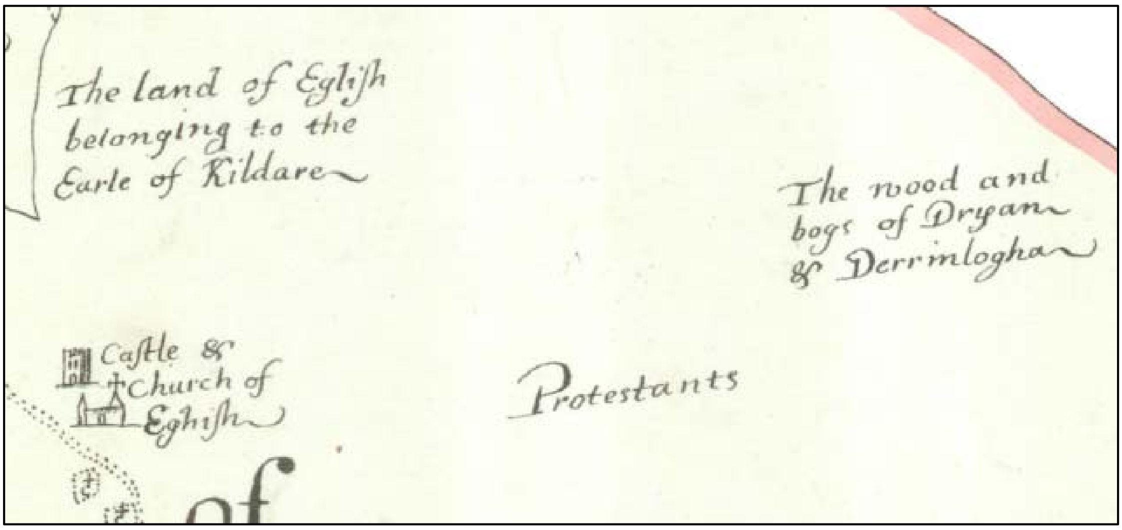

Figure 13.17: Down Survey map (http://downsurvey.tcd.ie/down-survey-maps.php#bm=Eglish&c=Offaly+(Kings))

13.3.1.10.2 1st and 2nd Edition OS maps

The Ordnance Survey came to Ireland in 1824 in order to carry-out a precise admeasurement of the country's 60,000 or so townlands as a preliminary to the larger task of reforming Ireland's local taxation system. The townland boundaries were demarcated by a Boundary Commission, and the Ordnance Survey had the task of measuring them. In addition to boundaries the maps are truly topographical in content. Drawn at the large scale of six inches-to-one-mile (1:10,560) it was important to mark all buildings, roads, streams, placenames, etc, that were required for valuation purposes. Ultimately the maps were used as a basis for the rateable valuation of land and buildings in what became known as Griffith's Valuation. Working from north to south, the survey began in Antrim and Derry in 1829 and was completed in Kerry in 1842. It was published as thirty-two county maps between 1832 and 1846, the number of sheets per county varied from 153 for County Cork to 28 for Dublin, each of the 1,994 sheets in the series depicting an area 21,000 by 32,000 feet on the ground. Each county was projected on a different central meridian and so the maps of adjacent counties do not fit neatly together at the edges. Map content stops at the county lines.

The First Edition

The early Ordnance Survey maps are an unrivalled source for the period immediately before the Great Irish Famine (1847-50) when the population was at the highest level ever recorded. The maps depict an open landscape in the area of the proposed turbines and infrastructure. No features of note are depicted.

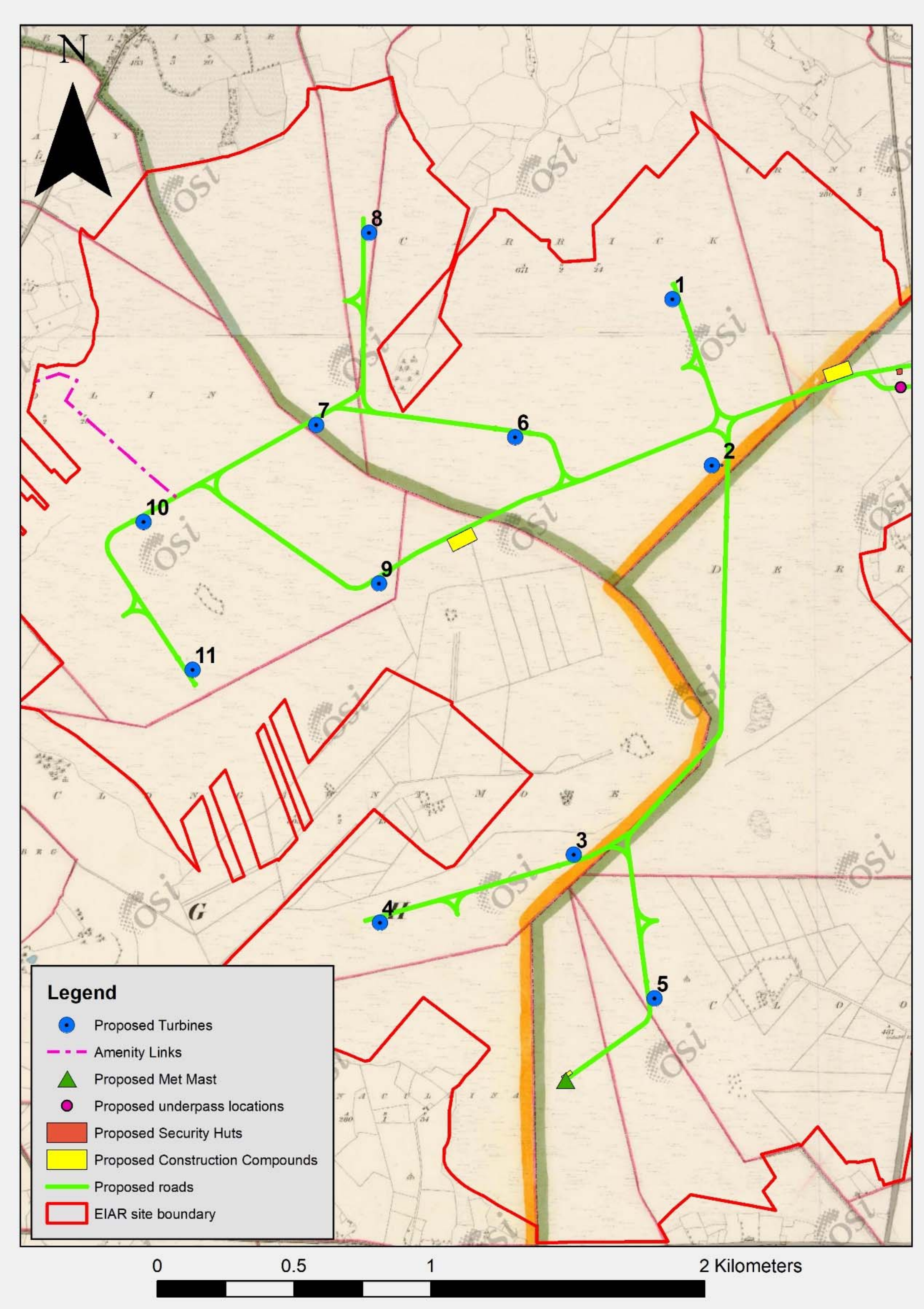

Figure 13.18: Clongawny bog with proposed infrastructure shown on 1st edition OS background.

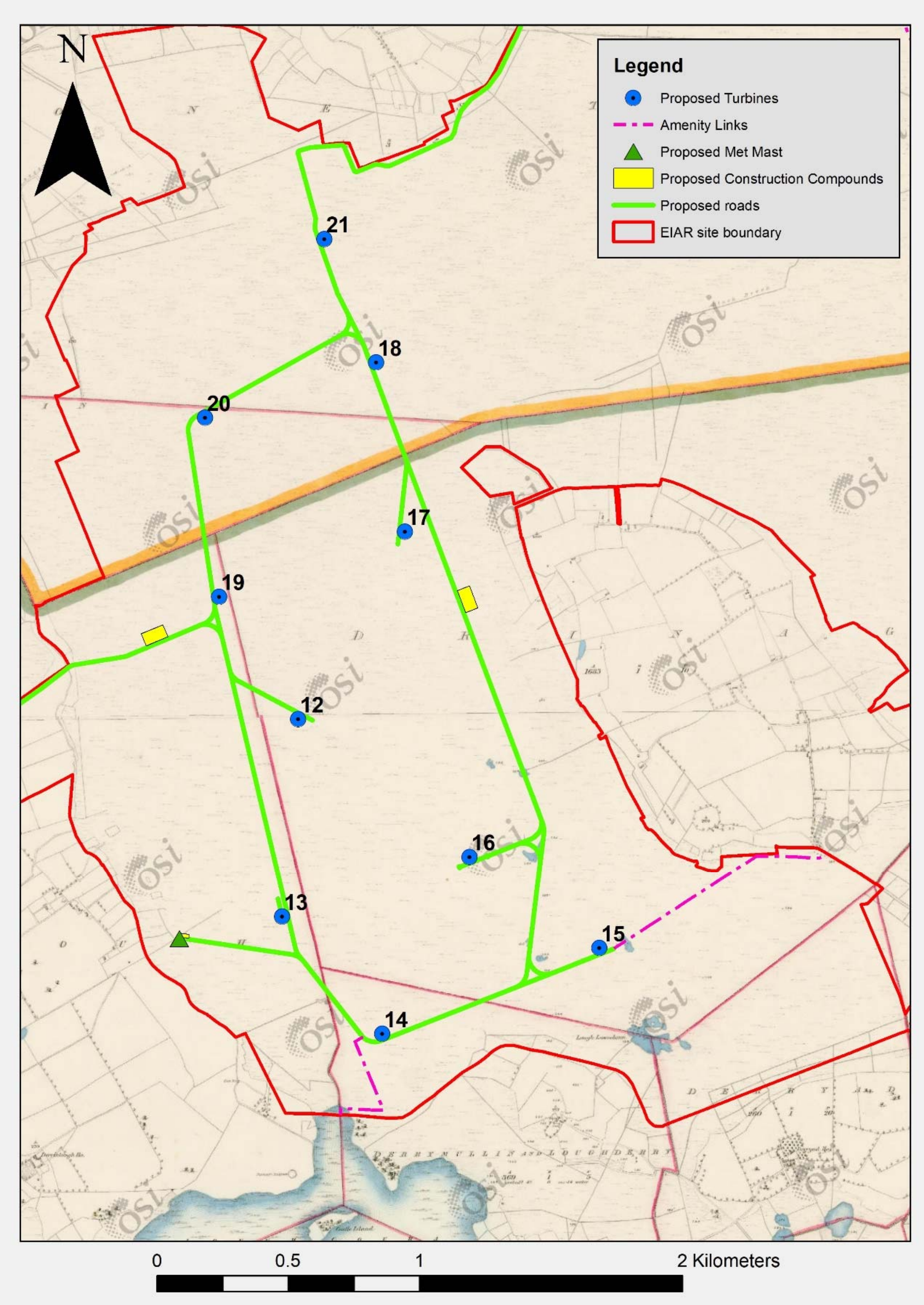

Figure 13.19: Proposed development shown on 1st edition OS map (Drinagh).

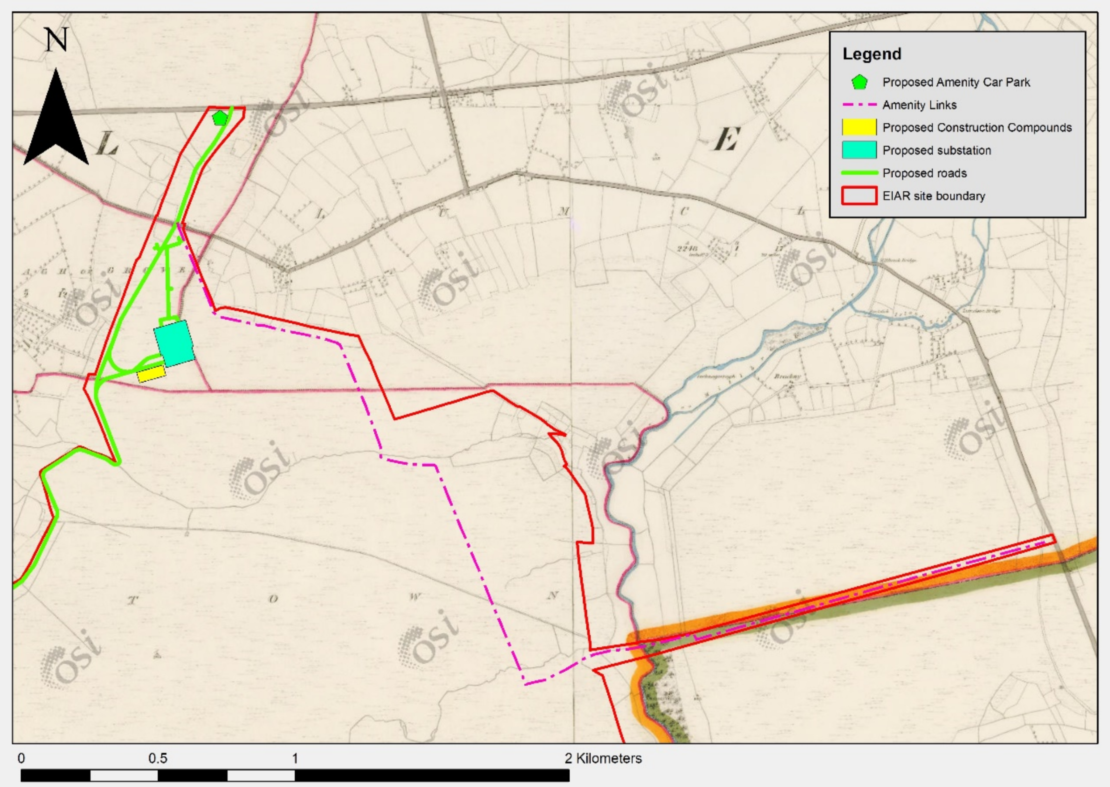

Figure 13.20: North-eastern section of Drinagh bog on 1st Edition OS map.

13.3.1.11 Description of the proposed Development Area

The description of the proposed development area and photographic record is presented in Appendix 13.1.

13.3.2 Architectural and Cultural Heritage

13.3.2.1 Protected Structures within the proposed development site boundary

No built heritage structures which are subject to statutory protection or otherwise are located within the proposed development boundary.

13.3.2.2 Protected Structures within 5km of the nearest proposed turbines

The RPS for County Offaly, as well as any additions was obtained as a dataset on ArcGIS online (from Offaly County Council) and added to the project base mapping. Structures within 5km are included here (See Section 13.2.5 above for distance criteria). The RPS is largely based on the NIAH and therefore some repetition/overlap occurs between both datasets. All RPS structures within 5km of the nearest proposed turbine are detailed in

Table 13.7 and are also represented on Figure 13.21. The distances to the relevant turbines are also detailed.

The majority of structures are located within 'urban' settings of Banagher and Cloghan and therefore their visual settings do not extend beyond the limits of those settlements. The ZTV shows that there will be limited to no visibility in the direction of the turbines from within Cloghan or Banagher. The majority of other outlying structures in the landscape may have some visibility in the direction of the proposed turbines as the ZTV suggests. Direct and Indirect Impacts are discussed in Section 13.4 below.

Table 13.7: RPS structures within 5km of the nearest proposed turbines

RPS ID	NAME / STRUCTURE	LOCATION 1	LOCATION 2	ITM E	ITM N	WTG ID	DISTANCE (M)
49-4	Thatched house	See Map	See Map	605013	709569	4	3655
49-2	Eglish Castle	Eglish	Birr	609813	709846	5	4123
49-3	Eglish Church of Ireland Church	Eglish	Birr	609856	709845	5	4154
30-27	L'Estrange Bridge	Clonony More	Shannonharbour	605572	720263	8	4658
29-Jan	Canal Bar	See Map	Shannon Harbour	603301	719035	8	4305
29-Feb	Griffith Bridge	See Map	Shannon Harbour	603265	719079	8	4361
29-Mar	Cast iron water pump	See Map	Shannon Harbour	603222	719056	8	4370
29-Apr	The Grand Hotel	See Map	Shannon Harbour	603207	719017	8	4348
29-May	House	See Map	Shannon Harbour	603164	718941	8	4316
29-Jun	2 Houses	See Map	Shannon Harbour	603017	718935	8	4407
30-28	Post box	See Map	See Map	604582	717262	8	2119
40-1	Balliver House	See Map	See Map	605179	716472	8	1130
29-Jul	Pair of dry docks	See Map	Shannon Harbour	603081	719004	8	4418
30-29	Gaybrook Mill	See Map	See Map	606717	717376	8	1931
RPS13_017	Clonony Bridge 34th lock	Clonony More	Ferbane	604533	719653	8	4267
RPS13_018	Park Brick Jack Arch Bridge	See Map	Ferbane	603100	717819	8	3576
39-14	Hunts Shop/House	Main Street	Banagher	600855	715452	10	4331
39-16	J.J. Houghs	Main Street	Banagher	600838	715548	10	4369
39-17	3 bay 2 storey house	Main Street	Banagher	600821	715569	10	4390
39-19	Cast iron post box	Main Street	Banagher	600796	715584	10	4418

RPS ID	NAME / STRUCTURE	LOCATION 1	LOCATION 2	ITM E	ITM N	WTG ID	DISTANCE (M)
39-25	The Royal Shannon	Main Street	Banagher	600696	715729	10	4550
39-26	K.P. Egan	Main Street	Banagher	600673	715698	10	4564
39-28	Banagher Billiard Hall	Main Street	Banagher	600685	715731	10	4561
39-29	Bridge Malt house	See Map	Banagher	600474	715769	10	4775
39-30	Quay	See Map	Banagher	600507	715812	10	4754
39-32	Banagher Bridge	See Map	Banagher	600492	715880	10	4787
39-22	Quigley	Main Street	Banagher	600722	715663	10	4508
39-18	Crank House Visitor Centre	Main Street	Banagher	600775	715595	10	4441
39-24	The Royal Shannon	Main Street	Banagher	600705	715719	10	4539
39-27	Detached 3 bay 2 storey house	Main Street	Banagher	600659	715703	10	4579
39-23	The Railway Bar	Main Street	Banagher	600701	715683	10	4534
39-4	Saint Rynagh's Roman Catholic Church	See Map	Banagher	601245	715095	10	3886
39-10	St. Helens	Main Street	Banagher	600950	715322	10	4213
39-13	S. Lyons Bar/House	Main Streeet	Banagher	600923	715444	10	4263
39-5	Saint Rynagh's Parochial House	See Map	Banagher	601289	715073	10	3839
39-6	Carved limestone monument	The Cresent	Banagher	601167	715069	10	3959
39-9	Bank of Ireland	Main Street	Banagher	600985	715299	10	4174
39-1	Saint Paul's Church of Ireland Church	See Map	Banagher	601384	714796	10	3717
39-31	Barracks	Main Street	Banagher	600543	715754	10	4704
39-3	Charlotte's Way B & B	Hill House, Main Street	Banagher	601312	714846	10	3793

RPS ID	NAME / STRUCTURE	LOCATION 1	LOCATION 2	ITM E	ITM N	WTG ID	DISTANCE (M)
39-33	Cuba Court	See Map	Banagher	601849	715367	10	3343
39-15	Flynn	Main Street	Banagher	600846	715488	10	4348
39-12	Wrapped Up	Main Street	Banagher	600917	715411	10	4262
39-2	Banagher Rectory	See Map	Banagher	601120	714532	10	3974
39-34	Detached 3 bay 2 storey house	See Map	Banagher	600734	715696	10	4505
39-36	Cummeen Lodge	Cummeen	Banagher	602595	715859	10	2815
39-37	Coolfin House	Coolfin	Banagher	602791	715864	10	2645
39-39	Claremount House	See Map	See Map	602409	713752	10	2805
39-40	Castle Garden House	See Map	See Map	601650	714081	10	3477
39-35	Fort Eliza	See Map	Banagher	600251	715575	10	4948
39-45	Garry Castle	See Map	Banagher	602075	713747	10	3127
39-44	Horans House	The Square, Banagher	See Map	600943	715364	10	4228
39-46	House & Shop	Kylebeg or Banagher	Banagher	600813	715539	10	4391
40-2	Whigsborough House	See Map	See Map	609960	711784	14	2274
40-3	Whigsborough Tower	See Map	See Map	610074	711980	14	2080
49-1	Saint James's Roman Catholic Church	See Map	See Map	610382	710660	14	3422
49-5	Eglish Cottage	See Map	See Map	610074	710449	14	3610
41-18	Ballynacard House	See Map	See Map	613563	713105	15	3038
41-15	Detached 5 bay thatched framhouse	See Map	See Map	613993	715905	15	3530

RPS ID	NAME / STRUCTURE	LOCATION 1	LOCATION 2	ITM E	ITM N	WTG ID	DISTANCE (M)
41-16	Detached 4 bay thatched farmhouse	See Map	See Map	613981	715849	15	3496
50-17	Tinnacross House	See Map	See Map	612294	709670	15	4943
RPS13_031	Tithe Barn	Glenamony Glebe	Birr	612358	711959	15	2879
30-Mar	House	Market Square	Cloghan	607840	719397	21	3005
30-May	Saint Mary's Roman Catholic Church	Banagher Street	Cloghan	607825	719272	21	2920
30-Jul	Weighbridge	Castle Street	Cloghan	607767	719376	21	3036
30-Aug	Thatched House	See Map	Cloghan	606748	719685	21	3979
30-Jun	Saint Mary's Parochial Hall	Ferbane Street	Cloghan	607914	719492	21	3033
30-Apr	House	Market Square	Cloghan	607794	719423	21	3054
30-2	House	Hill Street	Cloghan	607801	719362	21	3003
30-Jan	House	Hill Street	Cloghan	607874	719365	21	2958
30-31	Strawberry Hill House	See Map	See Map	607605	721059	21	4520
30-30	Strawberry Hill House	Drishoge or Strawberryhil		607466	720954	21	4497
30-34	House	Castle Street	Cloghan	607726	719382	21	3068
30-33	House	Hill Street	Cloghan	607837	719362	21	2980

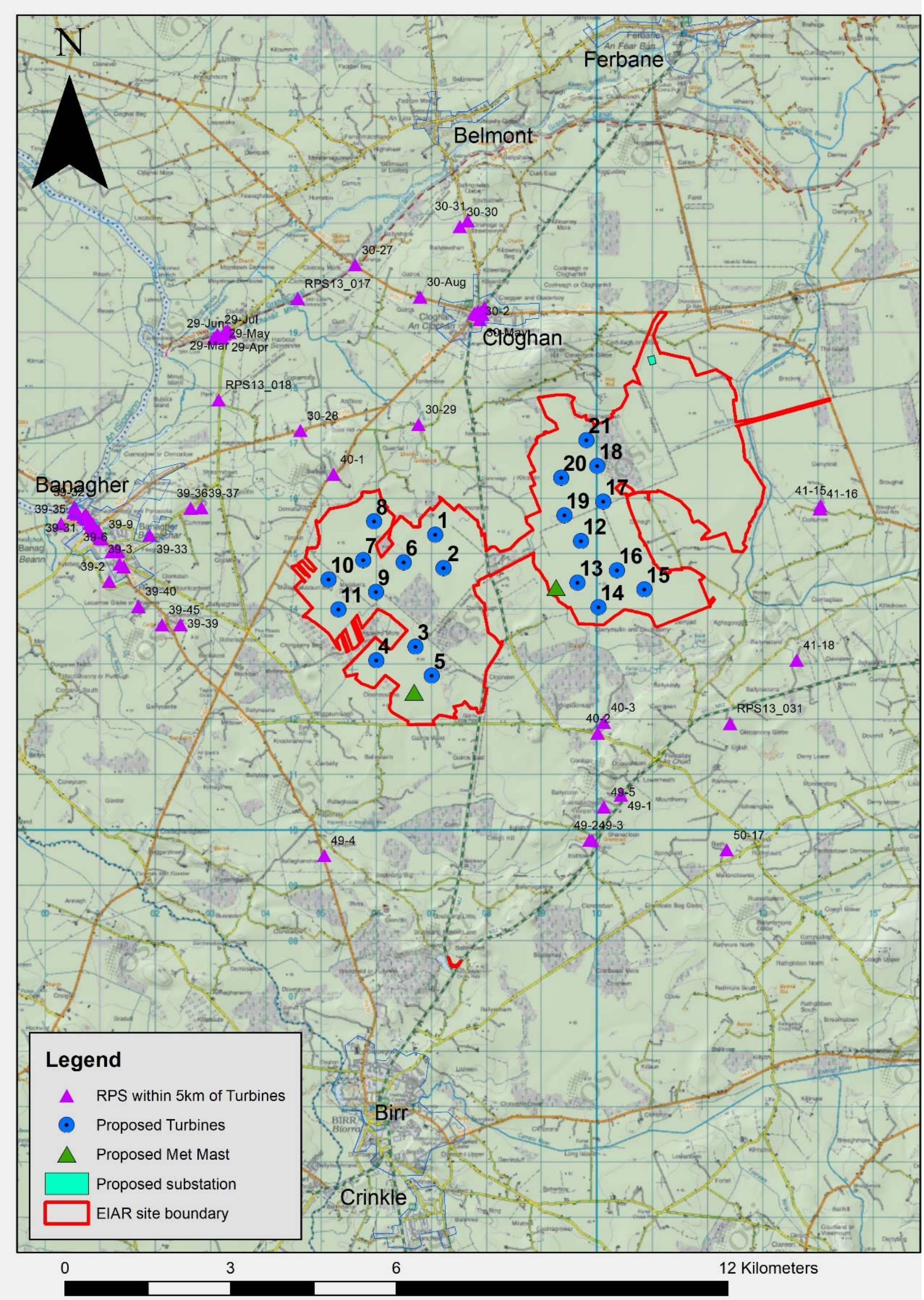

Figure 13.21: Record of Protected structures within 5km of the nearest proposed turbine.

13.3.2.3 NIAH within 5km of the nearest proposed turbine

The National Inventory of Architectural Heritage (thereafter NIAH) for County Offaly was downloaded from the Historic Environment Viewer on to the project GIS base mapping. All NIAH structures within 5km of the nearest proposed turbines are included here for purposes as assessing potential visual effects in the wider landscape setting of the architectural resource (See Section 13.2.5 above for distance criteria). The RPS is largely based on the NIAH and therefore some repetition/overlap occurs between both datasets. All NIAH structures within 5km of the nearest proposed turbine are detailed in

Table 13.8 and are also represented on Figure 13.21. The distances to the relevant turbines are also detailed.

As with the RPS, the majority of structures are located within the 'urban' settings of Banagher and Cloghan and therefore their visual settings do not extend beyond the limits of those settlements. The ZTV shows that there will be limited to no visibility in the direction of the turbines from within Cloghan or Banagher. The majority of other outlying structures in the landscape may have some visibility in the direction of the proposed turbines as the ZTV suggests.

Table 13.8: NIAH structures within 5km of the nearest proposed turbines

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14930006	N/A	Ballaghanoher	house	605013	709569	4	3655
14930004	Eglish Castle	Eglish	country house	609813	709846	5	4123
14930005	Eglish Church of Ireland Church	Eglish	church/chapel	609855	709845	5	4153
14922001	L'Estrange Bridge	Clonony More	bridge	605572	720263	8	4658
14922002	Canal Bar	Clonony Beg	house	603301	719035	8	4305
14922003	Griffith Bridge	Clonony Beg	bridge	603265	719079	8	4361
14922004	N/A	Clonony Beg	water pump	603222	719056	8	4370
14922005	The Grand Hotel	Clonony Beg	hotel	603207	719017	8	4348
14922006	Harbour Master's House	Clonony Beg	worker's house	603164	718941	8	4316
14922007	N/A	Clonony Beg	house	603017	718935	8	4407
14922008	N/A	Balliver	post box	604581	717262	8	2120
14922009	Balliver House	Balliver	country house	604547	717242	8	2126
14922011	Gaybrook Mill	Tonlemone	store/warehouse	606717	717375	8	1930

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14922014	N/A	Clonony Beg	dry dock	603081	719004	8	4418
14929002	Claremount House	Claremount	country house	602410	713752	10	2804
14929003	Castle Garden House	Garrycastle	house	601651	714081	10	3476
14929004	Garrycastle	Garrycastle	house	602042	713753	10	3157
14810032	N/A	Kylebeg Or Banagher	quay/wharf	600506	715812	10	4755
14810033	N/A	Kylebeg Or Banagher	barracks	600530	715734	10	4712
14810034	Banagher Bridge	Curraghavarna And Portavolla,Kylebeg Or Banagher	bridge	600491	715880	10	4788
14810037	Fort Eliza	Kylebeg Or Banagher	battery	600250	715575	10	4949
14810035	Cuba Court	Curraghavarna And Portavolla	school	601850	715367	10	3342
14810036	N/A	Curraghavarna And Portavolla	house	600734	715696	10	4505
14921001	Cummeen Lodge	Cummeen	gate lodge	602595	715858	10	2815
14921002	Cummeen Cemetery	Mullaghakaraun	graveyard/cemetery	602410	715834	10	2970
14922010	Coolfin House	Coolfin	hunting/fishing lodge	602791	715864	10	2645
14810001	N/A	Curraghavarna And Portavolla	water tower	601453	714955	10	3662
14810002	Saint Paul's Church of Ireland Church	Feeghs	church/chapel	601380	714797	10	3721

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14810003	Banagher Rectory	Lecarrow Glebe Or Britannia	rectory/glebe/vicarage/curate's house	601119	714532	10	3975
14810004	Charlotte's Way B & B	Kylebeg Or Banagher	house	601279	714853	10	3826
14810005	Saint Rynagh's Roman Catholic Church	Curraghavarna And Portavolla	church/chapel	601245	715095	10	3886
14810006	Saint Rynagh's Parochial House	Curraghavarna And Portavolla	presbytery/parochial/curate's house	601288	715073	10	3840
14810007	N/A	Kylebeg Or Banagher	monument	601167	715069	10	3959
14810008	La Sainte Union Chapel	Kylebeg Or Banagher	church/chapel	601035	715247	10	4116
14810009	La Sainte Union Boarding and Day School	Kylebeg Or Banagher	convent/nunnery	601016	715269	10	4139
14810010	Bank of Ireland	Kylebeg Or Banagher	bank/financial institution	600985	715299	10	4174
14810011	N/A	Kylebeg Or Banagher	house	600950	715322	10	4213
14810012	Clonamona Cottage	Curraghavarna And Portavolla	house	600968	715376	10	4205
14810013	Wrapped Up	Kylebeg Or Banagher	house	600917	715411	10	4262
14810014	S. Lyons	Curraghavarna And Portavolla	house	600922	715443	10	4264
14810015	Hunt	Kylebeg Or Banagher	house	600856	715475	10	4335

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14810016	Flynn	Kylebeg Or Banagher	house	600846	715488	10	4348
14810017	J.J. Houghs	Curraghavarna And Portavolla	house	600838	715548	10	4369
14810018	N/A	Curraghavarna And Portavolla	house	600819	715571	10	4392
14810019	J.J. Nallen	Kylebeg Or Banagher	house	600823	715518	10	4377
14810020	Crank House Visitor Centre	Kylebeg Or Banagher	house	600775	715595	10	4441
14810021	N/A	Curraghavarna And Portavolla	post box	600804	715587	10	4411
14810022	Crank Malt House	Kylebeg Or Banagher	granary	600707	715510	10	4488
14810023	N/A	Kylebeg Or Banagher	house	600732	715633	10	4491
14810024	Quigley	Kylebeg Or Banagher	house	600722	715663	10	4508
14810025	The Railway Bar	Kylebeg Or Banagher	house	600701	715683	10	4534
14810026	The Royal Shannon	Curraghavarna And Portavolla	house	600704	715719	10	4540
14810027	The Royal Shannon	Curraghavarna And Portavolla	outbuilding	600696	715729	10	4550
14810029	N/A	Kylebeg Or Banagher	house	600658	715702	10	4580
14810028	K.P. Egan	Kylebeg Or Banagher	house	600672	715698	10	4565
14810030	Banagher Billiard Hall	Curraghavarna And Portavolla	building misc	600685	715731	10	4561

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14810031	Bridge Malt house	Kylebeg Or Banagher	malt house	600473	715769	10	4776
14930010	Milltown House	Milltown (Ga. By.)	house	603139	712106	11	2868
14930001	Whigsborough House	Whigsborough	country house	610082	711941	14	2120
14930002	Whigsborough Tower	Whigsborough	folly	610066	711962	14	2098
14930003	Saint James's Roman Catholic Church	Ballycollin Lower	church/chapel	610381	710660	14	3422
14930009	Eglish Cottage	Eglish	house	610073	710449	14	3610
14930008	Eglish Lodge	Eglish	house	610376	710378	14	3701
14923003	N/A	Broughal	house	613992	715905	15	3529
14923004		Broughal	house	613980	715849	15	3495
14930007	Tinnacross House	Tinnacross	house	612294	709670	15	4943
14931004	Ballynacard House	Ballynacard	country house	613563	713106	15	3038
14811001	N/A	Magherabane (Ga. By.)	house	607874	719365	21	2958
14811002	N/A	Cloghan (Ga. By.)	house	607802	719362	21	3003
14811003	N/A	Creggan And Glosterboy	house	607849	719399	21	3001
14811004	N/A	Cloghan (Ga. By.)	house	607794	719423	21	3054
14811005	Saint Mary's Roman Catholic Church	Cloghan (Ga. By.)	church/chapel	607825	719273	21	2920
14811006	Saint Mary's Parochial Hall	Creggan And Glosterboy		607914	719492	21	3033

NIAH Ref	NAME	TD.	STRUCTURE	ITM E	ITM N	WTG ID	DISTANCE (M)
14811007	N/A	Creggan And Glosterboy	vent pipe	607946	719553	21	3062
14811008	N/A	Cloghan (Ga. By.)	weighbridge/weighhouse	607767	719376	21	3036
14811009	N/A	Galros	house	606749	719685	21	3978
14922012	Strawberry Hill House	Drishoge Or Strawberryhill	country house	607466	720954	21	4497
14922013	Strawberry Hill House	Drishoge Or Strawberryhill	farmyard complex	607605	721059	21	4520
14923001	Millbrook Bridge	Lumcloon	bridge	613491	718823	21	4114

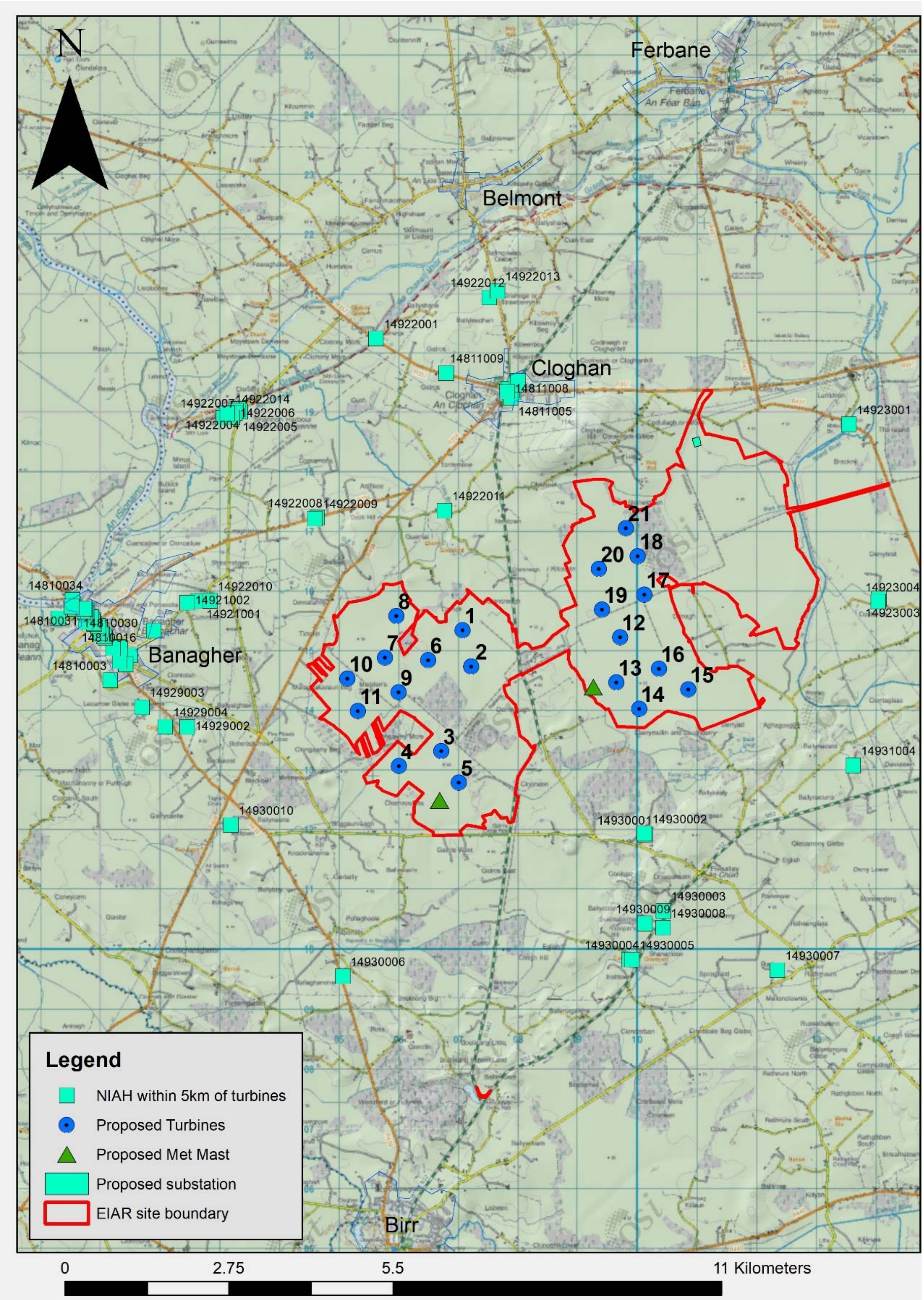

Figure 13.22: NIAH structures within 5km of the nearest proposed turbine.

13.3.3 Cultural Heritage

No new sites of cultural heritage significance either of regional or national importance were recorded during the walkover survey.

A memorial plaque was recorded along the proposed internal road which extends from T21 as far as the substation. It is proposed that this road will be used as an amenity pathway. The memorial is described in full in Appendix 13.1 (Description and Photographic Record of the Proposed Development Site). The memorial plaque is located within Drinagh bog in memory of a former employee of Bord na Móna Joseph Flanagan. He died in a tragic accident in Drinagh bog in 1956. The memorial is considered of local cultural heritage significance and the area should be preserved in situ. Protective measures are prescribed in Section 13.4 for the construction stage to prevent accidental loss or damage to the monument given its proximity to the proposed internal road. Overall, it is considered that the ultimate use of this road (post-construction) as part of the amenity trail may serve to highlight the memorial and allow formal access to same thus having a positive impact on the cultural heritage.

Plate 13.14: Memorial to Joseph Flanagan.

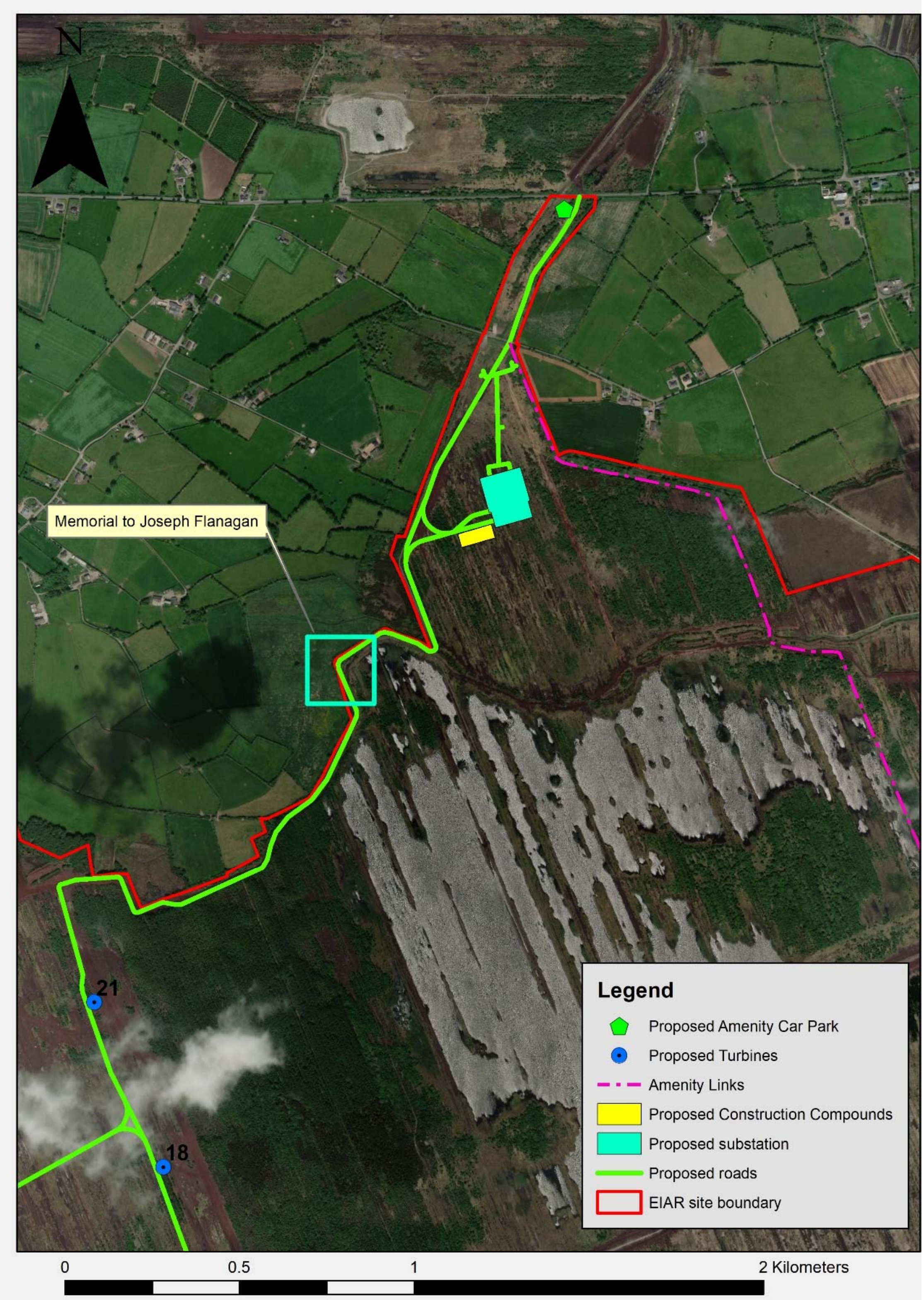

Figure 13.23: Location of Memorial plaque within Drinagh bog.

13.4 Likely Significant Effects and Associated Mitigation Measures

13.4.1 Do Nothing Scenario

The do-nothing scenario seeks to describe the consequences that are reasonably likely to occur without the proposed project.

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. This land-use will also continue if the proposed development does proceed.

Works within the bog could result in potential direct impacts to any sub-surface archaeological features that are present. Indirect effects to Cultural Heritage, in particular, in the wider landscape setting would not occur.

13.4.2 Construction Phase Potential Impacts – Indirect

Indirect effects, in terms of archaeology, architectural and cultural heritage are considered to be those effects which happen away from 'the site'. This includes impacts on visual setting of any cultural heritage asset in the wider landscape. Since these effects are only possible once the proposed turbines are constructed, they are considered operational effects and are therefore discussed in Section 13.4.4 below. No indirect effects were identified which would occur at the construction stage.

13.4.3 Construction Phase Potential Impacts (Direct)

Direct impact refers to a 'physical impact' on a monument or site. The construction phase of the development consists largely of earthmoving activities such as peat and topsoil removal. The potential impacts on the known and potential archaeological, architectural and cultural heritage of the area are outlined below with the suggested mitigation measures. The impacts are described according to each element of the Proposed Development, turbines, grid connection, delivery routes etc. Where any potential direct impacts do occur they are negated through the use of suitable mitigation measures such as exclusions zones (buffer zones), testing, monitoring, etc.

13.4.3.1 Turbines Bases, Hardstands and Met Masts (Direct Effects)

13.4.3.1.1 *Impact of proposed turbines on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship are located within the proposed development site boundary therefore no direct impacts on these aspects of the archaeological resource are identified.

Although a number of recorded monuments are located within the proposed development site boundary, they have been mitigated by avoidance. No recorded monuments are located within the footprint of any proposed turbine bases, hardstands or met masts and therefore no construction effects will occur in this regard.

Documented built heritage was assessed and included structures listed on the RPS and NIAH. No Protected Structures or NIAH structures are located within the footprint of any proposed turbine bases, hardstands or met masts therefore no direct impacts on these aspects of the architectural and cultural heritage resource will occur.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the construction of the turbine bases, hardstands and met masts.

Proposed Mitigation Measures

No mitigation measures are required

Residual Impact

No residual Impacts will occur.

Significance of Impacts

The construction of the turbine bases, hardstands and met masts will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.1.2 *Impact of proposed turbine bases, hardstands and met masts on unrecorded potential sub-surface sites*

The presence of the recorded monuments within the bog (to the south-east within the Drinagh bog and southwest within the Clongawny bog), regardless of their survival, is an indication that the bog is an area of high archaeological potential. The stray finds within the bog (documented in the Topographical Files of the National Museum of Ireland) is also an indication of high archaeological potential for material culture. Peat depth data was examined and varies somewhat through the site. The southern side of Clongawny Bog, has peat depths measuring 2.5 – 3.5m in particular in the area of T5 and T3. The northern side of this site has peat depths of up to 2m with many areas measuring 0.5m in depth. The Drinagh Bog to the east has shallower peats depths with the majority of the proposed roads in areas of 0.5-1m peat depths. Some areas are reduced to natural (light grey clay) evident from the walkover survey.

The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the turbine bases and hardstands may impact on any new sites, if present. Mitigation measures will include pre-development archaeological testing and construction stage monitoring.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring (under licence from the National Monuments Service) of any further geotechnical / engineering trial pits or investigations and a report detailing the results of same.

- Pre-development Licensed testing in areas where peat depths allow a meaningful investigation. Testing should only be undertaken in areas where ground disturbance will take place as part of the development. Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken.
- Archaeological monitoring of ground works during construction. The National Monuments Service will be informed of such findings to discuss how best to proceed. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance).Once the project is completed, a report on the results of the monitoring will be compiled and submitted to the relevant authorities.

Residual Impact

The sites/features, if detected, during testing and/or monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed turbine bases, hardstands and met masts will have no significant effects on unrecorded potential sub-surface sites. The impacts, after the implementation of mitigation, is likely to be slight.

13.4.3.2 Proposed New Roads, internal cable route, passing bays and site entrances (direct effects)

13.4.3.2.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the proposed development site boundary therefore no direct impacts on the known documented cultural heritage resource will occur.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the proposed new roads, internal cable route, passing bay or site entrances.

Proposed Mitigation Measures

No mitigation measures are required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed new roads, internal cable route, passing bay or site entrances will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.2.2 *Impact on Local Cultural Heritage*

A memorial plaque is located along the proposed road within Drinagh bog which extends from T21 as far as the proposed substation. This is within close proximity to the proposed road construction and therefore may be accidentally damaged by excavators causing a direct negative effect to the local cultural heritage. The memorial should be fenced off prior to construction by the appointed contractor under the direction of the appointed archaeologist.

Pre Mitigation Impact

A potential direct effect to the known cultural heritage resource as a result of the proposed new roads has been identified in Section 13.3.3. The potential direct effect is likely to be slight.

Proposed Mitigation Measures

The memorial will be fenced off prior to construction works in this location. Fencing will be maintained for the duration of the construction works.

Residual Impact

Following the implementation of the mitigation measures the residual impact will be imperceptible.

Significance of Impacts

The construction of the proposed new roads will have no significant effects on local cultural heritage and the overall impact (after mitigation) will be imperceptible.

13.4.3.2.3 *Impact on unrecorded potential sub-surface sites*

The potential effects as a result of proposed roads is the same as those resulting from turbine bases, hardstands etc (See Section 13.4.3.1.2 above). The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil (See mitigation measures below). The excavation of topsoil /peat for new road, passing bays, entrances and internal cable route may impact on any new sites, if present. There will be a combination of both excavate and replace and floating roads used throughout the site depending on local ground conditions.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of any further geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Pre-development testing (licensed by the National Monuments Service - NMS) in areas where peat depths allow a meaningful investigation. Testing should only be undertaken in areas where ground disturbance will take place as part of the development. For example, if roads are proposed to be floated, testing would not be required. Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken.
- Licensed archaeological monitoring of the proposed roads, internal cable, passing bays and entrances during construction. . If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed new roads, internal cable route, passing bay or site entrances will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation) will be slight.

13.4.3.3 Electricity Substation

The electricity substation area measures 145 N/S by 121m E/W and is located in the north-eastern corner of the proposed development site.

13.4.3.3.1 *Impact of Substation on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the footprint of the proposed substation site therefore no direct impacts on the known documented aspects of the cultural heritage resource will occur.

Pre-Mitigation Impact

The proposed substation works will have no direct effects on the known cultural heritage resource.

Proposed Mitigation Measures

There is no mitigation required.

Residual Impact

No residual Impacts will occur.

Significance of Impacts

The construction of the proposed substation will have no significant effects on national monuments, recorded monuments or built heritage.

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13.4.3.3.2 *Impact of Substation on unrecorded potential sub-surface sites*

Similar to any other aspect of the proposed development which involves ground disturbance and peat removal, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed substation site may impact on any new sites, if present (see mitigation below).

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of any further geotechnical / engineering trial pits or investigations in the area of the proposed substation and a report detailing the results of same.
- Pre-development licensed testing of the area of the substation (where peat depths allow a meaningful investigation). Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken.
- Licensed archaeological monitoring of the proposed substation ground works during construction. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during testing and/or monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed substation will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation) will be slight.

Proposed Compounds

Five temporary construction compounds are proposed within the site of the proposed development. Two are located within the western Clongawny bog and three in the Drinagh bog. All are located in areas where peat depths do not measure more than 2 metres with some areas measuring between 0.5 and 1m.

13.4.3.3.3 *Impact of Compounds on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the footprint of the proposed compounds therefore no direct impacts on these aspects of the cultural heritage resource will occur.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the proposed compounds.

Proposed Mitigation Measures

Mitigation measures are not required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed compounds will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.3.4 *Impact of Compounds on unrecorded potential sub-surface sites*

Similar to any other aspect of the proposed development which involves ground disturbance and peat removal, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed compounds may impact on any new sites, if present. Archaeological monitoring of Engineering Site Investigations was undertaken in 2019 under licence by Tobar Archaeological Services. The results of the monitoring are detailed in Appendix 13.2.

Pieces of wood were noted within three trial pits excavated at what were then named Compound 2, 3 and 6, respectively. Compound 2 and 3 (now proposed security hut) were located in Clongawny Bog, while Compound 6 (now Construction Compound 4) was located in Drinagh Bog (the proposed compound in Drinagh has now been moved further to the east).

Compound 3 (now proposed security hut in Clongawny) is dealt with below in Section 13.4.3.7.2.

At Compound 2 (TPCC2, now proposed Construction Compound 2) two east-west running pieces of wood were identified at a depth of 0.38m below the present ground level. A definitive archaeological structure was not identified here, and no other potentially associated wood or structure were identified within the limits of the trial pit.

At Compound 6 (TPCC4, now Construction Compound 4) four horizontal pieces of wood were observed within the trial pit at a depth of 0.65m. Two of the longer pieces were exposed for a distance of 2.4m and 1.2m (NE/SW) and had widths of 0.31m and 0.25m respectively and were 0.80m apart. Between the aforementioned pieces of wood two shorter pieces of wood were noted and measured 0.5m and 0.7m in length NW/SE. While it was not possible to discern a definitive archaeological structure from the wood observed within the limits of the trial pit, it is possible that they have some archaeological potential. The timbers were preserved in situ. The proposed compound and adjacent site road are now located c. 60m to the east of where the trial pit containing the wood was excavated. No direct impact to the wood is therefore anticipated. It does, however, highlight the potential for uncovering potential sub-surface archaeological sites and features during the construction stage of the wind farm development should it proceed.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of any further geotechnical / engineering trial pits or investigations in the area of the proposed compounds and a report detailing the results of same.
- Pre-development Licensed archaeological testing of the area of the compounds (in particular Compound 2 in Clongawny) (where peat depths allow a meaningful investigation). Investigation of any potential features is to be undertaken prior to construction. Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken.
- Licensed archaeological monitoring of the proposed compounds ground works during construction. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during testing and/or monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed compounds will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation) is slight.

13.4.3.4 Grid Connection

The grid connection route is located within the proposed development boundary in the north-eastern corner of Drinagh bog. The proposed substation will be connected to the national grid via either an underground grid connection cable or overhead cable which will connect into the existing 110kV transmission line located approximately 300m north of the substation.

13.4.3.4.1 *Impact of grid connection on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No known documented constraints such as National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the footprint of the proposed grid connection. No direct impacts on these aspects of the cultural heritage resource will occur therefore.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the construction of the proposed grid connection route.

Proposed Mitigation Measures

There will be no mitigation required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the grid connection will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.4.2 *Impact of grid connection on unrecorded potential sub-surface sites*

Similar to any other aspect of the proposed development which involves ground disturbance and peat removal, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed grid connection may impact on any new sites, if present (see mitigation measures below).

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of any further geotechnical / engineering trial pits or investigations in the area of the proposed grid connection route and a report detailing the results of same.
- Licensed archaeological monitoring of ground works associated with the grid connection during construction. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed grid connection will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation measures) will be slight.

13.4.3.5 Proposed Junction Bypass at Kennedy's Cross

A new section of road (bypass) will be required at Kennedy's Cross to allow the turbine delivery vehicles to negotiate this junction. The new road is proposed to be located in a greenfield location north east of the existing at the junction.

13.4.3.5.1 *Impact of Junction by-pass on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Two Recorded Monuments are located 150m to the west on the west side of the public road and in a forested area. The monuments consist of a Castle OF035-002002 and a deserted Medieval settlement OF035-002001 (Unlocated). No direct impacts on the monuments will occur given their distance from the proposed works.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource described above as a result of the construction of the proposed junction bypass works.

Proposed Mitigation Measures

There are no mitigation measures required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed new junction bypass will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.5.2 Impact of junction by-pass on unrecorded potential sub-surface sites

Similar to any other aspect of the proposed development which involves ground disturbance and peat removal, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil (see mitigation measures below). Groundworks associated with the road may impact on as yet unidentified sub-surface archaeological finds, features or deposits (if present within the road take). For example, fulachta fia are often located near to water sources such as rivers and streams. Archaeological monitoring should take place at the construction stage of the development however to alleviate any impacts.

Pre Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of any further geotechnical / engineering trial pits or investigations in the area of the proposed new road and a report detailing the results of same.
- Licensed archaeological monitoring of ground works associated with the excavation for the construction of the road. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed new junction bypass will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation) will be slight.

13.4.3.6 Amenity links and Amenity Car Park

An amenity carpark is proposed to be located just to the west of the Drinagh North construction access road. A total of approximately 18 km of amenity pathways (including walkways and cycleways) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. Where this is the case, roads will either be floated or excavated depending on local conditions and peat depths. In general roads located on peat in excess of 1m will be floated and those less than 1m will be excavated. The pathways will have a gravel/crushed stone finish surface.

In addition, approximately 6.5 km (TBC) of dedicated amenity pathways are proposed to provide access points/links into and out of the site. These will be constructed using a geotextile and stone (i.e. floated) and therefore no excavation is required. These dedicated paths will measure 3m in width.

13.4.3.6.1 Impact of amenity facilities on National Monuments, Recorded Monuments, Protected Structures, NIAH

One section of dedicated amenity pathway is proposed to be located in the south-east corner of the Drinagh bog which joins the public road to the east. A large cluster of recorded monuments is located to the south of the amenity trail. The nearest monuments are redundant records however. Since the dedicated pathways will be floated on the peat, no impacts to the known archaeological resource are likely to occur.

Pre Mitigation Impact

There will be no direct effects to the known documented cultural heritage resource as a result of the proposed amenity pathways and carpark. .

Proposed Mitigation Measures

Mitigation measures are not required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed amenity pathways and carpark will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.6.2 Impact of amenity paths on unrecorded potential sub-surface sites

It is proposed to float all dedicated amenity pathways (amenity links) using geotextile and stone thus avoiding the requirement for excavation. If sub-surface features such as toghers are present just below the surface, machinery may negatively impact on such sites, if present. Furthermore, some areas along the proposed amenity trails may require levelling in order to lay the geotextile and stone. Such groundworks may impact on sub-surface sites if present in these locations (especially if close to the surface). An archaeologist will be present during the placement of the geotextile and stone during construction as well as any required excavation and/or levelling of the ground.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Licensed archaeological monitoring of the construction of the amenity paths should take place. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed amenity pathways and carpark will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation measures) will be slight.

13.4.3.7 Security Huts

Two temporary security cabins will be installed within the site for the duration of the construction phase of the proposed development. The security cabins will be located close to the eastern and western construction site entrances off the N62 National Route.

13.4.3.7.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the proposed development site boundary therefore no direct impacts on the known documented cultural heritage resource will occur.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the proposed security huts.

Proposed Mitigation Measures

No mitigation measures are required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed new security huts will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.7.2 *Impact of security huts on unrecorded potential sub-surface sites*

The walkover survey carried out between 28th November 2019 and the 12th January 2020 did not result in the discovery of any new sites such as toghers either within drain sections or indeed on the surface of the peat in the area of the security huts. Overgrowth in some areas limits the chances of recording such features, however, if present. These limitations are dealt with by way of mitigation measures. Archaeological monitoring of Site investigations took place in the vicinity of the security hut (TPCSH1, previously named Compound 3) as part of the engineering site investigation phase. The method statement agreed with the National Monuments Service was that any potential features would be recorded and that the features would remain in situ. A loose piece of wood was noted at the base of the trench in the trial pit associated with Security Hut 1 and this is detailed in the Archaeological Monitoring Report (Appendix 13.2). The wood did not extend beyond the extent of the trial pit however and no tool marks were apparent.

In this regard, archaeological monitoring should take place at the construction stage of the development however to alleviate any such impacts. If sub-surface features such as toghers are present machinery may negatively impact on such sites, if present.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of the construction of the security huts should take place. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the NMS will be informed of such findings and a method statement for the resolution of the archaeology will be provided. The developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance). A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed security huts will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation measures) will be slight.

13.4.3.8 Underpasses

Two new permanent underpasses are proposed as part of the proposed development. The first underpass will traverse beneath the N62, immediately north of Derrinlough Briquette Factory. This underpass will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used during the operational phase for wind farm maintenance. A second underpass is proposed in Clongawny bog beneath an existing Bord na Móna railway line. This underpass will also be used for amenity purposes and for wind farm maintenance during the operational phase

13.4.3.8.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the proposed development site boundary therefore no direct impacts on the known documented cultural heritage resource will occur.

Pre-Mitigation Impact

There will be no direct effects to the known cultural heritage resource as a result of the proposed new underpasses.

Proposed Mitigation Measures

No mitigation measures are required.

Residual Impact

No residual Impacts.

Significance of Impacts

The construction of the proposed new underpasses will have no significant effects on national monuments, recorded monuments or built heritage.

13.4.3.8.2 *Impact on unrecorded potential sub-surface sites*

The walkover survey carried out between 28th November 2019 and the 12th January 2020 did not result in the discovery of any new sites such as toghers either within drain sections or indeed on the surface of the peat in the area of the proposed underpasses. Overgrowth in some areas limits the chances of recording such features, however, if present. In this regard, archaeological monitoring should take place at the construction stage of the development however to alleviate any such impacts. If sub-surface features such as toghers are present machinery may negatively impact on such sites, if present.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of the construction of peat removal associated with the underpasses should take place. A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance).

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Impacts

The construction of the proposed new underpasses will have no significant effects on unrecorded potential sub-surface sites and the overall impact (after mitigation measures) will be slight.

13.4.4 Operational Phase Potential Impacts (Direct)

In terms of archaeology, architecture and cultural heritage, since peat removal and groundworks would be complete, it is considered that no direct effects would occur at the operational stage.

13.4.5 Operational Phase Potential Impacts (Indirect)

Indirect impacts are where a feature or site of archaeological, architectural heritage merit or their setting is located in close proximity to a proposed development. Indirect impacts here are mainly concerned with impacts on setting. Impacts on settings of sites may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments or any cultural heritage asset. While the proposed development may not physically impact on a site, it may alter the setting of a monument or group of monuments. There is no standardised Irish industry-wide approach in for assessing the degree of impact to the setting of a monument. The assessment is based on previous experience, Geographical Information Systems (in particular Viewshed Analysis) and the '*Guidance on Setting and the Historical Environment*' (Historic Environment Division Northern Ireland) was utilised. The methodology through which indirect impact is assessed is presented in Section 13.2.5 above. According to the aforementioned document '*A range of tools may be employed in defining and assessing changes to setting, for example historic landscape analysis using Geographical Information Systems (GIS), which may include viewshed analysis*'.

Potential impact to the visual amenity of a site or area and the significance of same is dependent on a number of factors regarding the sensitivity of the location or 'receptor' and the scale or magnitude of the proposed development.

Potential operational impacts are discussed below according to each element of the proposed development. Those elements of the proposed development which are not capable of impacting on the visual setting of monuments (such as proposed roads, amenity trails, underground cables etc.) are scoped out of this section of the EIAR. Those elements which are deemed to be more likely to impact on visual setting such as turbines and substation buildings are discussed below.

13.4.5.1 Turbines

13.4.5.1.1 *Impact of proposed turbines on setting of Clonmacnoise (World Heritage – tentative list)*

Clonmacnoise is situated c. 15km to the north-west of the proposed development site (**Error! Reference source not found.** above). Given the intervening distance, the immediate visual setting of these archaeological sites will not be impacted by the proposed development. The ZTV (Figure 11.1 of the Landscape and Visual Impact Assessment section of the EIAR) shows that Clonmacnoise has limited to no visibility in the direction of the turbines within the proposed development. A viewshed analysis was also undertaken in ArcGIS from the south side of Clonmacnoise graveyard enclosure in the direction of the proposed development up to a 20km radius from the monument (i.e. visual assessment study zone). The results show there are potentially no instances where any component of the proposed turbines would be visible from the monument.

Pre-Mitigation Impact

There will be no indirect effect on the visual setting of Clonmacnoise as a result of the proposed turbines.

Proposed Mitigation Measures

Mitigation measures are not required since no negative effects were identified.

Residual Impact

No residual impacts will arise since no impacts were identified.

Significance of Impacts

The operation of the proposed turbines will have no significant effect on the setting of Clonmacnoise.

13.4.5.1.2 *Impact of proposed turbines on setting of National Monuments in State Care*

A review of all National Monuments in State Care was undertaken as part of the assessment in order to ascertain any potential impacts on their setting as a result of the proposed development. No National Monuments are located within the proposed development site boundary. These are detailed in

Table 13.2 above.

National Monument Preservation Order 49 (OF015-017, Coole Castle)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. Figure 13.4 shows that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m). It shows that potentially, 15 of the 21 turbines could be seen from mid shaft upwards (red areas) and it shows that the upper portion of all of the turbines (blue areas) could potentially be seen from the monument. This impact will be slight (an effect which causes changes in the character of the environment which are not high or very high and do not directly impact or affect an archaeological site).

National Monument Preservation Order 86 (OF022-008001, Clonony Castle)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. The results as shown on Figure 13.5 show that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m). The results also show that potentially, 12 of the 21 turbines could be seen from mid shaft upwards (red areas) and it shows that the upper portion of 20 of the 21 turbines (blue areas) could potentially be seen from the monument. One turbine (T14) has no visibility from the monument. This impact will be slight.

National Monument Preservation Order Jun-56 (OF023-010, Ringfort)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. The results on Figure 13.6 show that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level). The results show that potentially, 11 of the 21 turbines could be seen from mid shaft upwards (red areas) and that all of the upper portions of the turbines (blue areas) could potentially be seen from the monument. The impacts on this monument are likely to be slight.

National Monument State Care No 504 (OF014-029001, Gallen Abbey)

Viewshed analysis results are a worst case scenario since the model does not take natural screening such as vegetation, boundaries or buildings into consideration. The results on (Figure 13.7) show that there are no instances (green areas) where the full length of the turbines would be visible (i.e. from ground level (0m)). There are also no instances where the turbines would be visible from mid shaft (red areas). The results show that potentially, the upper portion of 10 of the 21 turbines may be seen from the monument. The remaining turbines at the western portion of the site have no visibility from the monument.

This impact is likely to be 'Not Significant' (An effect which causes noticeable changes in the character of the environment but without significant consequences).

Pre-Mitigation Impacts

Pre-mitigation indirect impacts on National Monuments in State Care vary from Slight to Not Significant (see above). In cases where there may be some noticeable changes in the wider landscape setting of some of the monuments, the impacts are considered to be 'Not Significant'. Some impacts are considered to be slight as the proposed turbines in the wider landscape setting may cause changes in the character of the environment (not deemed to be high or very high and do not directly impact or affect an archaeological site).

Proposed Mitigation Measures

As it is not possible to mitigate the indirect effects of the turbines in the wider landscape setting there are no mitigation measures for this potential impact.

Residual Impact

The residual impacts are considered to range from 'Not Significant' to 'slight' (see above).

Significance of Impacts

The operation of the proposed turbines will have no significant effect on the setting of National Monuments in State Care. Overall impacts after mitigation are considered to range from 'slight' to 'not significant'.

13.4.5.1.3 *Impact of proposed turbines on setting of Recorded Monuments within the proposed development site boundary*

Twenty-eight RMPs are located within the proposed development site boundary, 14 of which are now redundant records. The site inspection of the monuments did not reveal any visible trace of the monuments since their original and re-assessment survey. The reduction of the peat fields due to milling and the peat production process is such that any monuments recorded on the surface or near to the surface in the original 1997 assessment survey would not have survived. The below ground nature of the monuments is such that impacts on visual setting is not anticipated as the monuments themselves do not have any visible extent in the landscape.

Pre Mitigation Impact

Sub-surface sites which do not have any visible surface trace are not capable of having their setting impacted and therefore no impacts will occur in this regard.

Proposed Mitigation Measures

Since no indirect impacts will occur, no mitigation is necessary.

Residual Impact

Since no indirect impacts were identified and no mitigation was required, no residual impacts will occur.

Significance of Impacts

The operation of the proposed turbines will have no significant effect on Recorded Monuments within the proposed development site boundary.

13.4.5.1.4 *Impact of proposed turbines on Recorded Monuments within 5km*

Seven monuments are located within 1km of the nearest proposed turbines. Thirty-seven monuments are located between 1 and 2km of the nearest proposed turbine. Seven monuments are located between 2 and 3km with 29 monuments located between 3 and 4km. Thirty-six monuments (36) are located between 4 and 5km. The immediate setting of the recorded monuments within 5km will not be negatively impacted although it is likely that there will be some visibility in the direction of the proposed turbines given the flat topography of the surrounding landscape. The Zone of Theoretical Visibility (ZTV) shows that potentially all turbines (half-blade) may be visible from areas within the 5km zone (Figure 11.1, LVIA chapter 11). It is not possible to ascertain exactly what may be seen from various monuments within 5km as the majority are inaccessible to the public being located on private land. The potential to view turbines from various monuments depends on season (full vegetative growth in summer), buildings, forestry etc. The ZTV does not take natural screening, buildings or boundaries into consideration and therefore is a worst case scenario. Potential impacts on RMPs within 5km is likely to vary from slight to moderate.

Pre Mitigation Impacts

Potential impact on visual setting of the RMPs within 5km of the proposed development is considered to be slight to moderate.

Proposed Mitigation Measures

As it is not possible to mitigate the indirect effects of the turbines on monuments within 5km there are no mitigation measures for this potential impact.

Residual Impacts

Since mitigation measures are not possible, the residual impact will remain the same as the pre-mitigation impacts which are Slight to Moderate.

Significance of Impacts

The operation of the proposed turbines will have no significant effect on Recorded Monuments within 5 km of the proposed development. The effects are considered to be slight to moderate.

13.4.5.1.5 *Impact of proposed turbines on setting of NIAH/RPS structures within 5km of the nearest proposed turbine*

The majority of structures within the Record of Protected Structures (RPS) and the NIAH are located within the 'urban' settings of Banagher and Cloghan and therefore their visual settings do not extend beyond the limits of those settlements. The ZTV shows that there will be limited to no visibility in the direction of the turbines from within Cloghan or Banagher. The majority of other outlying structures in the landscape may have some visibility in the direction of the proposed turbines as the ZTV suggests. While no direct effects will take place and no curtilages or attendant ground will be affected, some indirect effects on visual setting are likely in the wider setting. The significance of effects is likely to be slight to moderate.

Pre Mitigation Impact

Slight to Moderate effects in the wider landscape setting may occur since some turbines may be visible from some locations. Factors such as distance, screening, buildings, boundaries in the landscape may vary from summer to winter and the impact may vary accordingly.

Proposed Mitigation Measures

As it is not possible to mitigate the indirect effects of turbines on NIAH/RPS structures within 5 km there are no mitigation measures for this potential impact.

Residual Impact

Since no mitigation measures can be implemented, the residual impact will remain the same as the per-mitigation impact which is Slight to Moderate.

Significance of Impacts

The operation of the proposed turbines will have no significant effect on NIAH/RPS structures within 5 km of the proposed development.

13.4.5.2 Electricity Substation and Grid Connection (over-ground)

13.4.5.2.1 *Impacts on setting of National Monuments, Recorded monuments.*

The electricity substation area and proposed overhead grid connection are located in the north-eastern corner of the proposed development site boundary within Drinagh bog. The substation is relatively small in scale (145 N/S by 121m E/W) from a wider landscape perspective and is likely to have localised effects rather than effects on the wider cultural heritage landscape setting. The nearest monument consists of a Holy Well (OF022-017, MAP ID 112) c. 1.1km from Turbine 21. It is situated on flat well drained land with bog on all sides. Circular well (D. 3.5m deep; Diam. 1.5m) with dry-stone lined shaft, water filled at time of visit. Holy well appears to have been filled in or covered over in recent times. Well shaft no longer visible above ground (pers. comm. Offaly Heritage Officer 17/08/2015). Since no above ground extent of this monument survives, no impacts on setting are likely. Similarly, the grid connection may consist of timber polesets and steel anglemasts and in this regard potential effects on setting are likely to be localised rather than extending to the wider landscape setting.

A second monument, some 1.6km to the west consists of an enclosure (OF022-016). It is not visible at ground level and was levelled in the 1960's during land improvement schemes.

Since none of the monuments in the immediate setting of the substation and overhead grid connection have any visible surface trace, no impacts on setting will occur.

Pre Mitigation Impact

No Impacts will occur since the nearest recorded monuments do not have any visible surface trace.

Proposed Mitigation Measures

No mitigation measures are required since no impacts were identified.

Residual Impact

Since no mitigation measures are required, residual impacts will not occur.

Significance of Impacts

The operation of the proposed substation and overhead grid connection will have no significant effect on the setting of National Monuments or Recorded Monuments.

13.4.5.2.2 Impacts on setting of NIAH/RPS

A cluster of protected structures and NIAH structures are located within Cloghan village some 3km to the north-west of the proposed substation building. Since the visual setting of those structures does not extend beyond the village limits no impacts on those assets are anticipated. A bridge (NIAH Ref 14923001 consisting of a single-arch masonry road bridge, built c.1800, carrying the Cloghan to Kilcormac road over the River Silver is situated 2.4km to the east of the proposed substation. Single-span in form, the bridge's stone elevations enhance the local landscape, bringing character to the rural setting. Impacts on setting of the bridge are not anticipated given its low landscape profile and distance from the proposed substation.

Pre-Mitigation Impact

No Impacts on the architectural resource in the immediate setting of the proposed substation and overhead grid connection will occur.

Proposed Mitigation Measures

No impacts were identified therefore no mitigation measures are required.

Residual Impact

Since no pre-mitigation impacts were identified and therefore no required mitigation measures, residual impacts will not occur.

Significance of Impacts

The operation of the proposed substation and overhead grid connection will have no significant effect on the setting of NIAH/RPS structures.

13.5 Cumulative Impacts

Cumulative impact is defined as ‘The addition of many small impacts to create one larger, more significant, impact’ (EPA 2017). Cumulative impacts encompass the combined effects of multiple developments or activities on a range of receptors. In this case, the receptors are the archaeological monuments and architectural/cultural heritage sites in the immediate vicinity of the Proposed development. Cumulative Impacts at the Construction and Operational Stages are considered.

13.5.1 Cumulative Impacts (Direct Impacts – Construction stage)

The addition of other projects to the proposed development project was considered in order to assess Cumulative Impacts. These included all other windfarms within 20km of the proposed development. Cumulative impacts are also considered in terms of the extraction of stone from nearby quarries since no borrow pits are being proposed as part of the proposed development.

13.5.1.1 Cumulative impacts (direct) considering other windfarms within 20km

The majority of projects (including existing, permitted and proposed developments) are located adjacent or within close proximity to the proposed Derrinlough windfarm, with the exception of the Skehanagh and Carrig turbines c. 15km to the southwest.

13.5.1.1.1 *Cumulative impacts to Recorded Monuments, National Monuments, NIAH or RPS*

There are no National Monuments, Recorded Monuments or any architectural heritage structures (such as RPS or NIAH) located within the footprint of the proposed development or within the footprint of other projects (including Proposed, Permitted or Existing developments within 20km). In this regard no cumulative direct impacts to the known documented cultural heritage sites will not occur.

13.5.1.1.2 *Cumulative impact to potential unknown sub-surface sites*

Direct effects to sub-surface archaeological features/sites can occur as a result of peat removal and groundworks. The proposed development in combination with other developments, could result in potential increased negative effects to sub-surface archaeological features ((i.e. cumulative impacts). Since all projects have been assessed from a cultural heritage perspective through the EIAR process, all potential negative effects are deemed to have been dealt with through the use of effective mitigation measures and planning conditions issued through the Planning Authorities.

If the mitigation measures prescribed in this EIAR are implemented then cumulative direct effects to unknown sub-surface archaeology will not occur, regardless of the other projects within 20km of the proposed development. For example, archaeological testing and monitoring at the construction stage of the nearby Meenwaun windfarm to the west of the Clongawny bog resulted in the discovery of early Bronze Age activity and a Neolithic stone axe. This material was preserved by record thus avoiding negative impacts. This demonstrates the effectiveness of suitable mitigation measures which if implemented should ameliorate cumulative direct impacts. Furthermore, archaeological monitoring of site investigations associated with the permitted Cloghan windfarm (within Derrinlough townland) did not reveal any archaeological features (See **2018:543** above) (See Section 13.3.1.7 above).

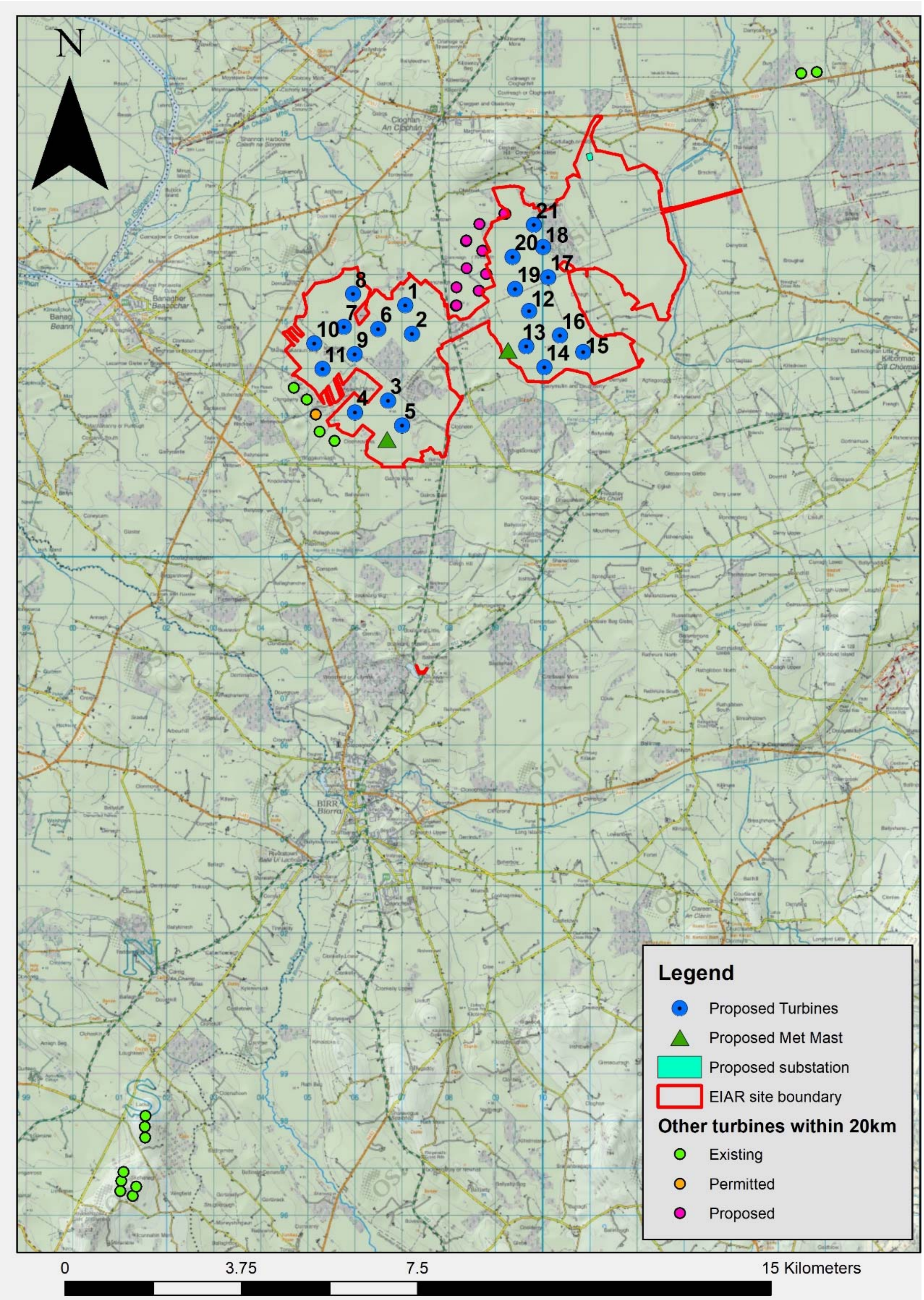

Figure 13.24: Other projects (wind farms) within 20km of the proposed development to assist in assessing cumulative impacts.

13.5.1.2 Cumulative direct impacts of Quarries to be utilised to provide stone for the Derrinlough Windfarm

Nine existing quarries in the vicinity of the proposed development have been considered to provide stone for the Derrinlough wind farm project since no borrow pits are proposed within the proposed development boundary itself. With this in mind, these quarries are considered cumulatively in terms of archaeological and cultural heritage potential.

As the quarries are existing and operational, the archaeological and cultural heritage potential of the continuation of quarrying activities is likely to be low. Cumulative direct impacts are not anticipated.

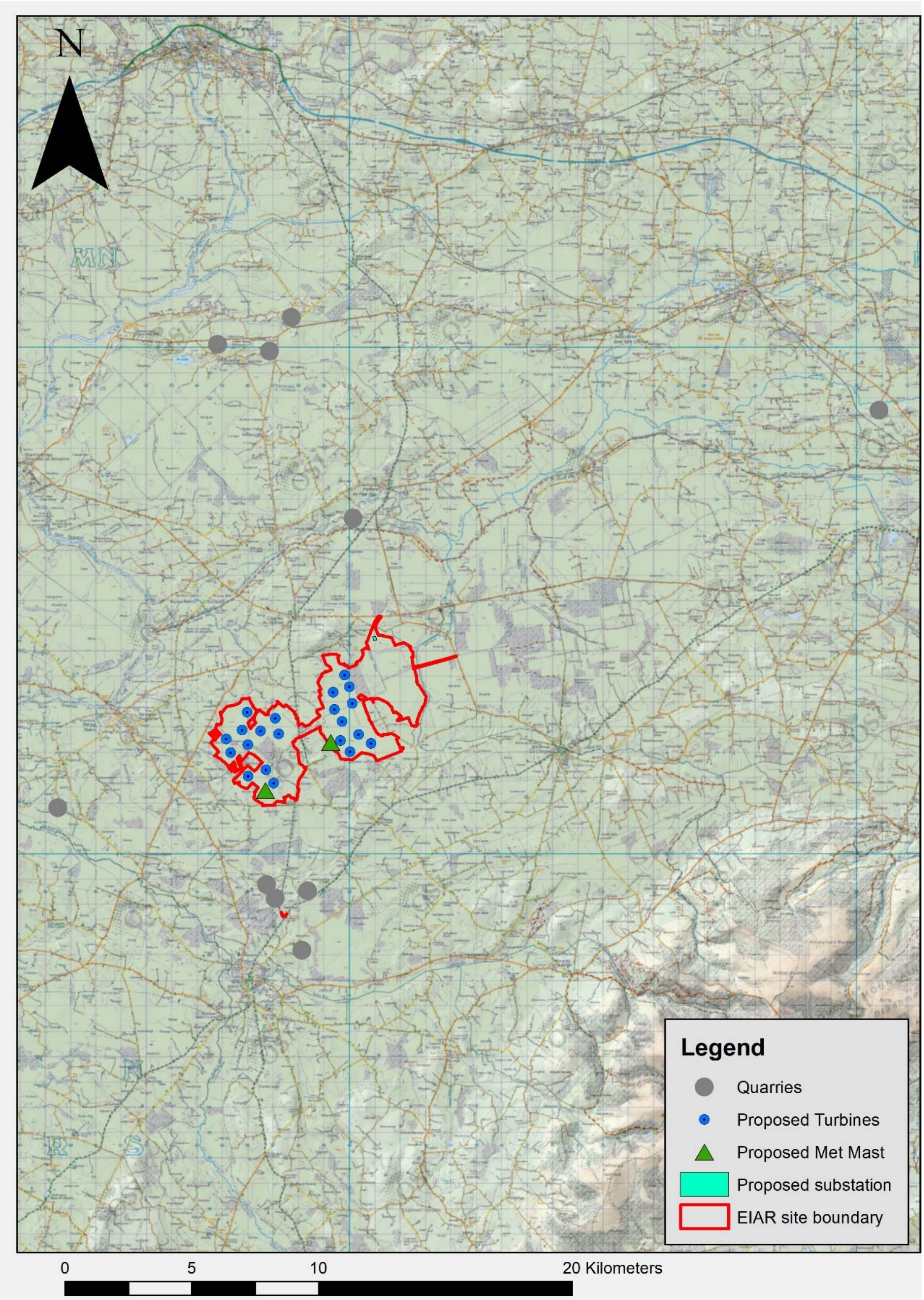

Figure 13.25: Quarries to be considered for use for stone for the proposed development.

13.5.2 Cumulative Impacts (Indirect Impact on Setting)

Indirect impacts on setting occur at the operational stage of the development (when turbines are operational). In this regard in order to assess overall cumulative effects on archaeology and cultural heritage, the proposed project is considered in the context of other developments, in particular other permitted and proposed wind farms as shown in Figure 13.24 above. This map shows the location of existing, permitted and proposed turbines within 20km of the proposed development.

13.5.2.1 National Monuments

When considered cumulatively, the proposed Derrinlough turbines along with the permitted, existing and proposed turbines within 20km could result in an increase in effects on the visual setting of the cultural heritage resource. If all of the turbines were constructed, it may result in more turbines being seen from various locations in the wider landscape setting.

In terms of cumulative visual impacts on Clonmacnoise World Heritage site (tentative list), however, viewshed analysis shows that no additional turbines would be seen from this location. No cumulative impacts on Clonmacnoise will occur since none of the Derrinlough turbines are potentially visible from this location.

The viewshed analysis model run for National Monuments within 10km of Derrinlough also shows other turbines within 20km and so it can be ascertained what level of visibility of turbines from the monuments is possible. As the viewsheds are based on a bare landscape with no vegetation boundaries or buildings, these cumulative impacts are a worst case scenario since screening is likely to alleviate some effects on setting.

National Monument Preservation Order 49 (OF015-017, Coole Castle)

The likely impacts on this monument arising from the proposed Derrinlough turbines was considered to be slight. The Cloghan (permitted) and existing and proposed Meenwaun turbines are also within the viewshed from this monument therefore the effects on setting will increase from slight to slight/moderate.

National Monument Preservation Order 86 (OF022-008001, Clonony Castle)

The likely impacts on this monument arising from the proposed Derrinlough turbines alone was considered to be slight. The Cloghan (permitted) and existing and proposed Meenwaun turbines as well as the Leabeg existing turbines are also within the viewshed from this monument therefore the effects on setting will increase from slight to slight/moderate.

National Monument Preservation Order Jun-56 (OF023-010, Ringfort)

The likely impacts on this monument arising from the proposed Derrinlough turbines alone was considered to be. The Cloghan (permitted) and existing and proposed Meenwaun turbines as well as the Leabeg existing turbines are also within the viewshed generated from this monument therefore the likely effects on setting will increase from slight to slight/moderate.

National Monument State Care No 504 (OF014-029001, Gallen Abbey)

The likely impacts on this monument arising from the proposed Derrinlough turbines alone was considered to be 'Not Significant'. The viewshed analysis from this monument shows potential visibility in the direction of the Leabeg and Cloghan turbines in addition to the Drinagh side of the proposed development. There is no visibility of the Meenwaun turbines or turbines from the Clongawny part of the proposed Derrinlough windfarm. The impact will increase from Not significant to Slight when considering all projects cumulatively.

13.5.2.2 Cumulative (Indirect) Impacts to Recorded Monuments, RPS and NIAH structures

The likely indirect impacts to recorded monuments within the proposed development has been considered in this assessment. Impacts on visual setting to such monuments is not anticipated as they do not have any visible extent in the landscape. Considered cumulatively with other projects within 20km this impact is not likely to change given the low-visibility nature of these monuments.

The immediate setting of the recorded monuments within 5km of the proposed development will not be negatively impacted although it is likely that there will be some visibility in the direction of the proposed turbines given the flat topography of the surrounding landscape. In this regard, a slight-moderate impact to their wider setting has been identified. When considered cumulatively with other projects within 20km this impact may increase to moderate given that more turbines are likely to be visible from such monuments.

A similar scenario is identified for RPS and NIAH structures within 5km of the proposed development, in particular turbines, for which a slight-moderate impact to their wider setting had been identified. This may increase to moderate when considered with permitted, existing and proposed turbines within 20km.

13.6 Decommissioning Phase

There will be no significant potential impacts on the archaeological, architectural and cultural heritage environment during the decommissioning of the proposed development. Any potential direct impacts will already have been resolved through mitigation measures during the construction phase.

14. MATERIAL ASSETS

Material Assets are defined in the '*Advice Notes for Preparing Environmental Impact Statements'* (EPA, Draft 2015) as "*resources that are valued and that are intrinsic to specific places" and in the* 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, Draft 2017) ''as "*built services and infrastructure. Traffic is included because in effect traffic consumes roads infrastructure*.' They may be either of human or natural origin. The cultural assets of Archaeology and Cultural Heritage are addressed in Chapter 13 of this Environmental Impact Assessment Report (EIAR). Economic assets of natural heritage include non-renewable resources such as minerals or soils, and renewable resources such as wind and water. These assets are addressed in Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, and Chapter 10: Air and Climate. Tourism and amenity resources, which are also considered material assets, are addressed in Chapter 5: Population and Human Health.

This chapter of the EIAR addresses the likely significant effects of the proposed development on transportation infrastructure (Section 14.1 Traffic and Transport) and on Telecommunications and Aviation (Section 14.2), which are economic assets of human origin. This chapter of the EIAR has been prepared in accordance with the requirements of the EIA legislation and guidance outlined in Chapter 1: Introduction.

14.1 Traffic and Transport

14.1.1 Introduction

14.1.1.1 Background and Objectives

The purpose of this section is to assess the effects, on roads and traffic, of the additional traffic movements that will be generated during the construction, operational and decommissioning phases of the proposed Derrinlough Wind Farm Development.

For developments of this nature, the construction phase is the critical period with respect to the traffic effects experienced on the surrounding road network in terms of both the additional traffic volumes that will be generated on the road network, and the geometric requirements of the abnormally large loads associated with the wind turbine plant. The requirements of the additional traffic and abnormal sized loads generated during the construction stage were assessed on both the external highway network and at the proposed junctions that will provide access to the site.

It should be noted that abnormal weight loads are not a feature of the turbine delivery vehicles, they are abnormal in size only. All construction and delivery vehicles for the proposed development will be subject to the standard axle weight requirements set out under Road Traffic Regulations and therefore the loadings from construction traffic will not exceed the relevant standards. Notwithstanding the need to use some specialist vehicles to facilitate turbine delivery, it should be noted that the number of load-bearing axles for any specialist vehicles carrying large loads are designed to ensure that the load on any one axle does not exceed acceptable load bearing statutory limits.

The magnitude of the increase in traffic volumes experienced on the surrounding network is identified during the various construction stages of the proposed development. A preliminary traffic management measures are also provided in Sections 14.1.7 and 14.1.10.6 aimed at minimising the traffic impact on the local highway network.

14.1.1.2 Statement of Authority

This section of the EIAR has been prepared by Alan Lipscombe of Alan Lipscombe Traffic and Transport Consultants Ltd. Alan is a competent expert in traffic and transport assessments. In 2007 Alan set up a traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic, including many wind farm developments including the following; Ardderoo, Derryadd, Knocknamork, Shehy More, Cloncreen, Derrykillew, Coole, Ballyhorgan, Cahermurphy, Lettergull, Barnadivane, Cleanrath and Knocknalough .

Alan has a BEng (hons) Degree in Transportation Engineering (Napier University, Edinburgh, 1989), is a member of Engineers Ireland and of the Institute of Highways and Transportation and is a TII accredited Road Safety Audit Team Member.

14.1.1.3 Guidance and Legislation

This section of the EIAR has been completed in accordance with the guidance set out in Chapter 1. The assessment uses standard terminology to describe the likely significant effects associated with the proposed development. Further information on the classification of effects used in this assessment is presented in Section 1.8 of this EIAR.

14.1.1.4 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as outlined in Section 2.6 of Chapter 2 of the EIAR, and summarised below.

Transport Infrastructure Ireland

Transport Infrastructure Ireland (TII) responded to Scoping on the 19th December 2019 in which it provided a list of recommendations to be followed when preparing the EIAR. All relevant TII guidelines and policies have been taken into account in the preparation of this assessment, including the following;

- PE-PDV-02045, Transport Assessment Guidelines, Transport Infrastructure Ireland, May 2014
- PE-PAG-02017, Project Appraisal Guidelines, Unit 5.3, Travel Demand Projections, Transport Infrastructure Ireland, May 2019
- DN-GEO-03060, Geometric Design of junctions, Transport Infrastructure Ireland, April 2017
- TII Automatic Traffic Count Data, N52, 2018,

Offaly County Council

Two pre-planning meetings (29th of August 2018 and 6th March 2019) were held with the Planning Department of Offaly County Council in relation to the proposed development prior to the submission of the current planning application on this site. The meetings were attended by representatives of the Planning Department, Environmental/Water Services Department, Roads Department, MKO and Bord na Móna Powergen Ltd.

At the meetings, the proposed haul route, site entrances and the underpass of the N62 was outlined by MKO and Bord na Móna. Issues raised by Offaly County Council in respect to the proposals were considered in the design of the proposed development.

14.1.1.5 Methodology and Section Structure

The traffic and transport assessment takes cognisance of guidance for such assessments set out by Transport Infrastructure Ireland (TII), in the document PE-PDV-02045 '*Traffic and Transport Assessment Guidelines',* (TII, 2014). The geometric requirements of the turbine delivery vehicles were assessed using Autocad and Autotrack with the assessment undertaken by Collett & Sons Ltd which is included as Appendix 14.1. The preliminary design and geometric assessments for the Proposed Development access junctions were prepared by Alan Lipscombe Traffic and Transport Ltd.

The Traffic and Transport Section of this chapter is set out as follows:

- A review of the existing and future transport infrastructure in the vicinity of the proposed development, including an assessment of 2019 traffic flows and traffic forecasts during an assumed construction year of 2024 (Sections 14.1.2 - Receiving Environment and 14.1.3 – Existing Traffic Volumes).
- A description of the nature of the proposed development and the traffic volumes that it will generate during the different construction stages and when it is operational (Section 14.1.4 – Proposed Development and Traffic Generation).
- A description of the abnormally sized large loads and vehicles that will require access to the site (Section 14.1.5 – Construction Traffic Design Vehicles).
- A review of the effects of development generated traffic on links and junctions during construction and when the facility is operational (Section 14.1.6 –Traffic effects during construction and during operation).
- Identification of traffic management for large deliveries during construction (Section 14.1.7 – Traffic Management for Large Deliveries).
- A geometric assessment of the route and its capacity to accommodate the abnormal-sized loads associated with the development (Section 14.1.8 – Route Assessment).
- An assessment of the provision for sustainable modes of travel (in this case primarily with respect to the transport of construction staff) (Section 14.1.9 – Provision for Sustainable Modes of Travel).

The description of likely significant effects is provided in Section 14.1.10.

14.1.2 Receiving Environment

14.1.2.1 Site Location

The proposed development, known as Derrinlough Wind Farm, will be located on Clongawny and Drinagh Bogs which are part of the Boora bog group in Co. Offaly.

The closest settlements to the site are Cloghan which is located approximately 2km to the north and Fivealley which is located approximately 2.5km to the south. Other settlements and towns in the area include Banagher (c. 3km west), Ferbane (c. 6km north), Birr (c. 7km south-west) and Shannonbridge (c. 15km north-west). The site location is shown on Figure 1.1.

14.1.2.2 Proposed Abnormal Size Load Delivery Route

A detailed assessment of the transport route was made from a point at which the route turns off the M6 Motorway at Kilbeggan. The route is shown in Figure 14.1 and is discussed in detail in Section 14.1.8.

Turbine Haul Route

Additional delivery route for sub-station construction traffic

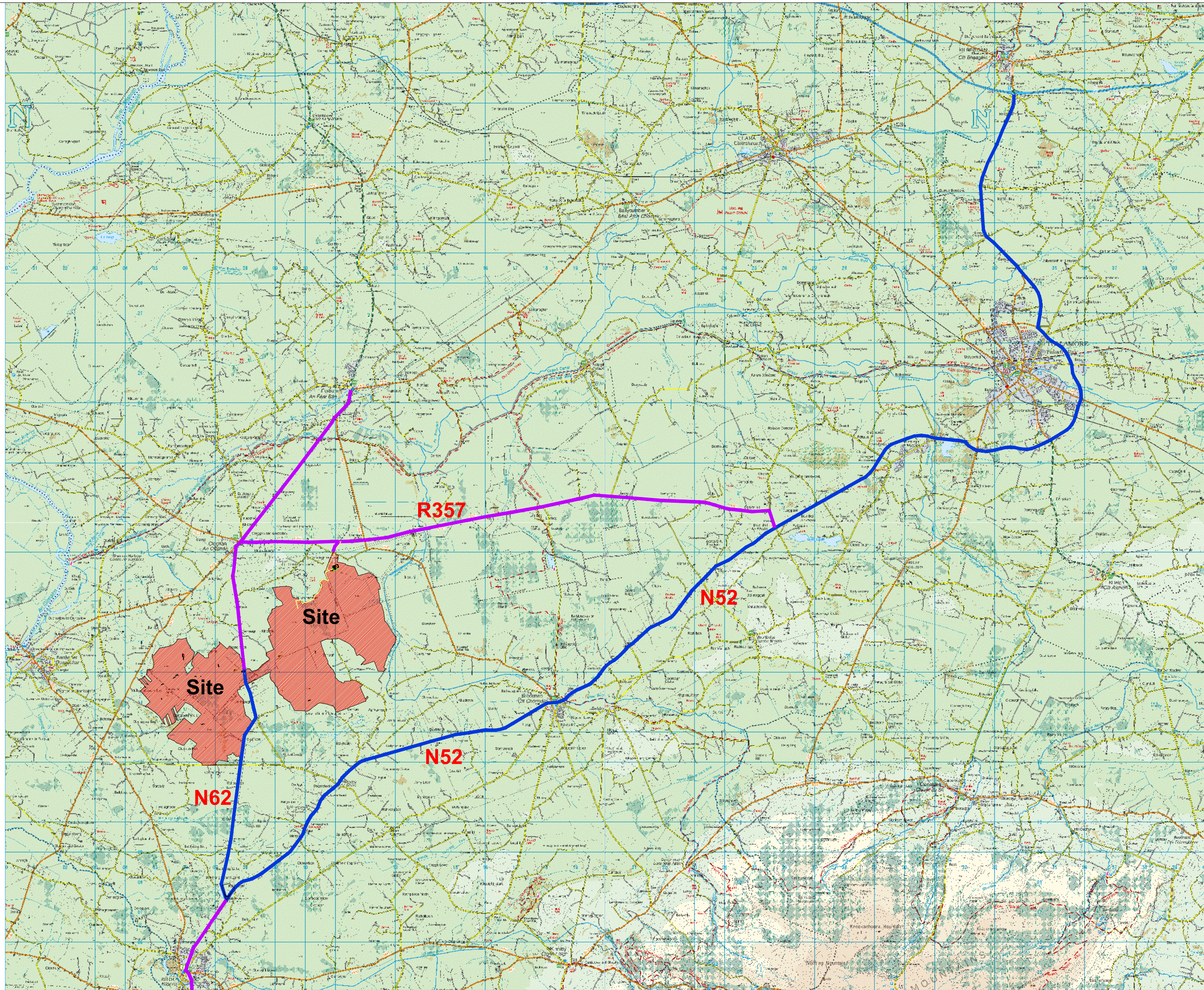

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Figure 14.1 Site location and delivery routes

PROJECT:	Derryinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7380	DATE: 05.11.19	DRAWN BY:	AL

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The route assessment is confined to the access route comprising of the turnoff from the M6 onto the N52 at Kilbeggan, before heading southbound on the N52 towards Tullamore for approximately 8km. The route then bypasses Tullamore on the N52 to the east and south for a further 8km before heading south west for a further 30 km on the N52, passing through the villages of Blue Ball and Kilcormac, in the direction of the town of Birr. The route then turns right onto the N62, using a temporary bypass of the existing junction (known as Kennedy's Cross), just to the north of Birr, heading due north for approximately 8km to the parts of the proposed site. The proposed access junctions are located approximately 200m north of the access to the existing Bord na Móna Briquette Factory, as shown in Figure 14.1 and 14.2a.

14.1.2.3 Proposed Construction Traffic Haul Route

The delivery route for general HGV construction traffic may vary depending on the location of quarries and the suppliers used for stone and other materials required to construct the proposed development. Based on the location of quarries in the vicinity of the Proposed Development and the fact that deliveries of stone comprise the majority of deliveries to from the site, it is estimated that the following proportion of concrete and general construction traffic will travel on the following links;

- N62 to from the north – 50%,
- N62 to from south – 50%
    - N52 to from Tullamore – 30%
    - N52 to from Birr – 20%.

For the purpose of this assessment it is assumed that deliveries of smaller component parts for the wind turbines, will travel to the site via Tullamore and the N52, followed by the N62 towards the site. In practice the delivery route for these component part could change but as the associated traffic volumes are low, as established in Section 14.1.4 of this EIAR, the impacts will be minimal regardless of the route selected. .

The assessment presented in this section of the EIAR is based on these assumptions.

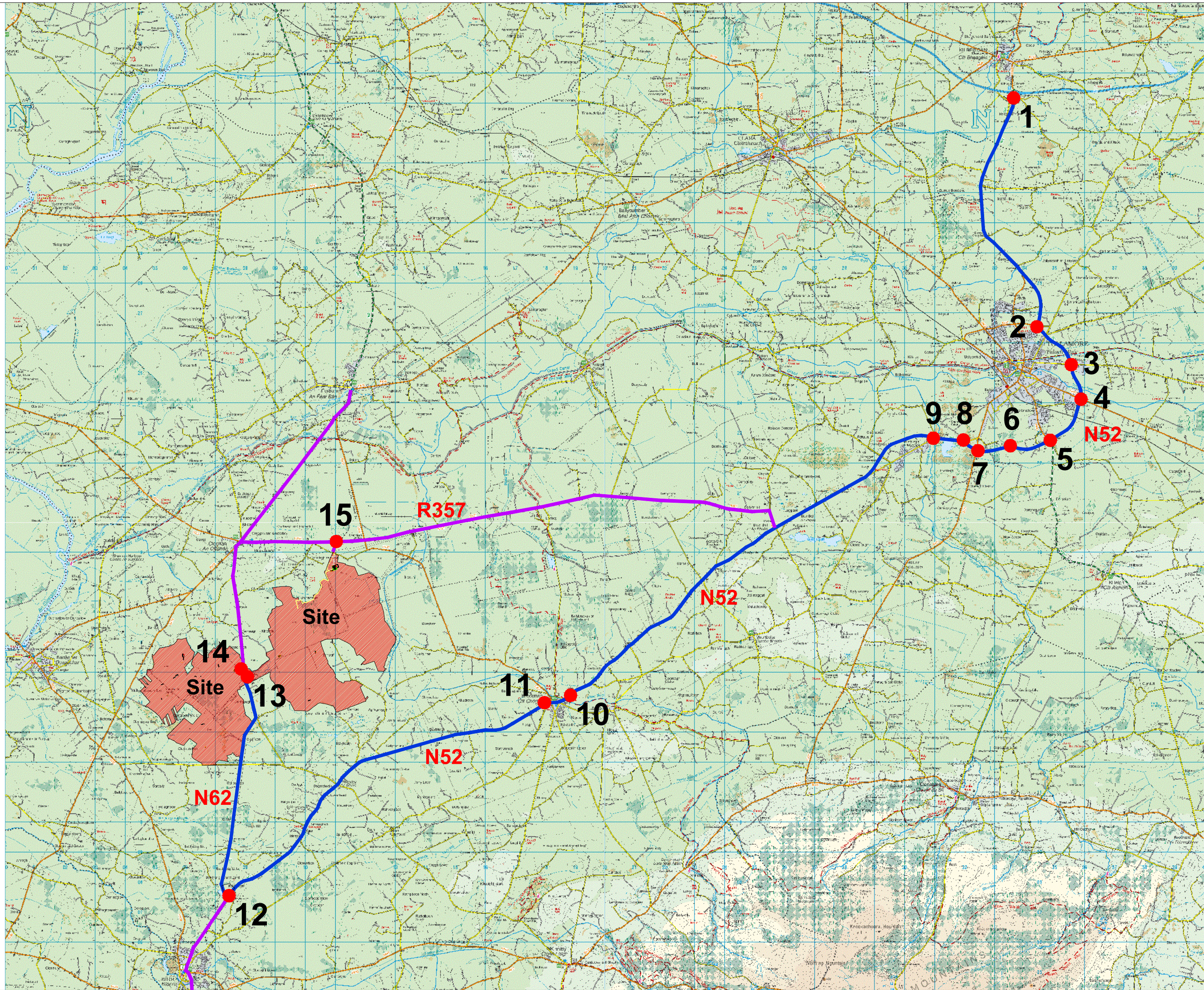
14.1.2.4 Site Entrances

Three entrances are proposed for the construction stage of the proposed development in order to transport turbine components, materials and equipment to the site. All are existing Bord na Móna machinery entrances which have been in use by the machinery involved in peat harvesting activities. The entrance locations are depicted on Figure 4.1 of this EIAR and can be described as follows:

- Existing entrance off the N62 to Drinagh Bog;
- Existing entrance off the N62 to Clongawny Bog; and
- Existing entrance off the R357 which connects Drinagh and Noggus Bog.

The main entrances for the construction phase of the proposed development are located along the N62. These two entrances will provide access east and west into Drinagh and Clongawny bogs, respectively and will be designed to facilitate both materials delivery to the site (stone, steel and concrete) as well as large oversize components such as turbine blades and tower sections. . Upgrade works will be required to these entrance locations in order to accommodate access and egress of turbine delivery and construction vehicles. Following the construction phase of the proposed development, the upgraded areas of these entrances will be closed by erecting fencing, however they may need to be reopened during the lifetime of the development should replacement blades or other abnormal loads be required to access the site.

The access off the R357 will be used for delivery of substation components and materials required for the construction of the substation and grid connection works only and will not be used to provide access for turbine components. As such, this site entrance will have a comparatively low level of



Turbine Haul Route

Locations for assessment

Additional delivery route for sub-station construction traffic

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Figure 14.2a Route assessment location map

PROJECT:	Derryinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7380	DATE: 05.11.19	DRAWN BY:	AL

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construction traffic and associated material deliveries. Minor upgrade works will be required to this entrance location in order to accommodate access and egress of construction vehicles. This entrance will be upgraded after construction to provide permanent access to a proposed amenity car park. In addition, the existing machine pass off the L7009 Local Road will be upgraded to provide permanent access to the proposed substation and local access to the proposed amenity pathway during the operational phase. Further information on the proposed amenity elements associated with the proposed development are outlined in Chapter 4.

14.1.3 Existing Traffic Volumes

It should be noted that traffic volumes are discussed in terms of vehicles and passenger car units, or PCUs, where each vehicle is expressed in terms of its demand on the network relative to the equivalent number of cars. For example, an articulated HGV was given a factor of 2.4 passenger car units (as per TII Project Appraisal Guidelines for National Roads Unit 5.2), while one of the extended loaders required to transport the wind turbine equipment was assigned a value of 10.

14.1.3.1 Background Traffic Flows

The link count locations included in the assessment are shown in Figure 14.2b.

A continuous traffic counter is maintained by TII on the N52 between Tullamore and Birr. Traffic data from this site together with a peak period classified turning count undertaken at the junction between the N52 and N62 (Kennedy's Cross) to the north of Birr (locations 1, 2 and 3 shown in Figure 14.2b) on Tuesday 8th October 2019, was used to provide background traffic volumes on the local public road network. A short period PM peak hour count was also undertaken on the R357, indicated as location 4 in Figure 14.2b.

For the peak period, count locations' daily flow profiles were applied to the short period traffic counts using the data from the continuous traffic counter site on the N52. This shows that the average annual daily traffic flow (AADT) is 11.32 times the flow observed during the evening peak hour period, as set out in Table 14.1.

Base year 2019 traffic volumes for the four link locations shown in Figure 14.2b range from 2,264 vehicles per day on the R357 to 7,935 on the N52 between the Kennedy's Cross and Birr. There were 2,864 vehicles per day on the section of the N62 leading to the proposed site.

Table 14.1 Observed flow in PM peak hour, all day factor, Average all day flows, year 2019 (2-way vehicles)

Link	2-way flow	hour	All day factor	All day flow
1 N52 – Tullamore	459	17:00 – 18:00	11.32	5,196
2 N52 – Birr	701	17:00 – 18:00	11.32	7,935
3 N62 – Athlone	253	17:00 – 18:00	11.32	2,864
4 R357	200	17:00 – 18:00	11.32	2,264

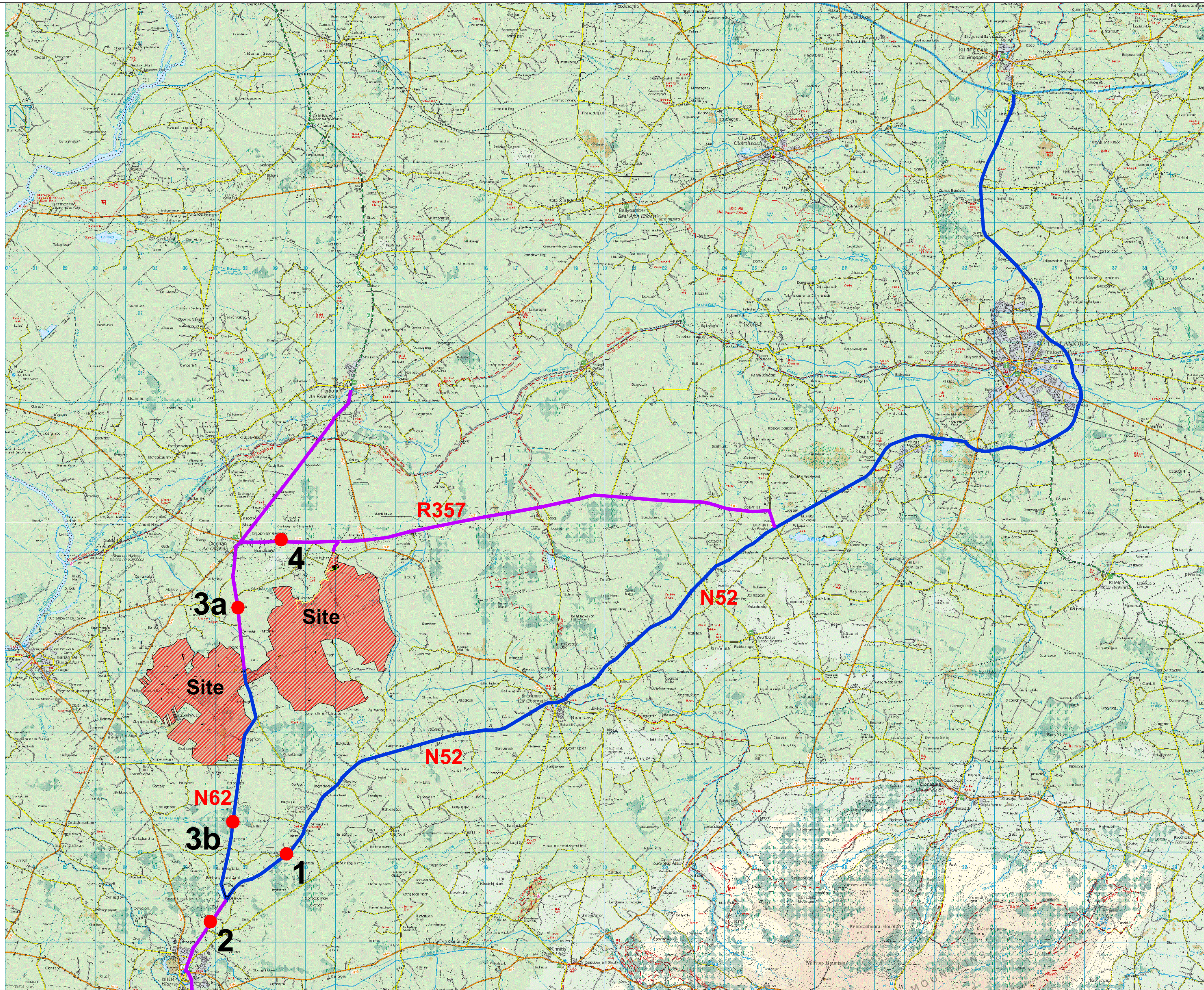
14.1.3.2 Future Background Traffic Volumes

This section describes the process adopted to produce background traffic forecasts for an assumed construction year of 2022.

Turbine Haul Route

Link count locations

Additional delivery route for
sub-station construction traffic



NOTES:

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Figure 14.2b Link count locations

PROJECT:	Derryinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7380	DATE: 05.11.19	DRAWN BY:	AL

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Revised guidelines for forecasting annual growth in traffic volumes were produced by TII in May 2019, as set out by county in the 'Project Appraisal Guidelines for National Roads (Unit 5.3)'. The annual growth rates for light vehicles for the County, and factors for the years relevant to this study, are shown in Table 14.2 and Table 14.5. Traffic volumes are forecast to increase during the period from 2019 (the observed traffic count year) to 2022 (the assumed construction year) by 3.6%, assuming a medium growth scenario. All day traffic flows, for the years 2019 and 2022, on the study area network are compared in Table 14.4.

It should be noted that while the assumed construction year of 2022 may vary slightly, this will not alter the forecast outcomes and effects presented in this section of the EIAR. This is due to the annual growth rate for background traffic being just 1.18% (as shown in Table 14.2) and the traffic volumes generated by the Proposed Development will remain unchanged regardless of construction year, as presented subsequently in Section 14.1.4.

Table 14.2 TII Traffic Growth Annual Factors and Indices for County Offaly

Year	Lights – Annual Factor			Lights – Cumulative Index		
	Low	Medium	High	Low	Medium	High
2019	1.0103	1.0118	1.0152	1.010	1.012	1.015
2020	1.0103	1.0118	1.0152	1.021	1.024	1.031
2021	1.0103	1.0118	1.0152	1.031	1.036	1.046
2022	1.0103	1.0118	1.0152	1.042	1.048	1.062
2023	1.0103	1.0118	1.0152	1.053	1.060	1.078
2024	1.0103	1.0118	1.0152	1.063	1.073	1.095

Source: TII Project Appraisal Guidelines – Unit 5.3, May 2019

Table 14.3 TII traffic growth rates by growth scenario

Period	New Factors		
	Low	Medium	High
2019 – 2022	1.031	1.036	1.046

Table 14.4 Average all day flows by location and year (2-way vehicles)

Link	2019	2022
1 N52 – Tullamore	5,196	5,383
2 N52 – Birr	7,935	8,221
3 N62 – Athlone	2,864	2,967
4 R357	2,264	2,346

The TII traffic count data recorded on the N52 and the peak period traffic count undertaken on the N62 was also used to determine the existing percentage of HGVs on the study area network. The observed percentage of HGVs was observed to vary from 7.2% on the N52, to 7.0% on the N62 approaching the site. Traffic volumes forecast on the study network for the year 2022 are shown by vehicle type in Table 14.5 .

Table 14.5 All day flows, percentage HGVs and flows by vehicle type, year 2022

Link	All day flow (vehs)	% HGV's	Vehicles		PCUs		
			HGVs	Cars / lgvs	HGVs	Cars / lgvs	Total
1 N52 – Tullamore	5,383	7.2%	388	4,995	930	4,995	5,925
2 N52 – Birr	8,221	7.2%	592	7,629	1,421	7,629	9,050
3 N62 – Athlone	2,967	11.0%	326	2,641	783	2,641	3,424
4 R357	2,346	7.2%	169	2,177	405	2,177	2,582

14.1.4 Proposed Development and Traffic Generation

14.1.4.1 Development Trip Generation – During Construction

The assessment of the effects of traffic generated during the construction of the proposed development is considered in two stages.

- Stage 1 – Site preparation and groundworks, and,
- Stage 2 – Turbine component delivery.

For the purpose of the traffic impact assessment, assumptions based on typical wind farm construction projects regarding the length of the construction phases and work periods etc. must be made to inform the assessment. These assumptions allow for a worst-case scenario assessment but should not be inferred as prescriptive limitations to the construction phase. There are numerous variables which can affect a construction project programme such as weather for example. The construction phase of the proposed development will be carried out in accordance with the CEMP, which is submitted as Appendix 4.3 of this EIAR. The CEMP will be agreed with the Local Authority prior to construction commencing.

14.1.4.1.1 *Stage 1 – Site Preparation and Ground Works*

The construction phase of the proposed development is expected to last approximately 24 months (2 years). While this could increase to 30 months, 24 months was assumed for the purpose of this assessment in order to test the worst-case scenario. For assessment purposes a standard 255 working days per annum was adopted, with 510 working days assumed for the site preparation and ground works stage with the total numbers of deliveries made to the site during that period shown in Table 14.6.

During this construction phase, there will be two distinct types of days with respect to trip generation. A total of 21 days will be used to pour the 21 concrete wind turbine foundations. Foundations will likely be poured one per day, with an estimated 75 concrete loads required for each turbine foundation delivered to the site over a 12-hour period. This will result in just over 6 HGV trips to and from the site per hour. On the remaining 489 working days for this stage, other general materials will be delivered to the site.

During all of Stage 1, based on trip rates typical of wind farm projects, it is estimated that 43,510 two-way trips will be made to the site by trucks and large articulated HGVs, as set out in

Table 14., with the daily effect on the local road network shown in Table 14.7 and 14.8. The figures show that on the 21 days that concrete will be delivered to the site an additional 360 two-way PCUs will be added to the network (comprising 75 two-way HGV trips or 150 movements, with 2.4 PCUs per movement), as shown in Table 14.7. Similarly, on the 489 days when other materials will be delivered to the site, traffic volumes on the local network are forecast to increase by an average of 412 PCUs, as set out in Table 14.8.

Table 14.6 Stage 1 – Site preparation and groundworks – total movements

Material	Total no. Truck Loads	Truck type
Concrete	1,575	Trucks
Concrete blinding and steel	230	Large artic
Plant / fencing / compound set-up	50	Large artic
Crushed rock and sand	40,848	Large artic
Ducting / cabling	618	Large artic
Grid cable laying	53	Large artic
Cranes	11	Large artic
Substation components	79	Large artic
Refuelling / maintenance / misc	46	Large artic
Total	43,510	

Table 14.7 Stage 1 – Concrete foundation pouring – total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Concrete	1,575	Truck	2.4	3,780	180.0	360.0
* Estimation based on 21 concrete pouring days						

Table 14.8 Stage 1 – Site preparation and groundworks – total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Concrete blinding and steel	230	Truck	2.4	552	1.1	2.3
Plant / fencing / compound set-up	50	Large artic	2.4	120	0.2	0.5
Crushed rock and sand	40,848	Large artic	2.4	98,035	200.5	401.0
Ducting / cabling	618	Large artic	2.4	1,483	3.0	6.1
Grid cable laying	53	Large artic	2.4	127	0.3	0.5
Cranes	11	Large artic	2.4	26	0.1	0.1
Substation	79	Large artic	2.4	190	0.4	0.8
Refuelling / maintenance / misc	46	Large artic	2.4	110	0.2	0.5
Total	41,935			100,644	205.8	411.6
* Estimation based on ground work period of 489 working days						

14.1.4.1.2 Stage 2 – Turbine Construction

During the turbine construction stage, including delivery and assembly, some deliveries to the site will be made by abnormally large vehicles, referred to in this section as extended artics, transporting the component parts of the turbines (nacelles, blades and towers). There will also be deliveries made by normal large HGVs, transporting cables, tools and smaller component parts. The types of load and associated numbers of trips made to the site during the turbine construction period are shown in Table 14.9, which summarises that a total of 189 trips will be made to and from the site by extended artics, with a further 84 trips made by conventional large articulated HGVs.

Table 14.9 Stage 2 – Wind turbine plant – total movements

Material	Units	Quantity per Unit	Total Quantity	Quantity per Truck	Total Truck Loads	Truck type
Nacelle	21	1	21	1	21	Extended Artic
Blades	21	3	63	1	63	Extended Artic
Towers	21	5	105	1	105	Extended Artic
Sub total					***189***	
Transformer	21	1	21	1	21	Large Artic
Drive train and blade hub	21	1	21	1	21	Large Artic
Base and other deliveries	21	2	42	1	42	Large Artic
Sub total					***84***	
Total					273	

For the purposes of this assessment an assumed delivery period is provided although this may be subject to change. It is assumed that the turbine delivery element will progress at the rate of 5 extended artic trips made by convoy to the site on 2 days per week, resulting in this stage taking approximately 38 days/nights spread over an assumed 19-week period. On a further two days per week, lasting for approximately 11 weeks, the remaining equipment required during this phase will be delivered to the site. The additional traffic movements for these 2 types of days are summarised in Table 14.10 and Table 14.11. In Table 14.10, a pcu equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 100 PCUs on the study network on these 2 days per week, while an additional 14.4 PCUs are forecast to be on the network on two other days per week, as shown in

Table 14., during the turbine construction phase.

Table 14.10 Stage 2 – Wind turbine plant, extended artics – total movements and volumes per delivery day

Material	Units	Truck Type	PCU Value	Total PCUs	2-way PCUs/ day
Nacelle	1	Extended Artic	10	10.0	20.0
Blades	3	Extended Artic	10	30.0	60.0
Towers	5	Extended Artic	10	50.0	100.0

Material	Units	Truck Type	PCU Value	Total PCUs	2-way PCUs/ day
Total per turbine	9			90.0	180.0
Total per delivery day	5			50.0	100.0
*Estimation based on 5 abnormal sized loads being delivered per day on 2 days per week (total 189 loads will take 38 nights spread over 19 weeks)					

Table 14.11 Stage 2 - Wind turbine plant, normal artic HGVs - total movements and volumes per delivery day

Material	Quantity per Unit	PCU Value	2-way PCUs / day
Transformer	1	2.4	4.8
Drive train and blade hub	1	2.4	4.8
Base & other deliveries	1	2.4	4.8
Total	3		14.4
*Estimation based on equipment for 2 turbines being moved per week spread over 2 days			

14.1.4.1.3 Construction Employee Traffic

It is estimated that a maximum of 100-120 staff members will be employed on the site at any one time during the site preparation and groundworks stage of construction, reducing to a maximum of 80 staff at any one time during the turbine construction stage. If a worst case is assumed that all staff will travel to / from the site by car, at an average of 2 persons per car, then a total of 120 pcu movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 80 pcu trips during the turbine construction stage.

14.1.4.2 Development Trip Generation – During Operation

It is assumed that the wind farm will be unmanned once operational and will be remotely monitored. Traffic associated with the operational phase of the wind farm will be from the wind farm developers, Eirgrid personnel visiting the substation, and maintenance personnel who will visit individual turbines.

It is estimated that the traffic volumes that will be generated by the development once it is operational will be minimal. The site will be unmanned but will generate maintenance trips, with approximately two maintenance staff travellingto site at any one time. The impact on the network of these trips during the operational stage is discussed in Section 14.1.6.

Once operational the site will also attract visitors for amenity purposes, with those travelling by car using the carpark provided via the access off the R357. Based on existing Bord na Móna sites it is forecast that up to 40 car trips per day will be generated by this use.

14.1.5 Construction Traffic Design Vehicles

14.1.5.1 Construction Traffic Vehicle Types

The delivery of turbine components including blades, tower sections and nacelles is a specialist operation due to the oversized loads involved. The blades are the longest turbine component and in the case of the Proposed Development blades up to 75m long have been considered for the purpose of this assessment.

The actual turbine to be installed on the site will be the subject of a competitive tender process, and could include turbines not amongst those originally considered as part of this assessment because they are not yet available on the market. Regardless of the make or model of the turbine eventually selected for installation on site, a detailed delivery assessment and program will be carried out by the turbine delivery company and a similar methodology will be adopted as set out here to ensure the findings of this assessment remain valid for whatever model of turbine is selected. Any references to the turbine dimensions in the text below must be considered in the context of the above and should not be construed as meaning it predetermines the dimensions of any wind turbine that could be used on the site.

The key dimensions are as follows:

Transport of Blades – Super Wing Carrier with blade

Total length	80.4 m
Length of blade	75.0 m
Inner radius	28.0 m

Transport of Tower – Using low-bed or drop deck trailers

Total length (with load)	49.6 m
Length of load	30.0 m
Inner radius	25.0 m

The critical vehicles in terms of size and turning geometry requirements, and used in the detailed route assessment discussed in Section 14.1.8 and included as Appendix 14.1 are the blade and tower transporters. The geometry of the design vehicles are included as Figures 14.4 and 14.5.

The vehicles used to transport the nacelles will be shorter in length compared to the blade and tower transporters.

All other vehicles requiring access to the site will be standard HGVs and will be significantly smaller than the design test vehicles.

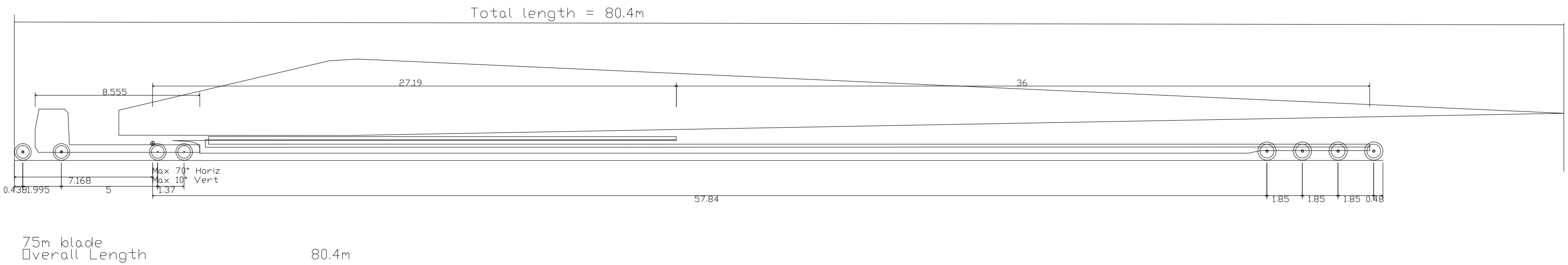

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FIGURE 14.4 Design blade extended artic profile

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7380	DATE: 22.12.19	DRAWN BY:	AL

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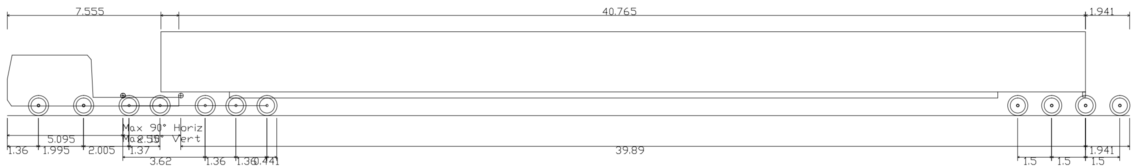

Tower

□verall Length	49.476m
□verall Width	2.550m
□verall Body Height	3.695m
Min Body Ground Clearance	0.427m
Max Track Width	2.520m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

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FIGURE 14.5 Design tower extended artic profile

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	NTS
PROJECT NO: 7380	DATE: 22.12.19	DRAWN BY:	AL

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14.1.6 Traffic Effects During Construction and During Operation

14.1.6.1 Traffic Effect During Construction and During Operation

As detailed below, transportation of large turbine components will be carried out at night when traffic is at its lightest and in consultation with the relevant Roads Authority and An Garda Síochána with deliveries accompanied by Garda escort.

Effect on Link Flows – During Construction

Background traffic volumes, as established previously and set out in Table 14.5, and development generated traffic volumes are shown for the typical construction day scenarios discussed in Section 14.1.4 are set out in Table 14.12 to 14.15, with the traffic effects summarised in Table 14.16 to 14.19. The actual figures presented in the tables will be subject to change, however they are considered to represent a robust estimation of the likely effects.

In terms of daily traffic flows the potential effects may be summarised as follows:

During Stage 1 – Concrete Pouring

For these 21 days an additional 480 PCUs will travel on the study network. On these days, the percentage increase in traffic volumes experienced on the study network will be between 5.3% on the N52 in the direction of Birr and 14.0% increase on the N62 leading to the site.

During Stage 1 - Site Preparation and Groundworks

On average an additional 532 PCUs will travel on the local highway network resulting in a percentage increase in traffic volumes on the study network of between 5.9% on the N52 to / from Birr, 11.5% on the N62 leading to the site and 20.6% on the R357.

During Stage 2 - Turbine Construction Stage – Delivery of large equipment using extended articulated vehicles

The additional 180 PCUs (made up of cars and large extended artics) will appear on the study network for 38 days. On the days this impact occurs, volumes will increase by 3.0% on the N52 from the direction of Tullamore, and by 5.3% on the N62 approaching the site.

The most significant traffic impact may be experienced during these days primarily due to the slow speeds, size and geometric requirements of these vehicles. The provision of traffic management measures, including ensuring that these deliveries are made at night (as set out in Sections 14.1.7 and 14.1.10.6 and included in the CEMP), will be required to minimise the impact of development traffic on the study network on these days.

During Stage 2 - Turbine Construction Stage – Other deliveries using conventional articulated HGVs

For 21 days on the delivery route 95 additional PCUs (made up of cars and standard articulated HGV movements to the site and back) will travel on the study network. On these days, the percentage increase on the study network will be between 1.6% on the N52 in the direction of Tullamore, and 2.8% on the N62 approaching the site.

Table 14.12 Effects of development traffic during concrete pouring

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1. N52 – Tullamore	4,995	930	5,925	120	360	480	5,115	1,290	6,406
2. N52 – Birr	7,629	1,421	9,050	120	360	480	7,749	1,781	9,530
3a. N62 - North of access	2,641	783	3,424	120	360	480	2,761	1,143	3,904
3b. N62 – South of access	2,641	783	3,424	120	360	480	2,761	1,143	3,904
4. R357	2,177	405	2,582	NA	NA	NA	NA	NA	NA

Table 14.13 Development traffic during site preparation and groundworks

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1. N52 – Tullamore	4,995	930	5,925	120	412	532	5,115	1,342	6,458
2. N52 – Birr	7,629	1,421	9,050	120	412	532	7,749	1,833	9,582
3a. N62 - North of access	2,641	783	3,424	120	412	532	2,761	1,195	3,956
3b. N62 – South of access	2,641	783	3,424	120	412	532	2,761	1,195	3,956
4. R357	2,177	405	2,582	120	412	532	2,297	817	3,114

Table 14.14 Development traffic during turbine construction - extended artics (large turbine components)

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1. N52 – Tullamore	4,995	930	5,925	80	100	180	5,075	1,030	6,106
2. N52 – Birr	7,629	1,421	9,050	NA	NA	NA	NA	NA	NA
3a. N62 - North of access	2,641	783	3,424	NA	NA	NA	NA	NA	NA

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
3b. N62 – South of access	2,641	783	3,424	80	100	180	2,721	883	3,604
4. R357	2,177	405	2,582	NA	NA	NA	NA	NA	NA

Table 14.15 Effect of development traffic during turbine construction – other deliveries (small turbine components)

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 N52 – Tullamore	4,995	930	5,925	80	15	95	5,075	945	6,021
2 N52 – Birr	7,629	1,421	9,050	NA	NA	NA	NA	NA	NA
3a N62 - North of access	2,641	783	3,424	NA	NA	NA	NA	NA	NA
3b N62 – South of access	2,641	783	3,424	80	15	95	2,721	798	3,519
4 R357	2,177	405	2,582	NA	NA	NA	NA	NA	NA

Table 14.16 Summary effect of development traffic during concrete pouring

Link	Background	Development	Total	% increase	Estimated No. of days
1. N52 – Tullamore	5,925	480	6,405	8.1%	6
2. N52 – Birr	9,050	480	9,530	5.3%	4
3a. N62 - North of access	3,424	480	3,904	14.0%	11
3b. N62 – South of access	3,424	480	3,904	14.0%	10
4. R357	2,582	NA	NA	NA	NA

Table 14.17 Summary effect of development traffic during site preparation and ground works

Link	Background	Development	Total	% increase	Estimated No. of days
1. N52 – Tullamore	5,925	532	6,457	9.0%	147

2. N52 – Birr	9,050	532	9,582	5.9%	98
3a. N62 - North of access	3,424	532	3,956	15.5%	245
3b. N62 – South of access	3,424	532	3,956	15.5%	245
4. R357	2,582	532	3,114	20.6%	7

Table 14.18 Summary effect of development traffic during turbine construction – extended artics (large turbine components)

Link	Background	Development	Total	% increase	Estimated No. of days
1. N52 – Tullamore	5,925	180	6,105	3.0%	38
2. N52 – Birr	9,050	NA	NA	NA	NA
3a. N62 - North of access	3,424	NA	NA	NA	NA
3b. N62 – South of access	3,424	180	3,604	5.3%	38
4. R357	2,582	NA	NA	NA	NA

Table 14.19 Summary effect of development traffic during turbine construction – other deliveries (small turbine components)

Link	Background	Development	Total	% increase	Estimated No. of days
1. N52 – Tullamore	5,925	95	6,020	1.6%	21
2. N52 – Birr	9,050	NA	NA	NA	NA
3a. N62 - North of access	3,424	NA	NA	NA	NA
3b. N62 – South of access	3,424	95	3,519	2.8%	21
4. R357	2,582	NA	NA	NA	NA

An assessment of the impact on link capacities in the study area was undertaken for the various construction stages as set out in Table 14.20, Table 14.21, and Table 14.22. The capacity for each link in the study area is shown in Table 14.. The capacities range from a daily flow of 11,600 vehicles on the N52 in the direction of Birr down to 5,000 on the R357 and are based on road widths and capacities set out in the TII Standards document DN-GEO-03031 Road Link Design, Table 6/1.

Background, or do nothing traffic flows, are compared to flows forecast for the various construction delivery stages in Table 14.21 with the percentage capacity reached for each link and stage shown in Table 14.22. Based on this assessment the following points are noted;

- On the external network the N52 in the direction of Birr is the busiest road with the link capacity forecast to operate at 78% for the do-nothing scenario, increasing to a maximum of 82% during the 21 days that the concrete foundations will be poured.
- The N62 leading to the site is forecast to operate well within capacity for all scenarios, increasing from 40% for the do-nothing scenario to a maximum of 46% on the 21 days that the foundations will be poured.

Table 14.20 Carriageway widths, link type and link capacity

Link	Width (m)	Link type	Link capacity
1. N52 – Tullamore	7.0	Type 2 single	8,600
2. N52 – Birr	7.0	Type 1 single	11,600
3. N62 – Athlone	7.0	Type 2 single	8,600
4. R357	6.0	Type 3 single	5,000

Table 14.21 Link capacity and summary of link flows by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1. N52 – Tullamore	8,600	5,925	6,405	6,457	6,105	6,020
2. N52 – Birr	11,600	9,050	9,530	9,582	NA	NA
3a. N62 - North of access	8,600	3,424	3,904	3,956	NA	NA
3b. N62 – South of access	8,600	3,424	3,904	3,956	3,604	3,519
4. R357	5,000	2,582	NA	3,114	NA	NA

Table 14.22 Link capacity and % of link capacity by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1. N52 – Tullamore	8,600	69%	74%	75%	71%	70%

Link	Link capacity	Construction delivery stage				
2. N52 – Birr	11,600	78%	82%	83%	NA	NA
3a. N62 - North of access	8,600	40%	45%	46%	NA	NA
3b. N62 – South of access	8,600	40%	45%	46%	42%	41%
4. R357	5,000	52%	NA	62%	NA	NA

Substation Construction

It is estimated that an additional 400 HGV trips will be generated to and from the site during the construction of the substation, associated compound and grid connection works. It is assumed that the construction of the substation will take place at the same time as the site preparation and groundworks stage, as set out in Table 14.6 and Table 14.7, with traffic effects included in the assessment for that construction period.

N62 Underpass Construction

It is estimated that the construction of the underpass of the N62 proposed to provide local access within the site will take 4 weeks to construct. During this period the N62 will require to operate with one live traffic lane at this location with 2-way traffic flow maintained at all times by means of a "stop and go" traffic management system. The impact on traffic travelling on the N62 as result of the proposed "stop and go" system is estimated as follows. If it is assumed that 150 metres of road will be impacted, for those vehicles arriving on a green signal it is estimated that they will take up to 30 seconds to pass the works at a slow speed of 20km/h with a further 10 seconds required for traffic to clear when the direction of flow is changed. It is therefore estimated that the traffic stopped will be delayed for approximately 40 seconds. As a significant amount of traffic will arrive on a green signal aspect and will experience only a minor delay as traffic slows to pass the site, on average it is forecast that the average delay will be less than 40 seconds.

It is concluded that the works required to construct the underpass will have a negative but slight impact on the 2,970 daily vehicle trips on the N62, and that the effects will be temporary lasting for 20 days.

Effect on Link Flows – During Operation

Once the wind farm is operational it is estimated that there will be approximately two maintenance staff will access the site at any particular time, to carry out operational maintenance, with a similar number of vehicle trips. It is considered that the traffic impact during this phase will be imperceptible.

Effect on Junctions – During Construction

The capacity of the study area junction most affected, the N52 / N62 junction, was assessed using the industry standard junction simulation software PICADY, which permits the capacity of any junction to be assessed with respect to existing or forecast traffic movements and volumes for a given period. The capacity for each movement possible at the junction being assessed is determined from geometric data input into the program with the output used in the assessment as follows:

- Queue – This is the average queue forecast for each movement and is useful to ensure that queues will not interfere with adjacent junctions.
- Degree of Saturation or Ratio of Flow to Capacity (% Sat or RFC) – As suggested, this offers a measure of the amount of available capacity being utilised for each movement. Ideally each movement should operate at a level of no greater than 85% of capacity.
- Delay – Output in minutes, this gives an indication of the forecast average delay during the time period modelled for each movement.

Scenarios Modelled

While other junctions and links on the network will experience an increase in traffic volumes passing through them, as discussed previously and as set out in Table 14.16 to 14.20 above, the worst-case effect will be experienced during peak hours when, during peak construction periods, up to 120 workers (60 cars) will pass through it. It is noted that deliveries of materials to the site will take place during the day after the workers have arrived on site, and before they leave at the end of the day, and will therefore not occur at the same time.

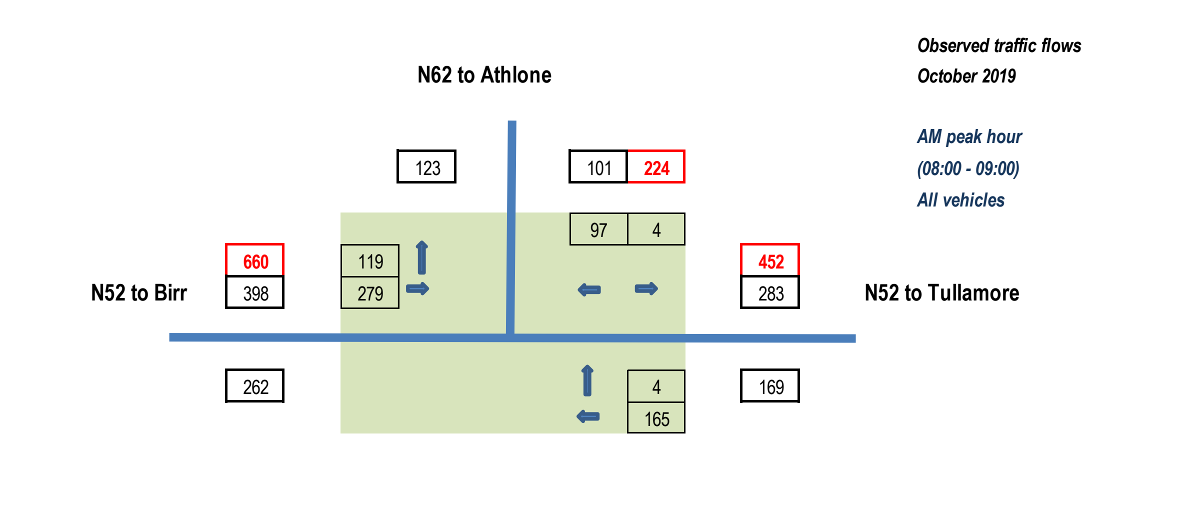
N52 / N62 junction Capacity Test Results

The AM and PM peak hour traffic flows through the N52 / N62 junction are shown for the year 2019 in Figure 14.3a, with background traffic flows for the assumed construction year of 2022 shown in Figure 14.3b. Traffic flows generated by the proposed development during the AM and PM peak hours are shown in Figure 14.3c while the year 2022traffic flows with development generated traffic are shown in Figure 14.3d.

The results of the capacity assessment, as set out in Table 14.23, show that additional car trips passing through the junction will have a slight effect, increasing the maximum ratio of flow to capacity (RFC) at the junction for the traffic movements impacted from 0.8% to 6.5% in the AM peak hour, and from 33.2% to 46.0% during the PM peak hour, which is within the acceptable limit of 85%.

Table 14.23 Junction capacity test results, N52 / N62 junction, AM and PM peak hours, without and with construction staff, year 2022

Period	Location	Without construction traffic			With construction traffic		
AM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
	From N62	26.0%	0.35	0.18	26.8%	0.36	0.19
	Right turn from N52	0.8%	0.01	0.10	6.5%	0.07	0.11
PM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
	From N62	33.2%	0.49	0.20	46.0%	0.84	0.24



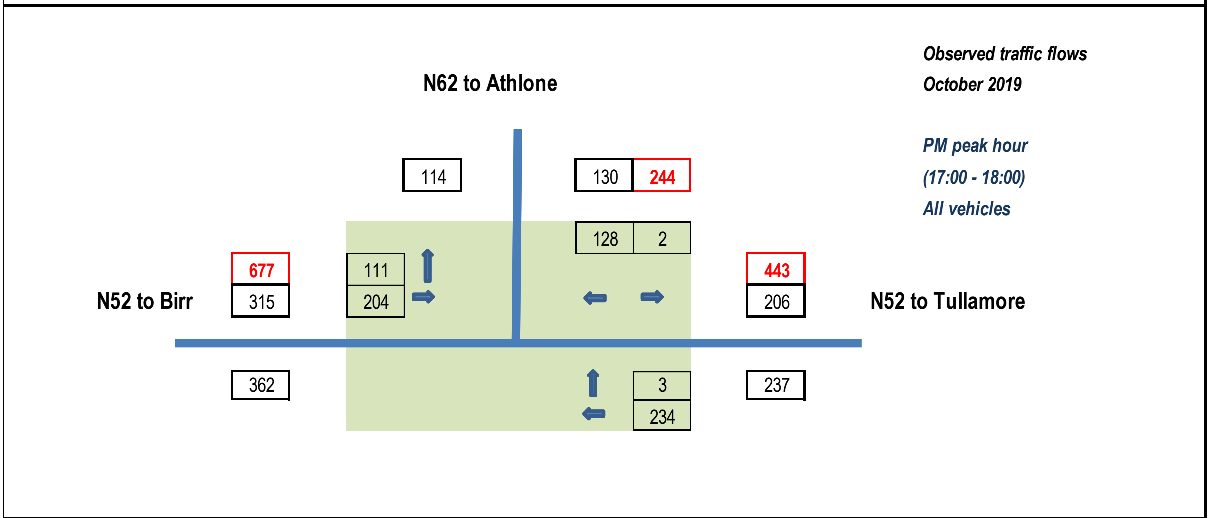


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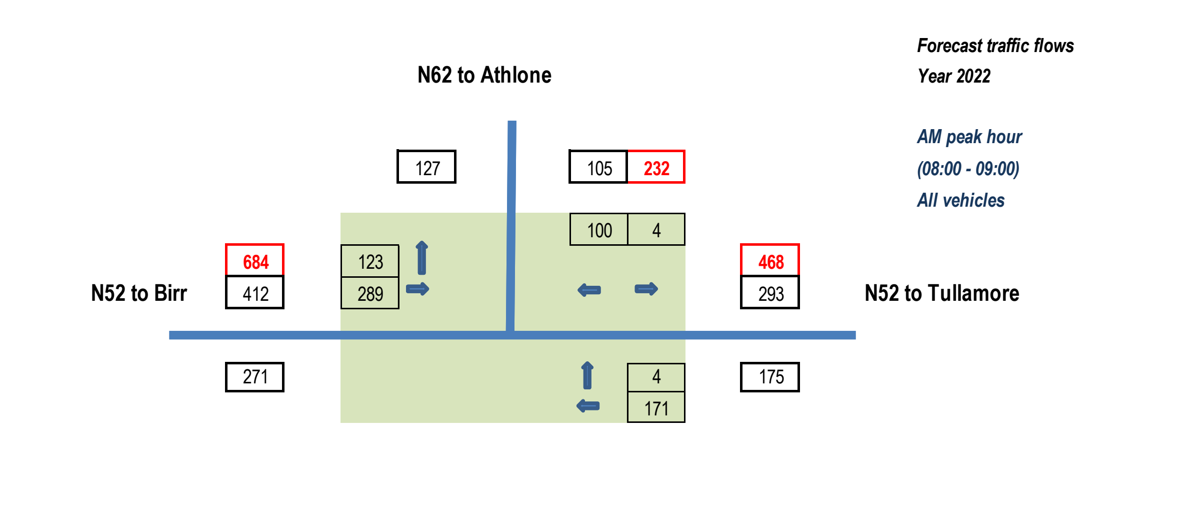
Figure 14.3a Observed traffic flows, AM & PM peak hours,
N52 / N62 junction, October 2019 - All vehicles



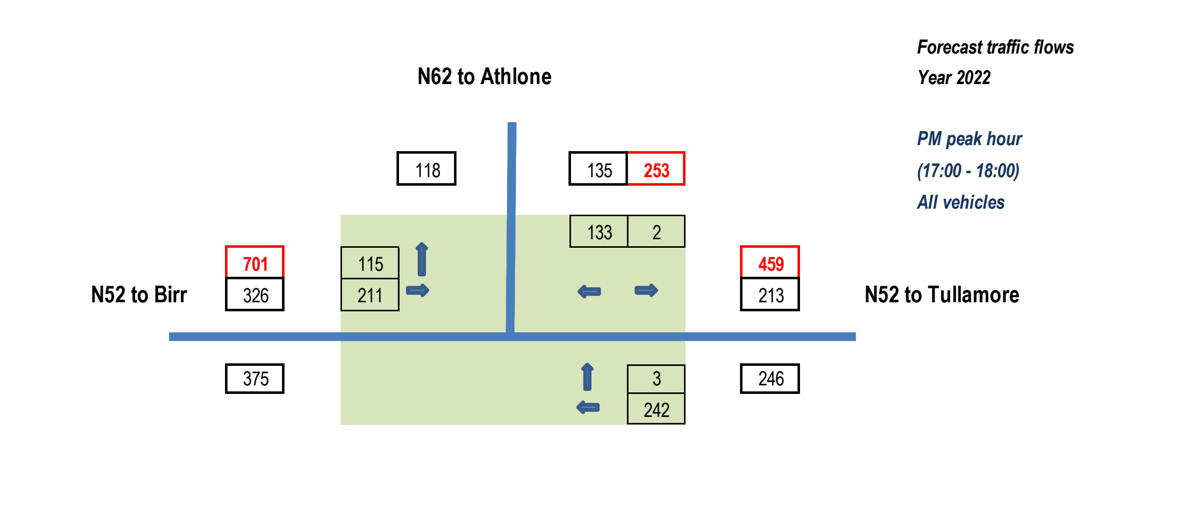


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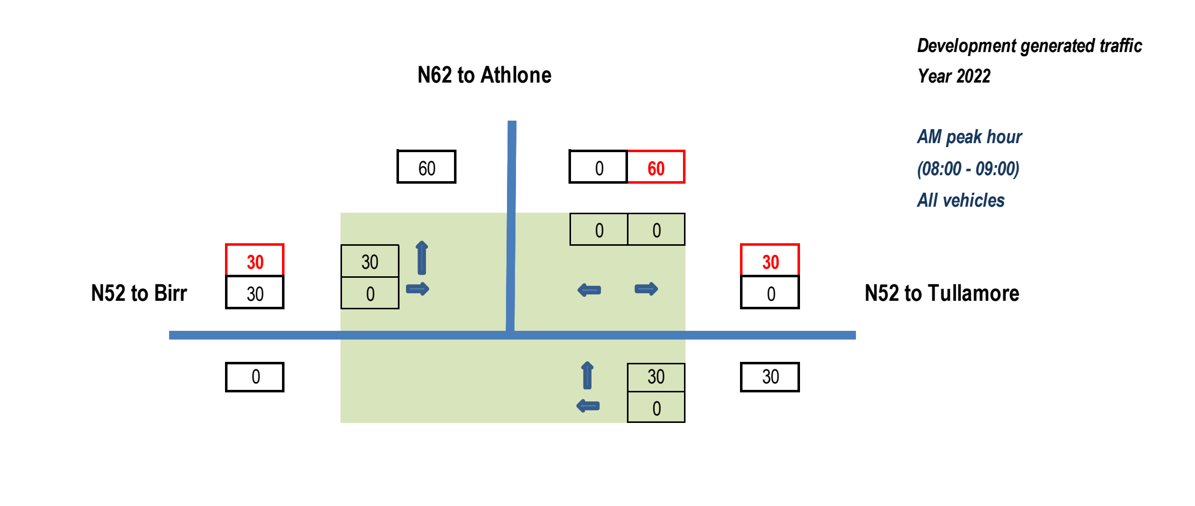
Figure 14.3b Forecast background traffic flows, AM & PM peak hours, N52 / N62 junction, October 2022 - All vehicles



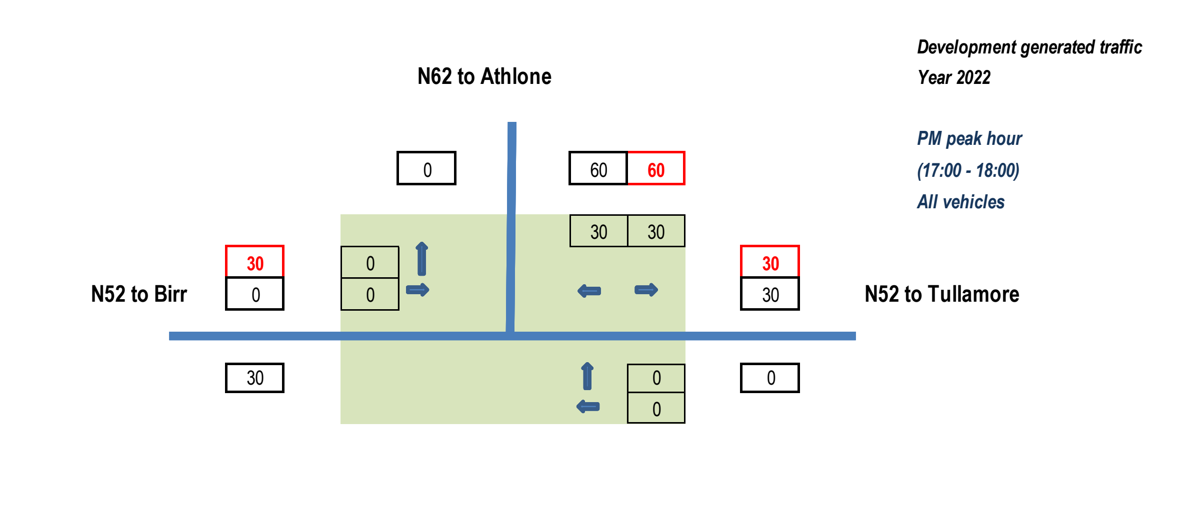


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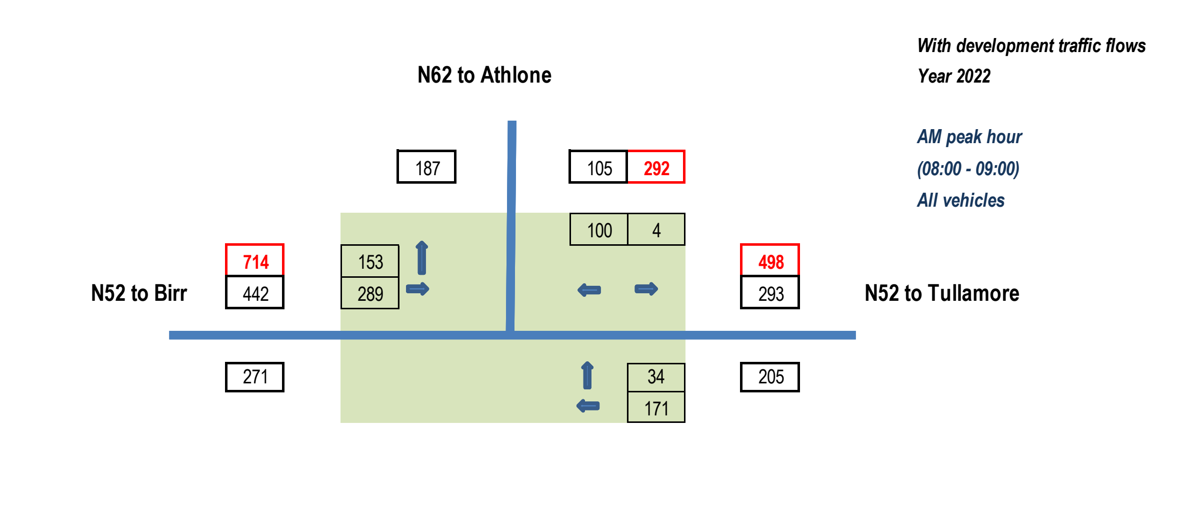
Figure 14.3c Development generated traffic flows, AM & PM peak hours, N52 / N62 junction, October 2022 - All vehicles



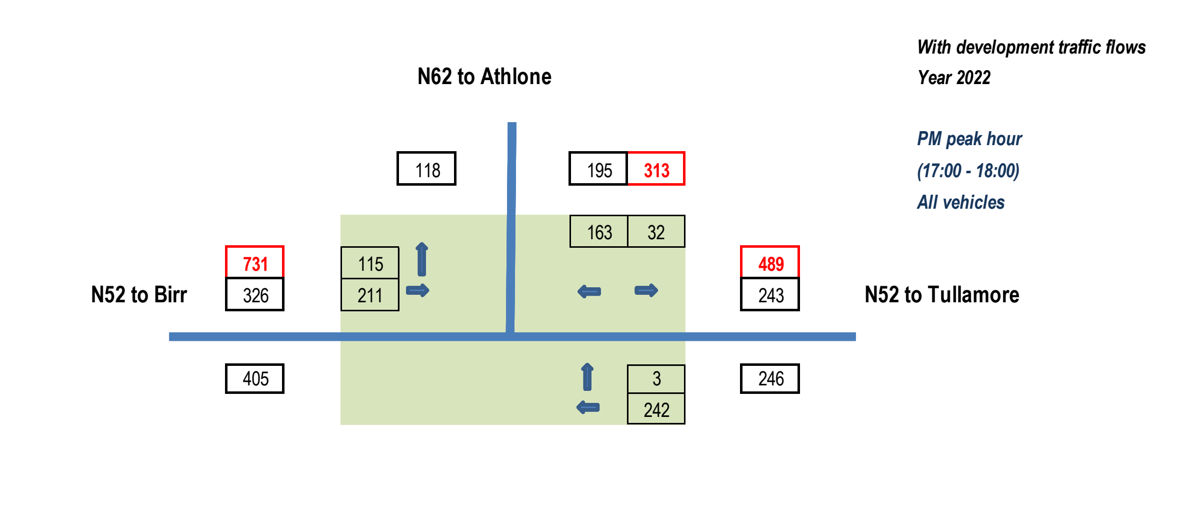


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Figure 14.3d With development traffic flows, AM & PM peak hours, N52 / N62 junction, October 2022 - All vehicles

Period	Location	Without construction traffic			With construction traffic		
	Right turn from N52	0.5%	0.01	0.10	0.5%	0.01	0.10

Effect on Junctions – During Operation

As discussed in Section 14.1.6 it is forecast that once operational, the development will generate approximately 2 trips per day for maintenance purposes. It is therefore concluded that the development will not have a significant effect on the local network once constructed.

14.1.7 Traffic Management of Large Deliveries

The greatest effect on the road network will likely be experienced on the approximately 38 days during which the 5 large loads comprising the tower sections, the blades and the nacelles are delivered to the site.

Traffic management measures are included in Section 14.1.10.6 and include the following:

- Identification of a delivery schedule,
- Details of the alterations required to the infrastructure identified in Section 13.1.8 of this report and any other minor alteration identified (hedge rows etc),
- A dry run of the route using vehicles with similar dimensions.

The transport of large components is challenging and can only be done following extensive route selection, route proofing and consultation with An Garda Síochána and the various local authorities. Turbine components are often transported at night when traffic is lightest and this is done in consultation with the roads authorities / An Garda Síochána and special permits are generally required.

In some cases, temporary accommodation works are required along the turbine delivery route (TDR) such as hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and minor road verge works. Any updates to the road will be carried out in advance of turbine deliveries and following consultation and agreement with the appropriate local authorities.

It is not anticipated that any sections of the local road network will be closed, although there may be delays to local traffic at various locations if the deliveries are made during daylight hours. During these periods, it may be appropriate to operate local diversions for through traffic. The effect of this stage may be minimised by the deliveries of the abnormally sized large loads taking place during the night. It is noted that it is proposed that all deliveries of abnormally sized loads will be made during night time hours, as is the norm for such deliveries.

14.1.8 Route Assessment

A route assessment was undertaken covering the proposed delivery route for the abnormal loads, with the route and assessment locations shown in Figure 14.2a. The preliminary route assessment discussed in this section,undertaken by Collett & Sons Ltd, indicates that the optimum route to the site would be via the M6, the N52 to Tullamore and towards Birr before turning northwards to the site on the N62. This route was therefore selected as the transport route for the abnormal loads. All locations along the route referred to in this section are highlighted in Figure 14.2a. For these locations, preliminary road and junction alignments, based on site surveys, were supplied by the project team. A preliminary swept path analysis was then undertaken using Autotrack in order to establish the locations where the wind turbine transport vehicles will be accommodated, and the locations where some form of remedial measure may be required.

The assessment also presents the preliminary design of the proposed site access junctions (two off the N62 for abnormal loads and general construction traffic, and one off the R357 for substation traffic), and the autotrack assessments for the appropriate vehicle types relevant to each access.

The locations discussed are as follows;

- Location 1 – Exit from Junction 5 of the M6 onto the N52
- Location 2 – N52 Ardan Roundabout with R420,
- Location 3 – N52 Cappancur Roundabout with L2025,
- Location 4 – N52 Cloncollog Roundabout with R420,
- Location 5 – N52 Clonminch Roundabout with R443 and N80,
- Location 6 – N52 Distillery Roundabout,
- Location 7 – N52 Ballard Roundabout with R421,
- Location 8 – N52 Charleville Roundabout with R421,
- Location 9 – N52 Mucklagh Roundabout with L6009,
- Location 10 – N52 Kilcormac east – right hand bend,
- Location 11 – N52 Kilcormac west – left hand bend,
- Location 12 – N52 / N62 Kennedy's Cross junction,
- Location 13 – Access junction 1 to eastern site on N62,
- Location 14 – Access junction 2 to western site on N62,
- Location 15 – Access junction 3 on R357.

14.1.8.1 Access to the Wind Farm site via N52, N62 and R357

The following text summarises the findings of the swept path analysis for Locations 1 to 12 undertaken by Collett & Sons Ltd and included as Appendix 14.1. The preliminary design and autotrack assessments for the three site access junctions, situated at locations 13, 14 and 15 were prepared by Alan Lipscombe Traffic and Transport Ltd.

Location 1 – Exit from Junction 5 of the M6 onto the N52

See Drawing No 324740-100B1.1

The swept path analysis undertaken for this location indicates that an area of the centre island of the roundabout will be required to be levelled and surfaced in order to accommodate the 75m blade transporter. The temporary removal of some road signs will also be required while the deliveries of the abnormally long loads are being made to the Proposed Development site.

Location 2 – Ardan Roundabout with R420

See Drawing No 324740-110B1.1

Similarly, the swept path analysis undertaken for this location also shows that an area of the centre island of the roundabout will require to be levelled and surfaced in order to accommodate the 75m blade transporter. The temporary removal of some road signs will also be required.

Location 3 – N52 Cappancur Roundabout with L2025

See Drawing No 324740-120B1.1

It is proposed that abnormal loads will negotiate this roundabout contra-flow in order to minimise the impact on the roundabout centre island. A strip of the centre island will be required to facilitate the abnormal loads and the temporary removal of some road signs will also be required.

Location 4 – N52 Cloncollog Roundabout with R420

See Drawing No 324740-130B1.1

As for location 3 it is proposed that abnormal loads will negotiate this roundabout contra-flow. A strip of the centre island will be required to facilitate the abnormal loads and the temporary removal of some road signs will also be required at this location.

Location 5 – N52 Clonminch Roundabout with R443 and N80

See Drawing No 324740-140B1.1

A strip of the centre island will be required to facilitate the abnormal loads and the temporary removal of some road signs will be required at this location.

Location 6– N52 Distillery Roundabout

See Drawing No 324740-150B1.1

A narrow strip of road widening on the southern carriageway of the approach to the roundabout and a section of the centre island will be required to facilitate the abnormal loads during the delivery stage. The temporary removal of some road signs will also be required at this location.

Location 7 – N52 Ballard Roundabout with R421

See Drawing No 324740-160B1.1

As for location 6 a narrow strip of road widening on the southern carriageway of the approach to the roundabout and a section of the centre island will be required to facilitate the abnormal loads during the delivery stage. The temporary removal of some road signs will also be required at this location.

Location 8 – N52 Charleville Roundabout with R421

See Drawing No 324740-170B1.1

In order for the abnormal sized vehicles to negotiate this roundabout a significant section of the centre island will require to be temporarily levelled and surfaced.

Location 9 – N52 Mucklagh Roundabout with L6009

See Drawing No 324740-180B1.1

While it is proposed that wheels of the abnormal load transporters will over-run onto the footpaths on the southern side of the roundabout in order to minimise the impact on the roundabout, a significant section of the centre island will require to be temporarily levelled and surfaced for this delivery stage. Some existing signs will also require to be removed on the delivery days/nights.

Location 10 – N52 Kilcormac east – right hand bend

See Drawing No 324740-190B1.1

While the swept path analysis shows that the abnormal loads will be accommodated at this location temporary parking restrictions will be required on the proposed delivery days / nights to permit these vehicles to negotiate this location.

Location 11 – N52 Kilcormac west – left hand bend

See Drawing No 324740-200B1.1

As for location 10, temporary parking restrictions will be required at this location on the proposed delivery days / nights.

Location 12 – N52 / N62 Kennedy's Cross

See Drawing No 324740-210B1.1

The swept path analyses undertaken by Collett & Sons Ltd. is based on the delivery route bypassing the existing Kennedy's Cross junction to the east, with the area of land required to accommodate the largest turbine vehicles highlighted.

Locations 13 and 14 – Site access junction to east (Access junction 1) and west (Access junction 2) off the N62

The temporary works required to accommodate the wind farm turbine vehicles, together with the junction layouts proposed for the general site clearance and construction stages are shown for the east and west sites off the N62 in Figures 14.6 to 14.17. The figures confirm that the junction layouts proposed for the delivery stage will accommodate all wind farm transport vehicles. Visibility splays of 3m x 215m, which will require to be kept clear of all obstructions above 1.05m, are shown in Figures 14.7 and 14.13 for the eastern and western junctions respectively.

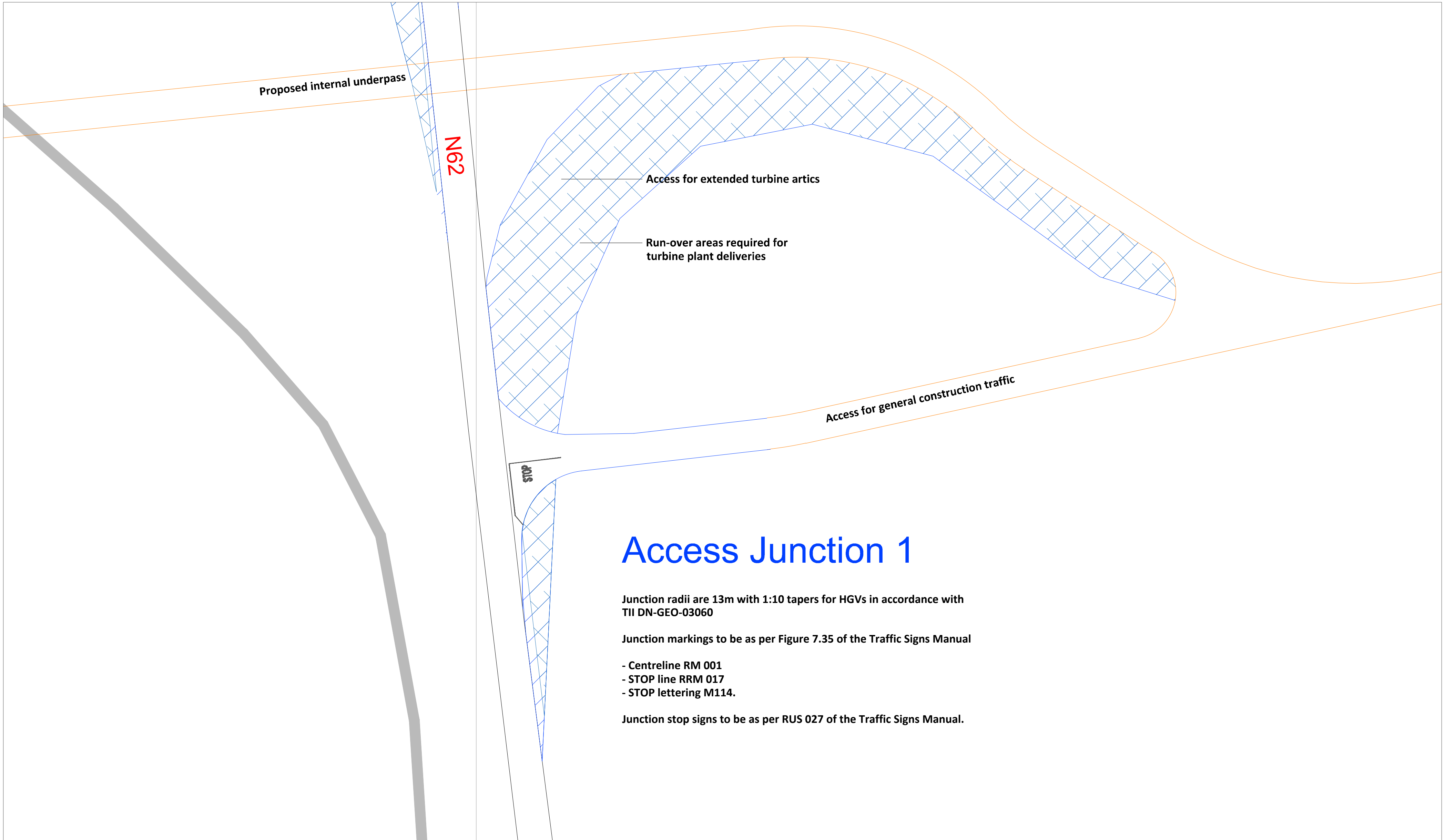
Location 15 – Access junction 3 - site access for sub-station traffic off the R357

The proposed junction layout, visibility splays and autotrack assessments for deliveries approaching from the west and east are shown for the proposed improved junction in Figures 14.18 to 14.21. The figures confirm that the junction layout proposed for the delivery stage will accommodate all vehicles requiring access to the site at this location. Visibility splays of 3m x 160m, which will require to be kept clear of all obstructions above 1.05m, are shown in Figure 14.19.

This access, together with the local L7009 Stonestown Road will also provide access to the site for amenity trips during the operational stage. The L7009 Stonestown Road will also provide operational access to the substation.

Existing Derrinlough Briquette Factory Entrance on the N62

It is proposed that the existing access junction on the N62 that serves the Bord na Mona Briquette factory will be used during the operation stage for maintenance staff visits to the site only. There will be no deliveries made via this access during the construction stage and it will be not be available for amenity trips during the operational stage.



NOTES:

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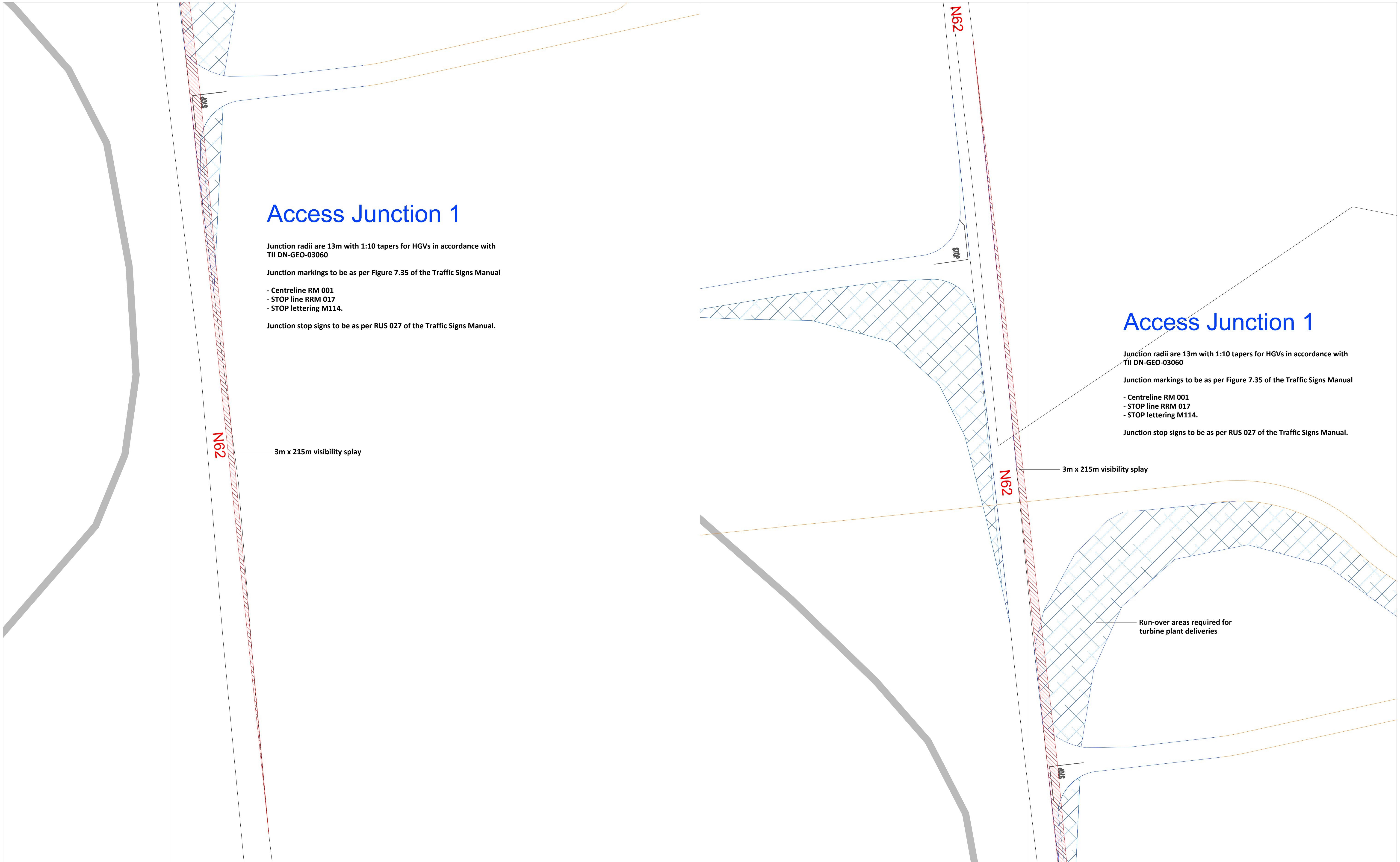
Base mapping provided by MKO

Figure 14.6 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, proposed layout

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

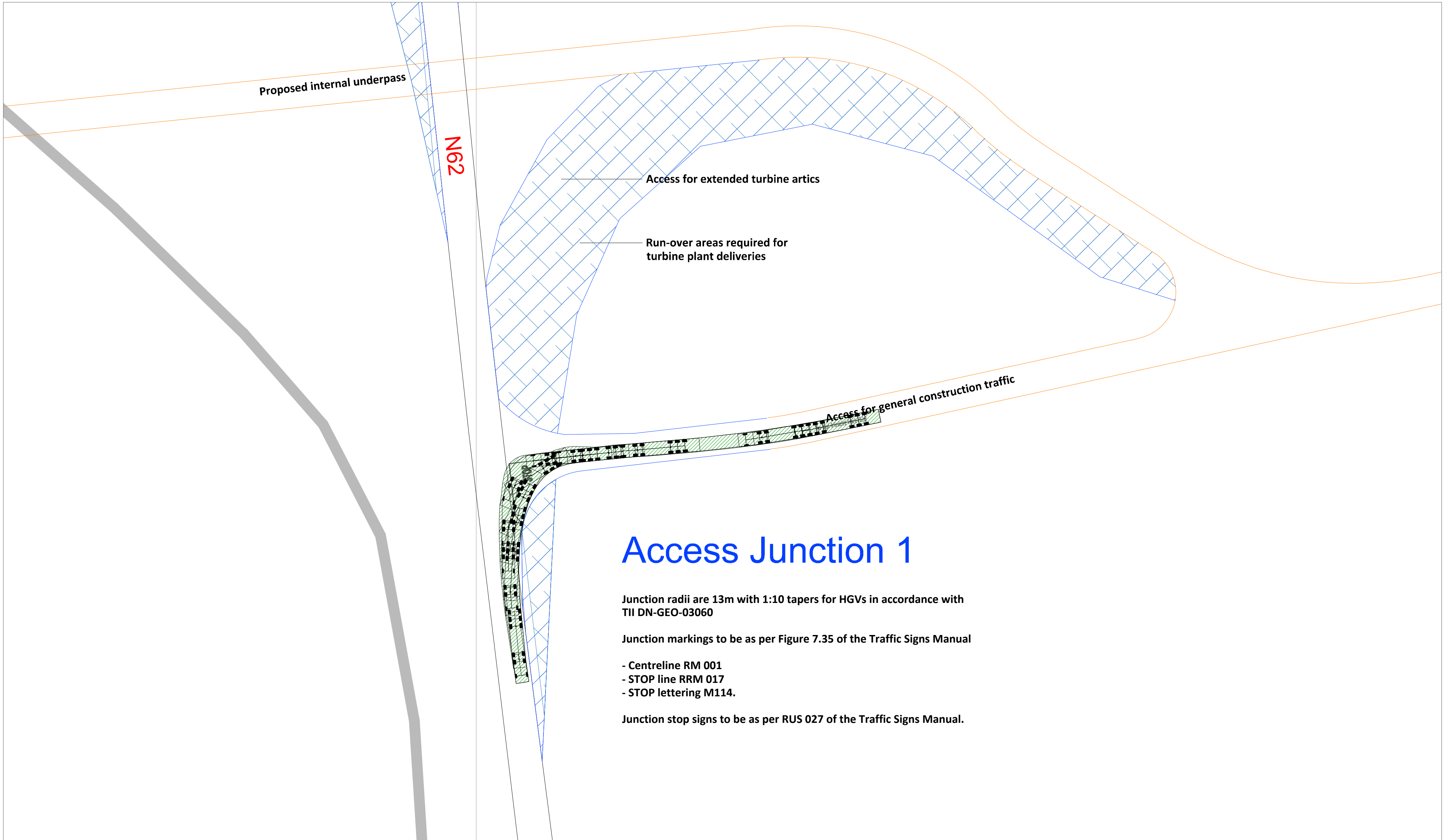
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.7 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, proposed layout and visibility splays

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



Access Junction 1

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.

NOTES:

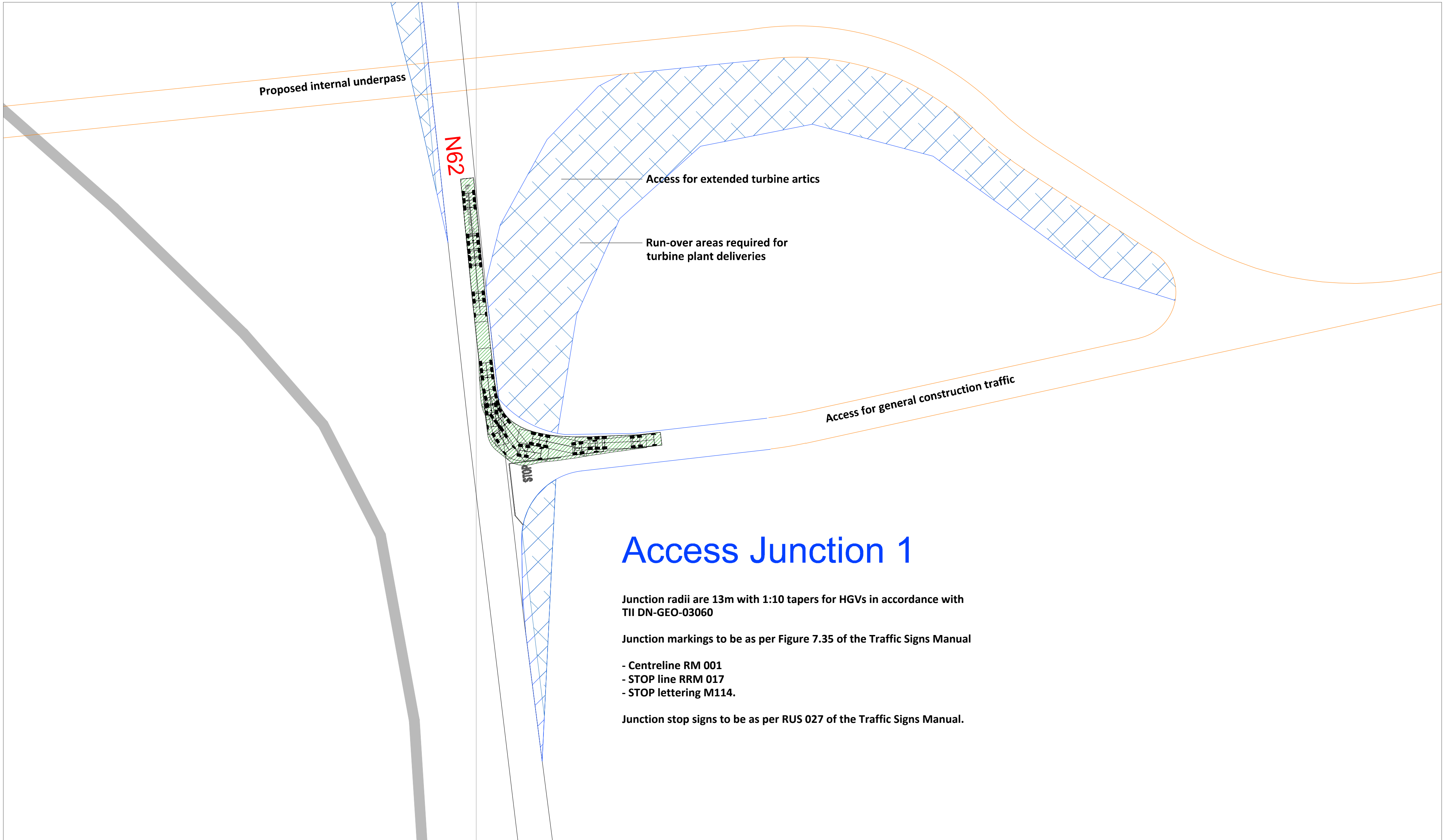
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.8 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, autotrack assessment for large standard artic HGVs to/from south

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

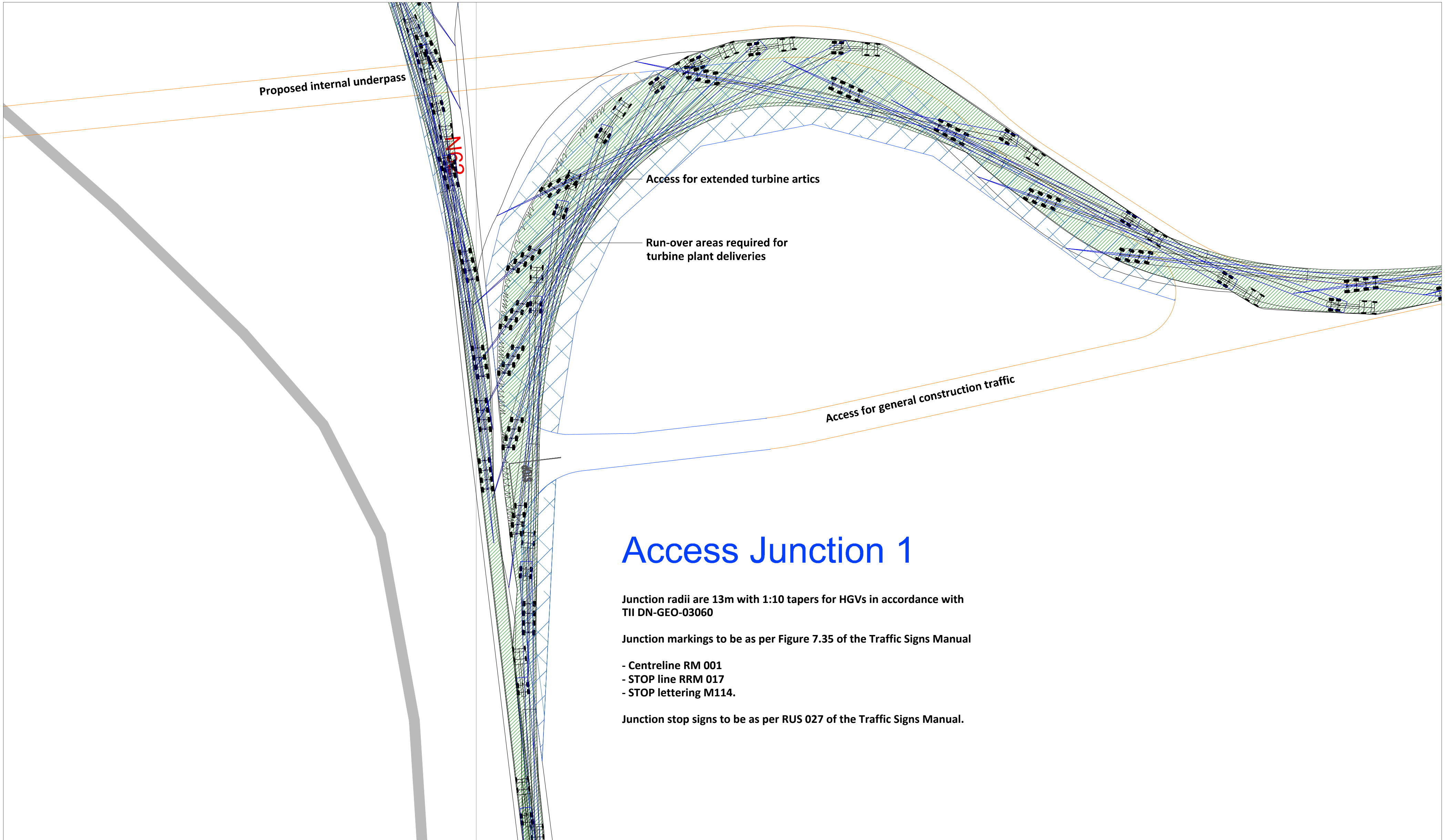
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.9 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, autotrack assessment for large standard artic HGVs to/from north

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



Access Junction 1

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.

NOTES:

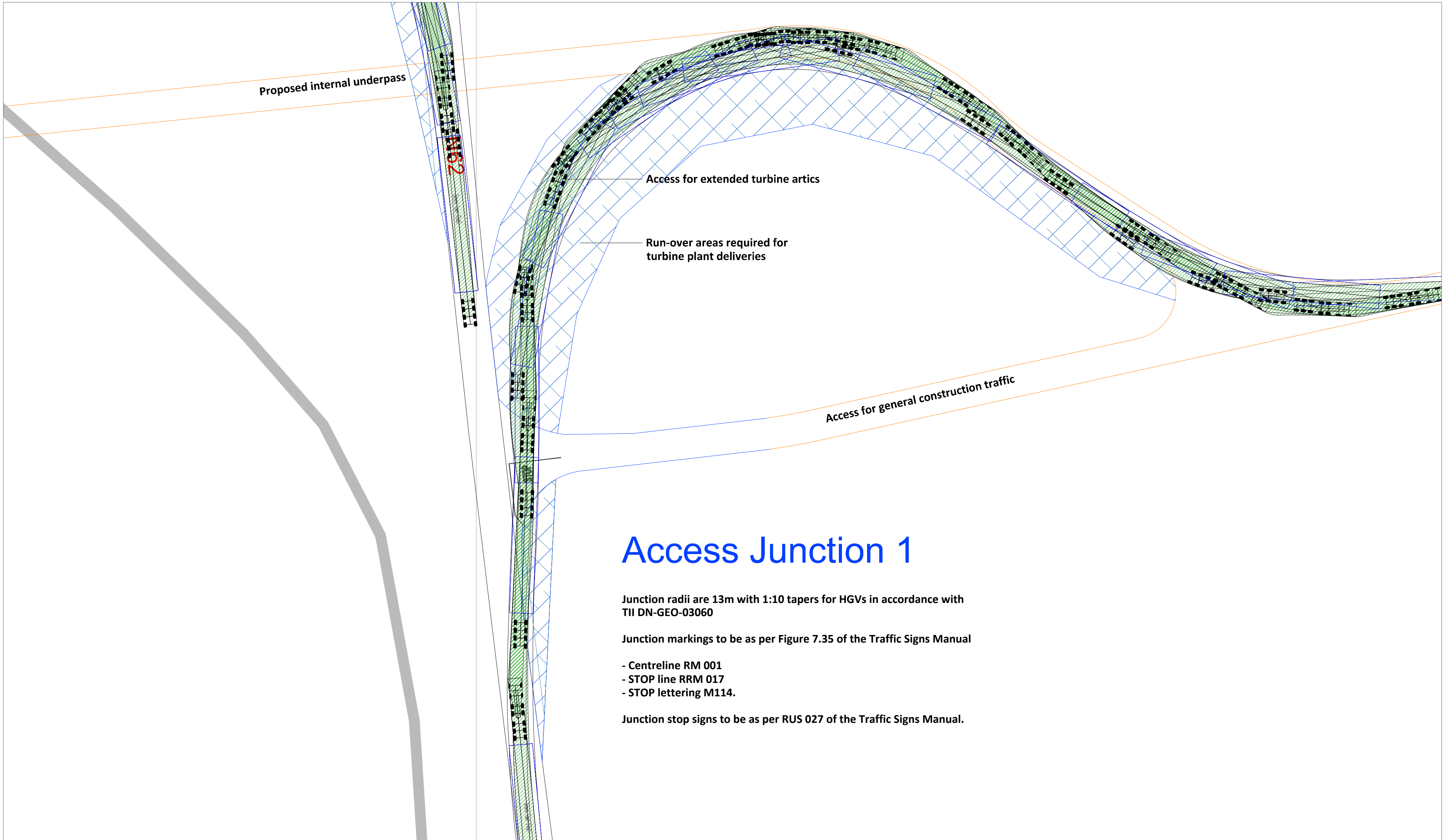
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.10 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, autotrack assessment for blade extended artic

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



Access Junction 1

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.11 Access Junction 1 - N62 - Turbine artics and general construction traffic access to eastern site, autotrack assessment for tower extended artic

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

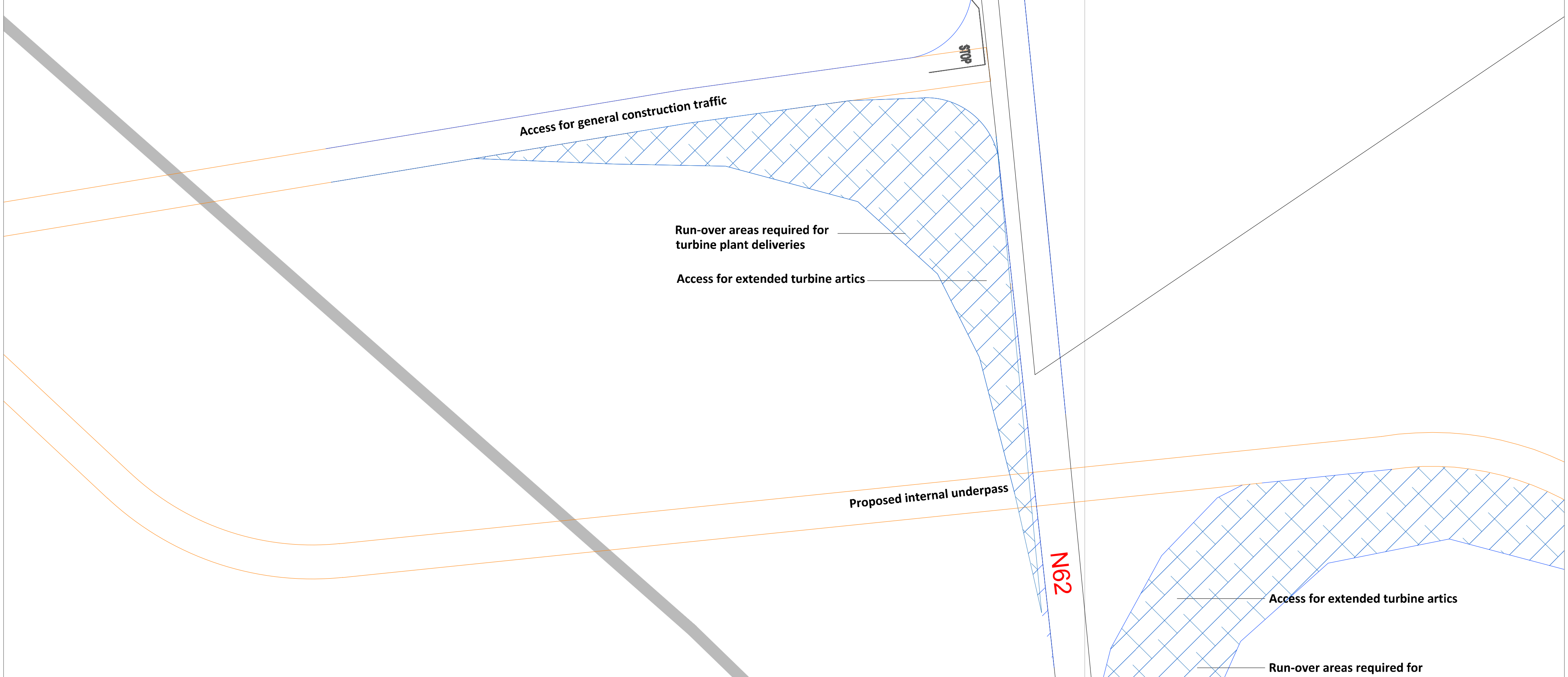
Access Junction 2

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- **Centreline RM 001**
- **STOP line RRM 017**
- **STOP lettering M114.**

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

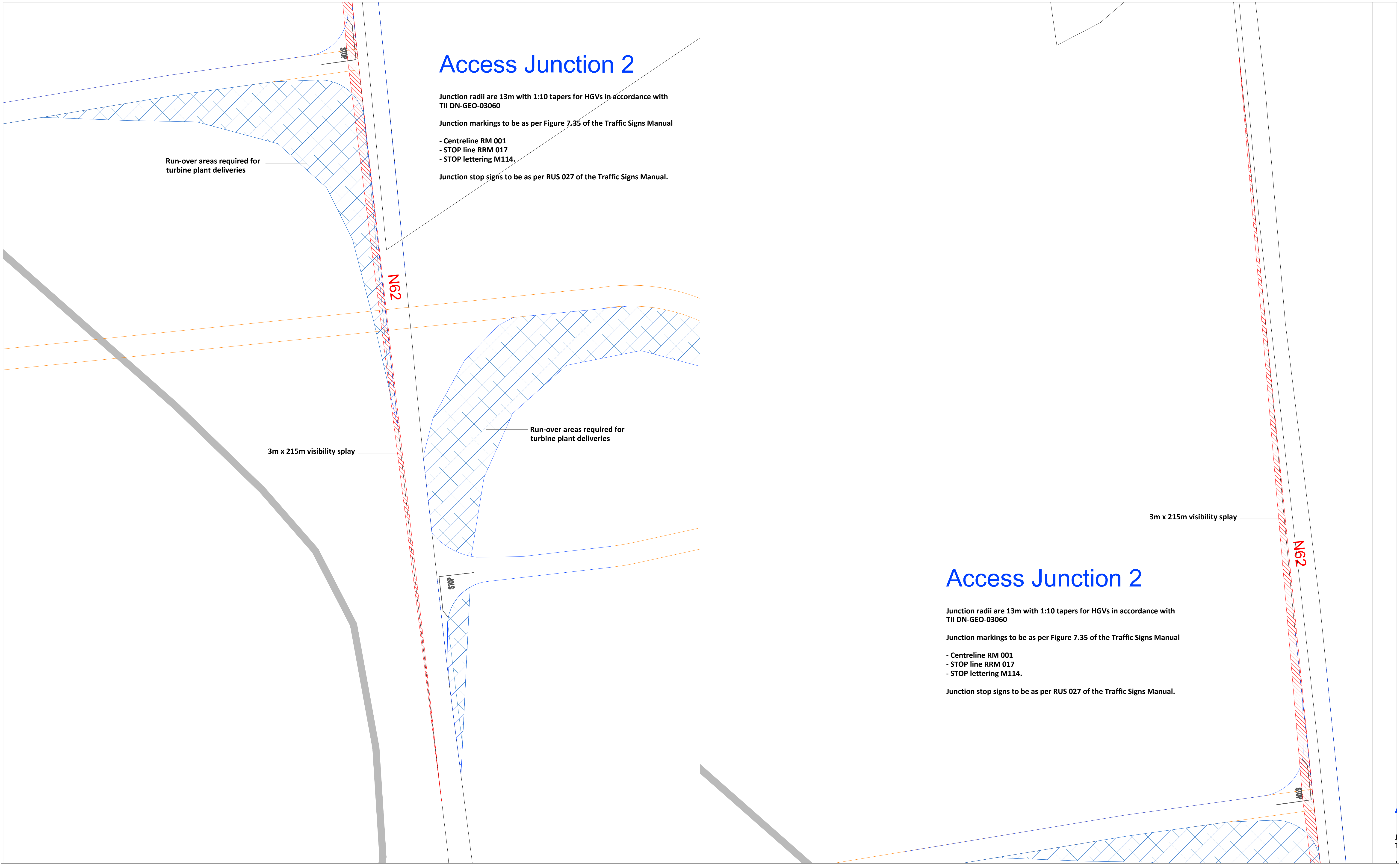
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.12 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, proposed layout

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.13 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, proposed layout and visibility splays

PROJECT: Derrinlough Wind Farm, County Offaly

CLIENT: Bord na Mona

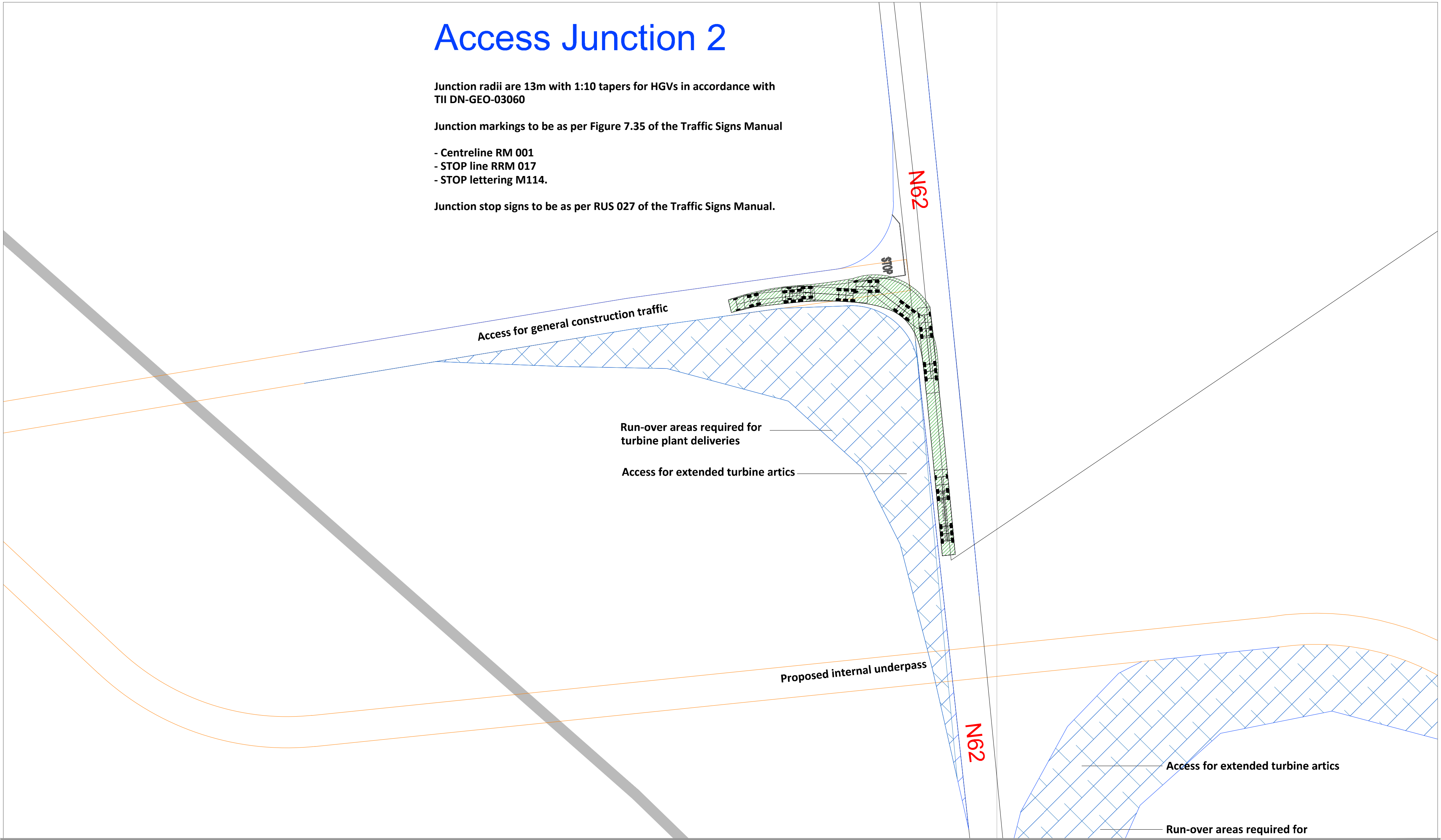
SCALE: 1:1000

PROJECT NO: 7380

DATE: 12.02.20

DRAWN BY: AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.14 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, autotrack assessment for large standard artic HGVs to/from south

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

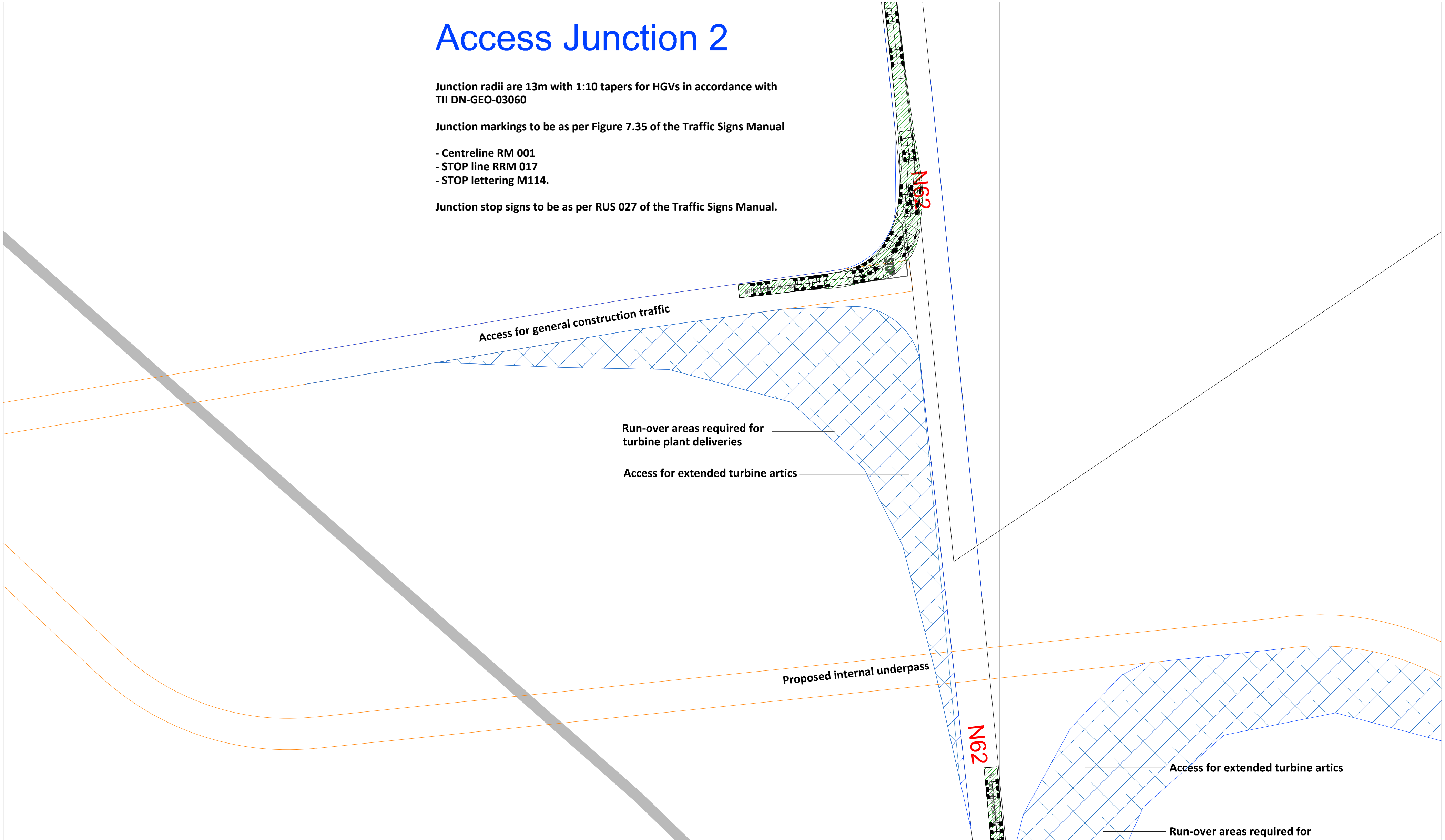
Access Junction 2

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.15 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, autotrack assessment for large standard artic HGVs to/from north

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

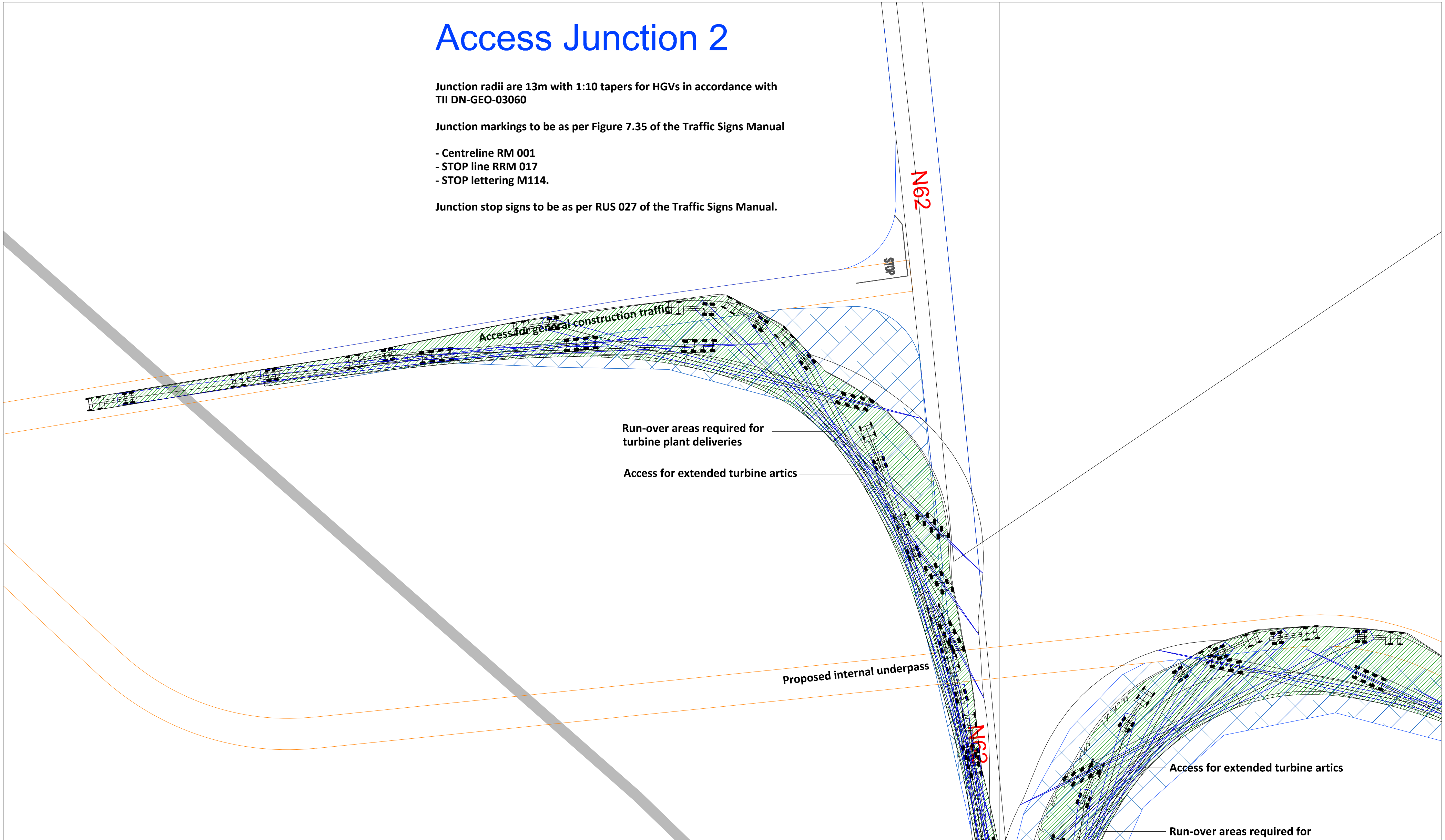
Access Junction 2

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES. Base mapping provided by MKO	Figure 14.16 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, autotrack assessment for blade extended artic			
	PROJECT: Derrinlough Wind Farm, County Offaly			ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS
	CLIENT: Bord na Mona		SCALE: 1:1000	
	PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY: AL	

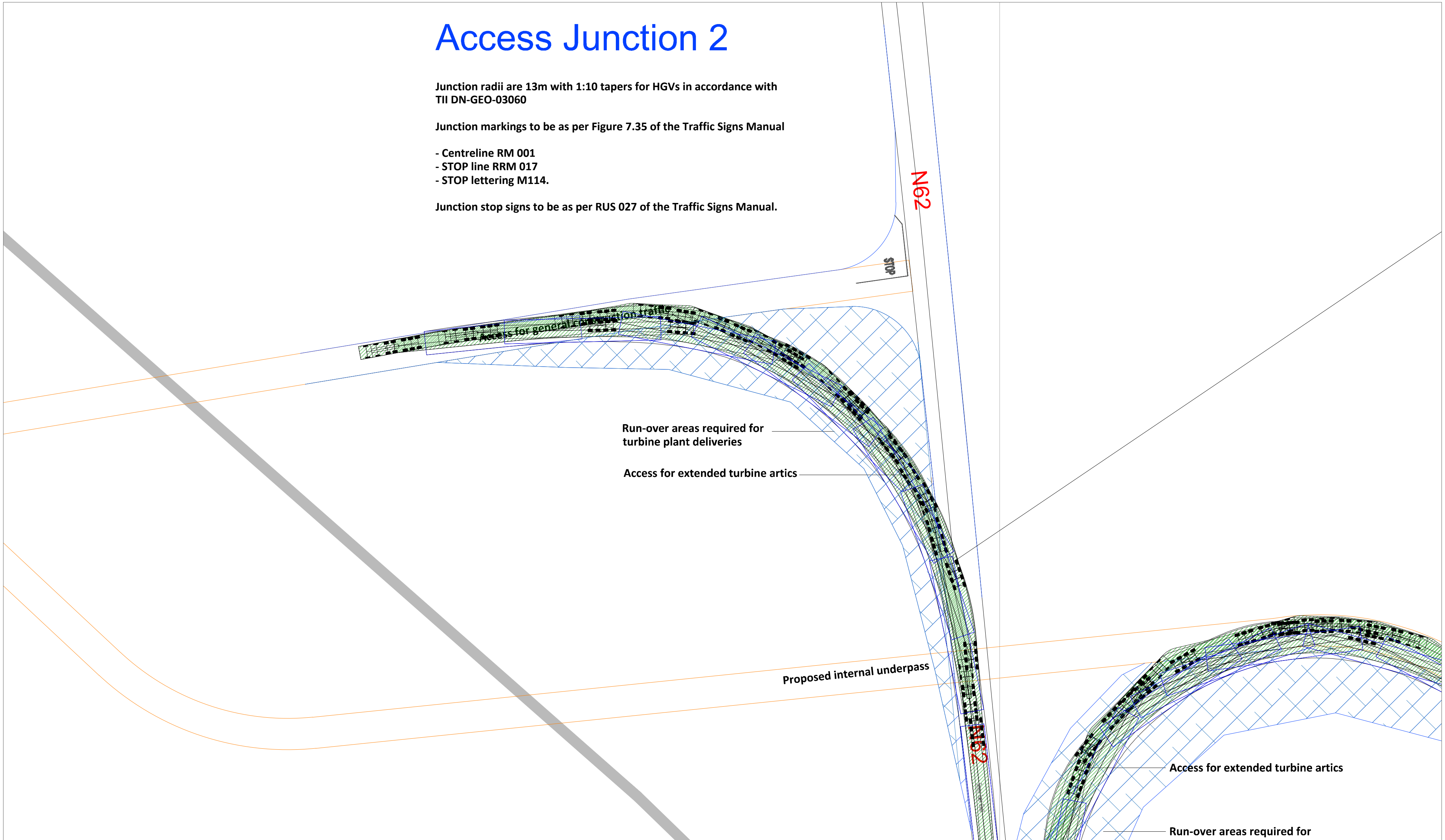
Access Junction 2

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

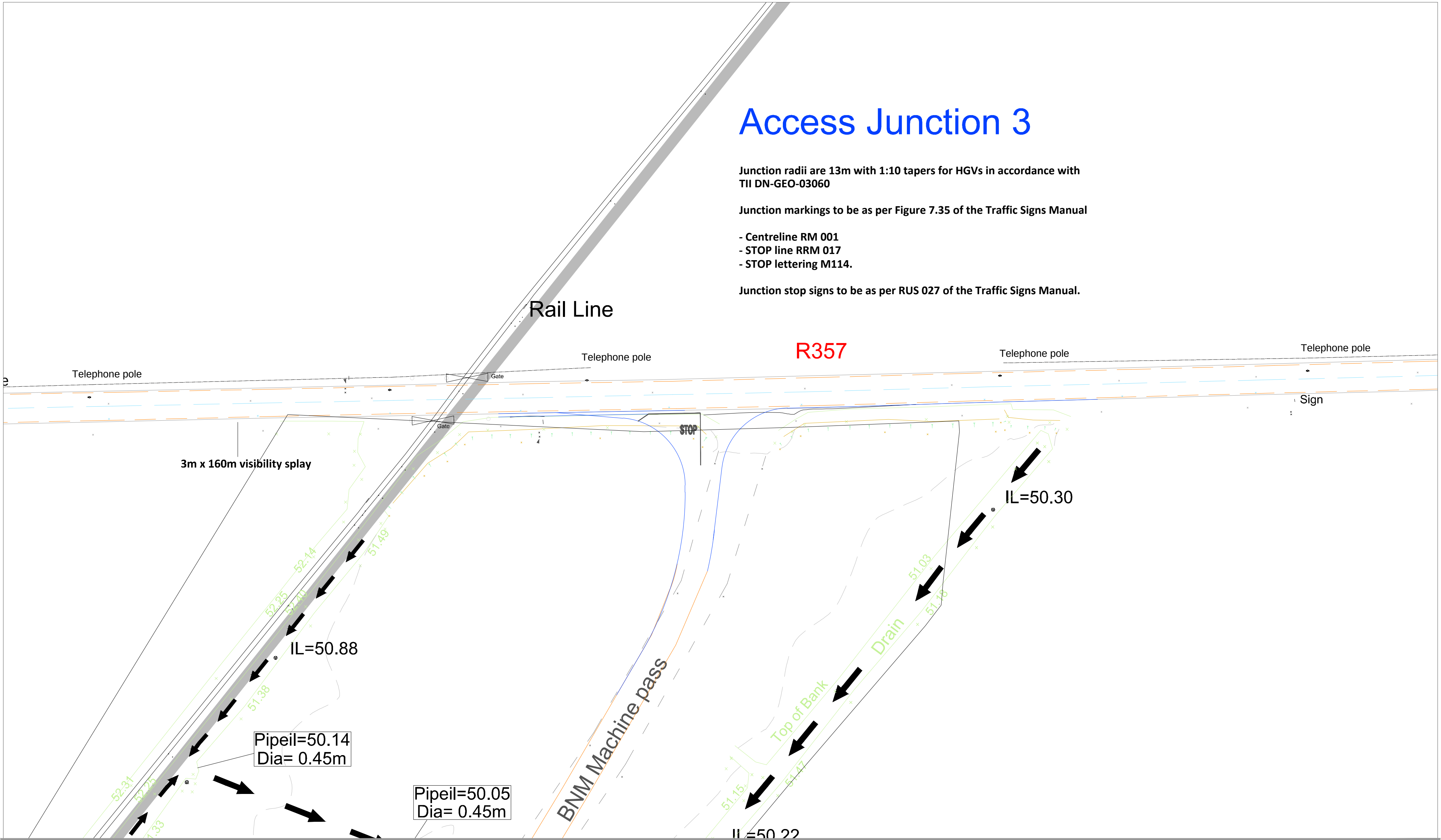
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.17 Access Junction 2 - N62 - Turbine artics and general construction traffic access to western site, autotrack assessment for tower extended artic

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.18 Access Junction 3 - R357 - Sub-station traffic access, proposed layout

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 13.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

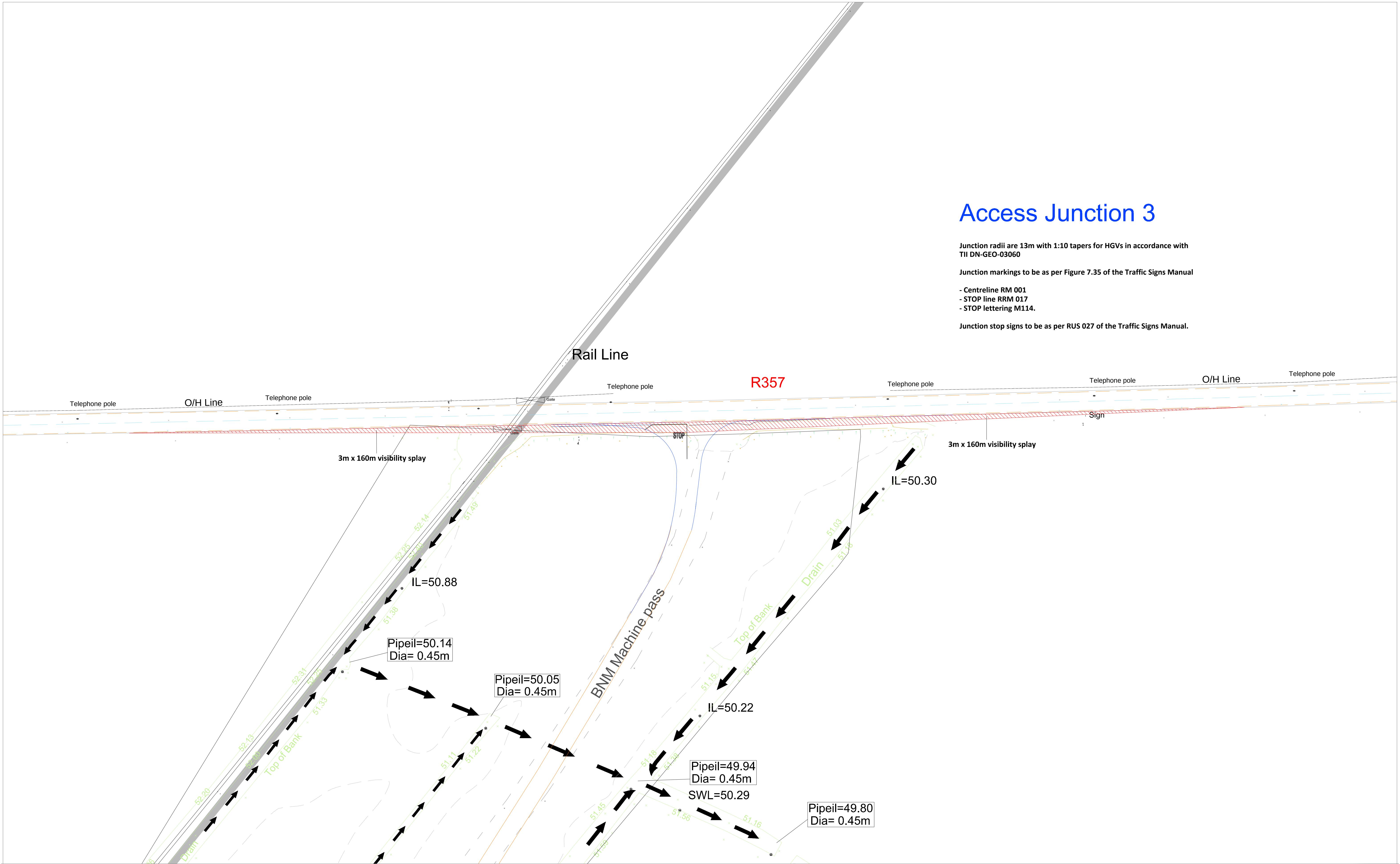
Access Junction 3

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

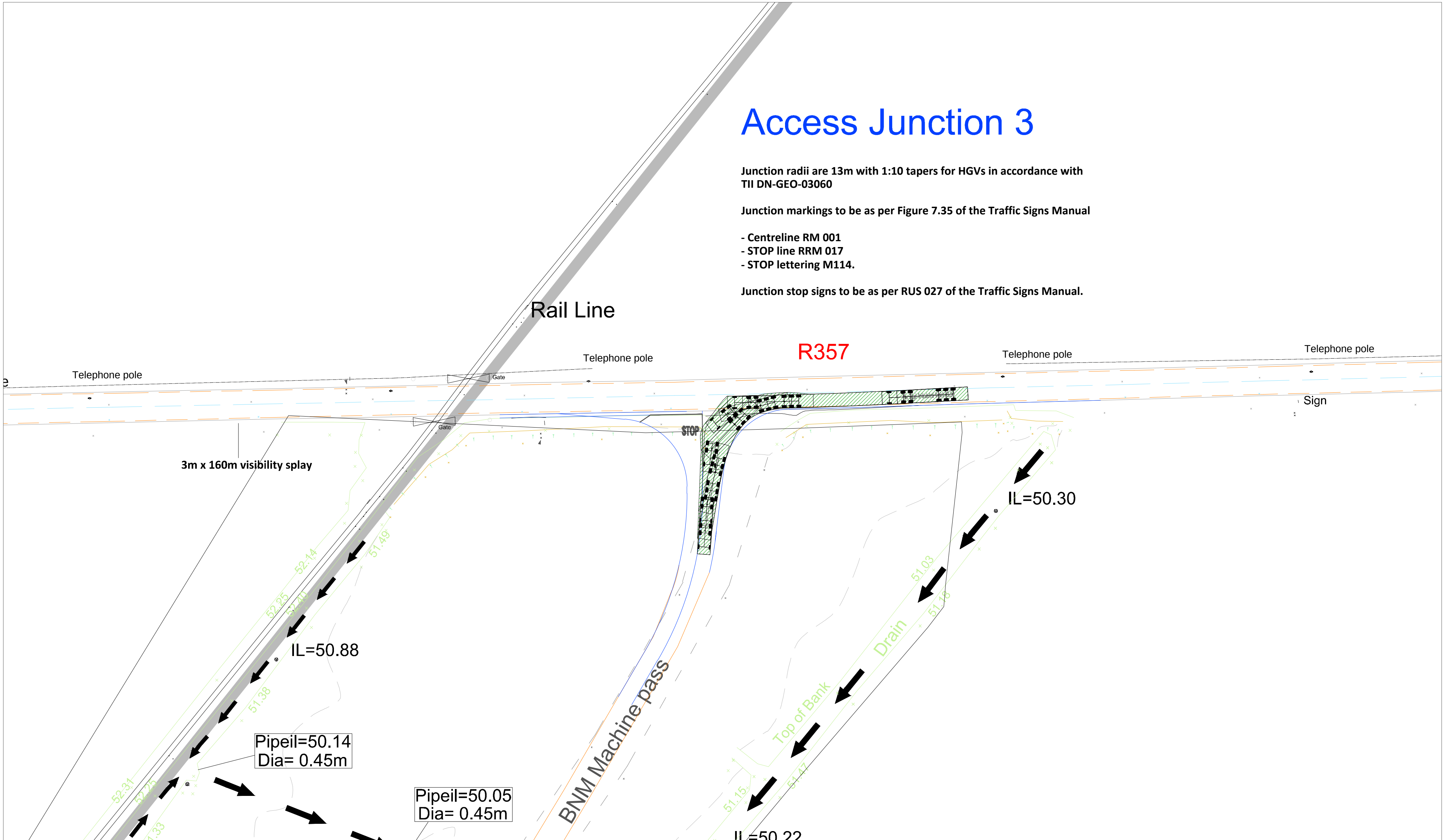
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.19 Access Junction 3 - R357 - Sub-station traffic access, proposed layout and visibility splays

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES:

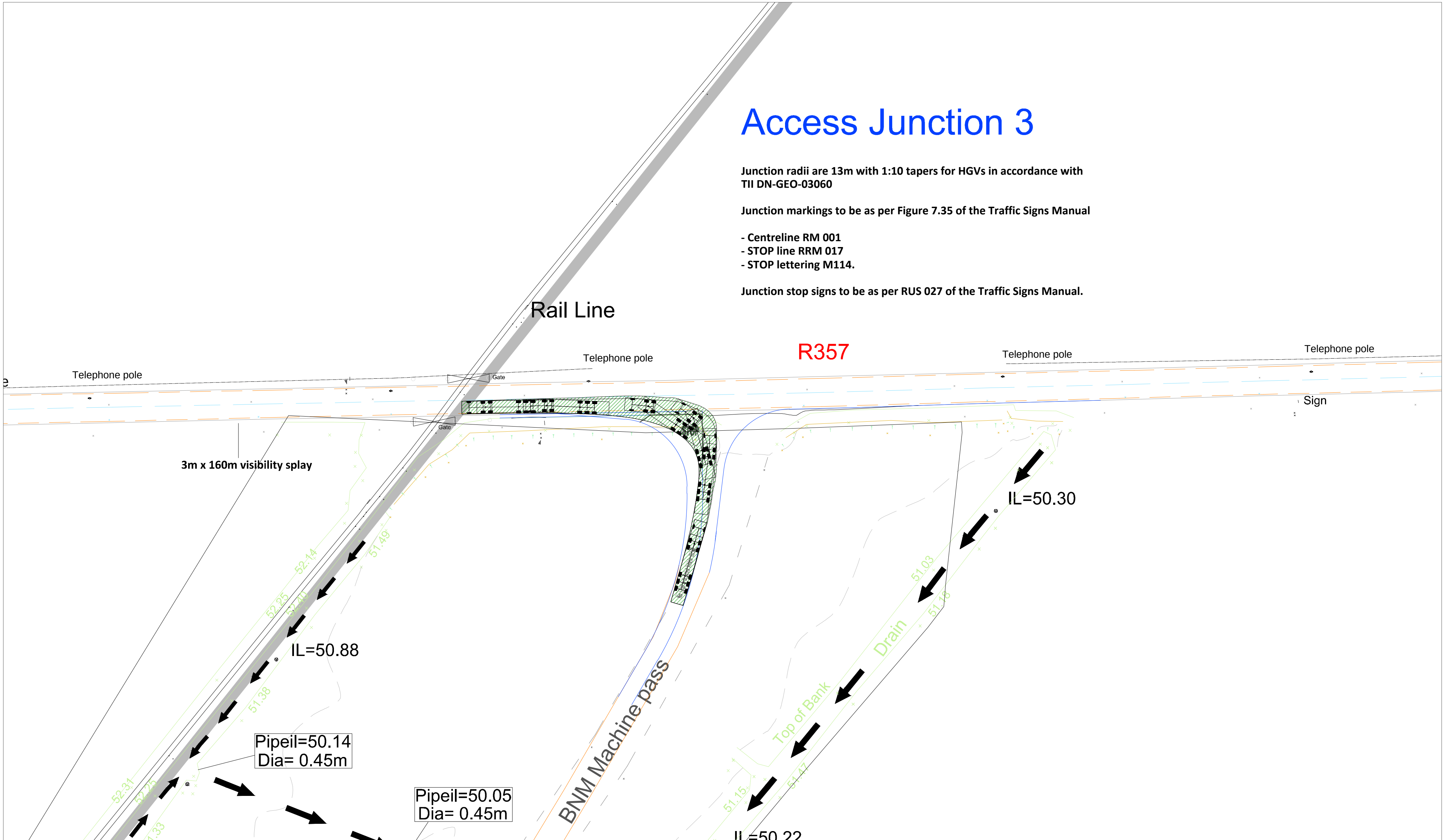
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.21 Access Junction 3 - R357 - Sub-station traffic access, autotrack assessment for large standard artic HGVs to/from east

PROJECT:	Derrinlough Wind Farm, County Offaly		
CLIENT:	Bord na Mona	SCALE:	1:1000
PROJECT NO: 7380	DATE: 12.02.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS



NOTES: PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES. Base mapping provided by MKO	Figure 14.20 Access Junction 3 - R357 - Sub-station traffic access, autotrack assessment for large standard artic HGVs to/from west
PROJECT:	Derrinlough Wind Farm, County Offaly
CLIENT:	Bord na Mona
SCALE:	1:1000
PROJECT NO:	7380
DATE:	12.02.20
DRAWN BY:	AL

ALAN LIPSCOMBE TRAFFIC & TRANSPORT CONSULTANTS

14.1.9 Provision for Sustainable Modes of Travel

14.1.9.1 Walking and Cycling

The provision for these modes is not relevant during the construction stage of the development and travel distances will likely exclude any employees walking or cycling to work.

14.1.9.2 Public Transport

There are no public transport services that currently pass the site although mini-buses may be considered for transporting construction staff to and from the site in order to minimise traffic generation and parking demand on site.

14.1.10 Likely and Significant Effects and Associated Mitigation Measures

14.1.10.1 "Do Nothing" Scenario

If the proposed wind farm does not proceed, there will be no additional traffic generated or accommodation works carried out on the local road network and therefore no direct or indirect effects on roads and traffic.

14.1.10.2 Construction Phase

During the 21 days when the concrete foundations are poured the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 8.1% on the N52 to an increase of 14% on the N62 leading to the site. The direct effect will be temporary, and will be slight.

During the remaining 489 days for the site preparation and ground works when deliveries to the site will take place, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 5.9% on the N52, to an increase of 15.5% on the N62 and 20.6% on the R357 approaching the site. On these days, the direct effect will be temporary and will be slight.

During the 21 days of the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will result in a negative impact on the surrounding road network, increasing traffic levels, ranging from 1.6% on the N52, to an increase of 2.8% on the N62. The direct effect during this period will be temporary and will be slight.

During the 38 days when the various component parts of the wind turbine plant are delivered to the site using extended articulated HGVs, the effect of the additional traffic on these days will be moderate due to the size of vehicles involved, resulting in increased traffic volumes of between 3.0% on the N52 to 5.3% on the N62 leading to the site, but will be temporary. The direct effect may be reduced to slight if the delivery of the large plant is done at night, as is proposed.

It was determined that all links in the study area will operate within operational capacity for all days within the construction period.

14.1.10.3 Operational Phase

During the operational phase the direct effect on the surrounding local highway network will be neutral and long term given that there will be approximately two maintenance staff travelling to site at any one time, resulting in typically two visits to the site on any one day made by a car or light goods vehicle.

Should the proposed wind farm be consented and developed, the recreational and amenity proposals set out in Chapter 4 will be implemented which means that there will be some levels of traffic accessing the site for amenity use during the operational stage. This traffic will access the site via the R357 where the proposed amenity car park is located. The volumes are likely to be small (up to a maximum of 40 car trips per day) based on information from other similar Bord na Móna facilities. Given the capacity of the local highway network there is no significant effects anticipated on roads and traffic.

14.1.10.4 Decommissioning Phase

The design life of the wind farm is 30 years. If the site is decommissioned, cranes will disassemble each turbine tower and all equipment.

All turbine infrastructure including turbine components will be separated and removed off-site for re-use, recycling and waste disposal.

It is proposed that turbine foundations and hardstanding areas will be left in place and covered with soil/topsoil. It is proposed to leave the access roads in situ at the decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstanding areas in situ will cause less environmental damage than removing and recycling them. However, if removal is deemed to be required all infrastructure will be removed with mitigation measures similar to those during construction being employed.

After decommissioning, the areas around the turbine bases and other disturbed areas will be encouraged to revegetate naturally and will be backfilled with peat and spoil similar to that removed during excavation so as to allow natural recolonisation.

14.1.10.5 Cumulative Effects

A detailed assessment of all developments at varying stages in the planning process (from pre-planning to operational), is set out in Section 2.6 of this EIAR, with an assessment of the potential cumulative traffic effects with the proposed subject wind farm assessed on the following criteria;

- Project status (proposed to operational)
- Degree of overlap with the Proposed Development delivery highway network (low to high)
- Traffic volumes (low to high)

The development or activities that were considered to have potential cumulative impacts with the proposed wind farm development in terms of traffic impacts are summarised in Table 14.25.

All other wind farm developments located within a 20km radius and shown in Figure 2.7 are also listed in Table 14.25. It is noted that the delivery routes for the granted Cloghan and Meenwaun Wind Farms are common to the delivery route (the N52 and the N62) for the Proposed Development. In the event that the Proposed Development is constructed at the same time as either of these developments it is forecast that there will be a temporary and moderate level of cumulative impact. This will be avoided by ensuring that the construction phases for all 3 developments do not overlap through careful scheduling of deliveries to each site and with agreement of Offaly County Council .

Reference was also made in the preparation of this assessment to other planning applications as set out in Chapter 2.

Table 14.24 Summary of projects considered in cumulative assessment and potential for cumulative traffic effects with proposed Derrinlough Wind Farm

Project	Status	Degree of overlap of highway network (low / medium / high)	Traffic volumes (low / medium / high)	Potential cumulative traffic effects
1. Gas fired electricity generating station, Lumcloon Energy Ltd	Permission granted	Medium	Low	Slight
2. Leabeg Wind Farm, 2 turbines (PL Ref 10/130), Gaelectric Developments Ltd	Existing	Not relevant	Not relevant	Included in background traffic levels
3. Cloghan Wind Farm, 9 turbines (PL ref 14/188 & 19/404) Gaeltech Developments Ltd	Permission granted	High	Medium	Moderate
4. Meenwaun Wind Farm, 5 turbines (PL ref 15/44), Meenwaun Wind Farm Ltd	Almost complete	High	Low	Slight
5. Carrig Wind Farm, 3 turbines (PL ref 5123496) T and G Armitage	Existing	Not relevant	Not relevant	Included in background traffic levels
6. Skehanagh Wind Farm, 5 turbines (PL ref 5123495) N and R Alexander	Existing	Not relevant	Not relevant	Included in background traffic levels
7. Lumcloon 100 MW Energy Storage Facility, Lumcloon Energy Ltd	Under construction	Medium	Low	Slight

14.1.10.6 Mitigation Measures

This section summarises the mitigation measures to minimise the effects of the Proposed Development during both the construction and operational stages.

Mitigation by Design

Mitigation by design measures includes the following;

- Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles as set out in Section 14.1.8.
- Construction of temporary improvements to the local highway network at locations identified in Section 14.1.8.

Mitigation Measures During the Construction Stage

The successful completion of this development will require significant coordination and planning and it is therefore recommended that the following comprehensive set of mitigation measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional traffic generated by the proposed wind farm.

Delivery of abnormal sized loads

The following are the main points to note for these deliveries which will take place after peak evening traffic:

- The delivery of turbine components is a specialist transport operation with the transportation of components carried out at night when traffic is at its lightest and the impact minimised.
- The deliveries will be made in consultation with the Local Authority and An Garda Síochána.
- It is estimated that 189 abnormal sized loads will be delivered to the site, comprising 38 convoys of 5, undertaken over 38 separate nights.
- These nights will be spread out over an approximate period of 19 weeks and will be agreed in advance with the relevant authorities
- In order to manage each of the travelling convoys, for each convoy there will be two police escort vehicles that will stop traffic at the front and rear of the convoy of 5 vehicles.
- There will also be two escort vehicles provided by the haulage company for each convoy.

Other traffic management measures

A detailed **Traffic Management Plan (TMP)**, will be provided specifying details relating to traffic management and included in the CEMP prior to the commencement of the construction phase of the proposed development. The TMP will be agreed with the local authority and An Garda Síochána prior to construction works commencing on site. The detailed TMP will include the following:

- **Traffic Management Coordinator** – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
- **Delivery Programme** – a programme of deliveries will be submitted to the County Council in advance of deliveries of turbine components to site. Liaison with the relevant local authorities and Transport Infrastructure Ireland (TII) will be carried out where required regarding requirements such as delivery timetabling. The programme will ensure that deliveries are scheduled in order to minimise the demand on the local network and minimise the pressure on the access to the site.
- **Information to locals** – Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-ordinator, who will be

the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.

- **A Pre and Post Construction Condition Survey** – Where required by the local authority, a pre-condition survey of roads associated with the proposed development can be carried out immediately prior to construction commencement to record an accurate condition of the road at the time. A post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.
- **Liaison with the relevant local authority** - Liaison with the County Council and An Garda Síochána, will be carried out during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required. Once the surveys have been carried out and "prior to commencement" status of the relevant roads established, (in compliance with the provisions of the CEMP), the Roads section will be informed of the relevant names and contact numbers for the Project Developer/Contractor Site Manager as well as the Site Environmental Manager.
- **Implementation of temporary alterations to road network at critical junctions** – at locations highlighted in section 14.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers will also be used where deemed practicable.
- **Identification of delivery routes** – These routes will be agreed with the County Council and adhered to by all contractors.
- **Delivery times of large turbine components** - The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.
- Travel plan for construction workers – While the assessment above has assumed the worst case in that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, which will include the identification of routes to / from the site and identification of an area for parking.
- **Additional measures** - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required. These are set out in the CEMP which is contained in Appendix 4.3.
- **Re-instatement works** - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.

Mitigation Measures During Operational Stage

Due to the very low volumes of traffic forecast to be generated during this stage no mitigation measures are required.

Mitigation Measures During Decommissioning Stage

In the event that the Proposed Development is decommissioned after the 30 years of operation, a decommissioning plan, including material recycling / disposal and traffic management plan will be prepared for agreement with the local authority. This plan will contain similar mitigation measures to those implemented during the construction phase.

14.1.10.7 Residual Impacts

Construction Stage

During the 24-month construction stage of the Proposed Development, it is forecast that the additional traffic that will appear on the delivery route indicated in Figure 14.2a will have a slight, negative and temporary impact on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

Operational Stage

As the traffic impact of the optimised development will be imperceptible during the operational stage, there will be no residual impacts during this stage.

Decommissioning Stage

As stated above, in the event that the wind farm is decommissioned a decommissioning plan will be prepared and implemented in order to minimise the residual impacts during this stage.

14.2 Telecommunications and Aviation

14.2.1 Introduction

This section of the EIAR assesses the likely significant effects of the proposed wind farm on telecommunications and aviation. Section 14.2.3 describes the way in which wind turbines can potentially interfere with telecommunications signals or aviation activities. Section 14.2.4 presents details on how such effects will be avoided, with the likely significant effects assessed (and mitigation measures proposed) in Section 14.2.5.

14.2.2 Methodology and Guidance

This section of the assessment focuses particularly on the scoping and consultation exercise conducted with telecommunications operators and aviation authorities. Scoping was carried out in line with the above EPA guidelines, and the '*Best Practice Guidelines for the Irish Wind Energy Industry*' (Irish Wind Energy Association, 2012), which provides a recommended list of telecommunications operators for consultation.

A full description of the scoping and consultation exercise is provided in Section 2.7 of Chapter 2 of this EIAR. Consultation with the telecommunications operators and aviation bodies informed the constraints mapping process, which in turn informed the layout of the proposed development, as described in Chapter 3 of the EIAR.

The assessment of likely significant effects on material assets uses the standard methodology and classification of impacts as presented in Section 1.8.1 of Chapter 1 of this EIAR. The full project description, including proposed turbine locations and elevations, is provided in Chapter 4.

14.2.2.1 Statement of Authority

This section of the EIAR has been prepared by Eoin McCarthy (B.Sc. Env.), Environmental Scientist with MKO. Eoin has over 8 years' experience in the preparation of EIARs for wind energy developments, including the assessment of likely significant effects on material assets. He has coordinated the scoping and consultation exercise with telecommunications operators and aviation authorities for numerous wind energy developments and prepared the relevant sections of the EIARs.

14.2.3 Background

14.2.3.1 Broadcast Communications

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path.

14.2.3.2 Domestic Receivers

Depending on local topography, a domestic receiver may receive broadcast signals from more than one location. The strength of the signals varies with distance from the transmitter, and the receiver's antenna is generally always directed towards the most local, and usually strongest, broadcasting station.

There are two types of potential electromagnetic interference to domestic receivers, depending on the location of the receiver in relation to a wind farm. 'Shadowed' houses are located directly behind a wind farm, relative to the location from where the signal is being received. In this case, the main signal passes through the wind farm and the rotating blades can create a degree of signal scattering. In the case of viewers located beside the wind farm (relative to the broadcast signal direction), the effects are likely to be due to periodic reflections from the blade, giving rise to a delayed signal.

In both cases, i.e. shadowed houses located behind the wind farm and those located to the side of it, the effects of electromagnetic interference may depend to some degree on the wind direction, since the plane of rotation of the rotor will affect both the line-of-sight blockage to viewers located behind the wind farm and the degree of reflection to receivers located to the side.

14.2.3.3 Other Signal Types

Wind turbines have the potential to affect other signal types used for communication and navigational systems, for example tower-to-tower microwave communication links, and airborne and ground radar systems. Interference with radar systems occurs when wind turbines are located close to an airport or directly in line with the instrument landing approach. These effects are generally easily dealt with by detailed micro-siting of turbines in order to avoid alignment with signal paths or by the use of repeater relay links out of line with the wind farm.

14.2.4 Preventing Electromagnetic Interference

14.2.4.1 National Guidelines

Both the adopted 2006 and the Draft Revised 2019 '*Wind Energy Development Guidelines for Planning Authorities'* produced by the Department of the Environment, Heritage and Local Government (DOEHLG) state that interference with broadcast communications can be overcome by the installation of deflectors or repeaters where required.

Developers are advised to contact individual local and national broadcasters and mobile phone operators to inform them of proposals to develop wind farms. This consultation has been carried out by MKO as part of the assessment of the proposed development as summarised below; full details are provided in Section 2.7 in Chapter 2 of this EIAR.

The layout and design of the proposed development has taken into account nearby telecommunications links.

14.2.4.2 Scoping and Consultation

As part of the EIAR scoping and consultation exercise, MKO contacted the relevant national and regional broadcasters, fixed and mobile telephone operators, aviation authorities and other relevant consultees. Consultation was also carried out with ComReg in order to identify any other additional licensed operators in the vicinity of the proposed site to be contacted, who may not have been on the list of main operators.

The responses received from the telecommunications and aviation consultees are summarised below in Table 14.25.

Table 14.25 Telecommunications and Aviation Scoping Responses

Consultee	Response	Potential for Interference Following Consultation Exercise	Action Required	Potential for Interference Following Final Consultation Exercise
Airspeed	No Response	N/A	N/A	N/A
Broadcasting Authority of Ireland	Received 08.11.2019	No	N/A	No
BT Communications Ireland	Received 08.03.2018	No	N/A	No
ComReg (Commission for Communications Regulation)	No Response	N/A	N/A	N/A
Department of Defence - Telecoms	No Response	N/A	N/A	N/A
Department of Defence – Aviation	Received 02.07.2018	Please see Section 14.2.4.2.3 below for details.	N/A	No
Eir (Formerly Meteor)	Received 13.03.2018 & 11.04.2018	Requested buffer for link site Please see Section 14.2.4.2.2 below for details.	Buffer applied as per Eir response.	No
EMR Solutions	No Response Received to date	No	N/A	No
ESB Telecoms	Received 16.03.2018	Requested buffer for 1MW link and multiple point to point links. Please see Section 14.2.4.2.2 below for details.	26m buffer incorporated into design	No
Irish Aviation Authority	25.06.2018	Please see Section 14.2.4.2.3 below for details.	N/A	No

Consultee	Response	Potential for Interference Following Consultation Exercise	Action Required	Potential for Interference Following Final Consultation Exercise
Imagine Group	08.03.2018 & 11.11.2019	No Please see Section 14.2.4.2.2 below for details.	N/A	No
Ripplecom	No response received to date	N/A	N/A	N/A
RTE Transmission Network (2rn)	Received 12.03.2018 & 19.12.2019	No	N/A	No
Tetra Ireland Communications (emergency services)	Received 23.03.2018 & 13.11.2019	Requested a 500m buffer to link site Please see Section 14.2.4.2.2 below for details.	500m applied	No
Three Ireland	Received 09.03.2018 & 09.04.2018	Please see Section 14.2.4.2.2 below for details.	NA	No
Towercom	Received 20.03.2018	No	N/A	No
Virgin Media	Received17.04.2018 & 11.11.2019	No	N/A	No
Viatel Ireland Ltd	Received 09.03.2018	No	NA	No
Vodafone Ireland	Received 27.03.2018	Requested 30m buffer at link site. Please see Section 14.2.4.2.2 below for details.	30m buffer applied	No

The scoping responses from the telecommunications and aviation consultees are described below. Relevant copies of scoping responses are provided in Appendix 2-1.

14.2.4.2.1 Broadcasters

RTÉ Transmission Network (operating as 2rn) replied on the 12th of March 2018 to a scoping request from MKO stating that there is no potential for interference to RTÉ television or radio reception due to the operation of the proposed wind farm. A further response was received on the 19th December 2019 requesting that a protocol agreement be signed between 2rn and the wind farm developers.

Virgin Media replied on the 17th of April 2018 and the 11th November 2019 to scoping requests from MKO stating stated no potential for interference.

14.2.4.2.2 Other Operators

Of the scoping responses received from telephone, broadband and other telecommunications operators, those who highlighted an initial potential interference risk are addressed below. The final proposed turbine layout does not overlap with any of the telecoms links or clearance zones requested by operators. The remaining consultees who responded to scoping, operate links either outside the proposed development site, and therefore are not subject to any interference risk, or do not operate any links in the area.

Vodafone Ireland

Vodafone Ireland replied on the 27th March 2018 to a scoping request from MKO, noting a link in the area of the proposed development and requested a minimum 30 buffer between the maximum diameter of the '1st Fresnel zone and the rotor blade tip'. The requested buffer was implemented, and the final design layout sent to Vodafone for approval on 8th November 2019.

Eir (Meteor)

Eir replied on the 13th March 2018 to a scoping request from MKO noting 6 links within the proposed 5km study area. Eir requested 100m buffer to be included with a minimum of 30m. A 100m buffer zone was implemented and the final design layout sent to Eir for approval on 8th November 2019.

Three Ireland

Three Ireland replied on the 9h March 2018 to a scoping request from MKO stating a link within 5km of the proposed site boundary and requested buffer details. Three Ireland sent a follow up response on the 9th April 2018 stating that the link in the area 'Wolftrap Mountain to Banagher' will not be retained by the company and therefore no buffer zone is required. The final design layout was sent to Three Ireland on the 8th November 2019 and 17th December 2019.

Tetra

Tetra Ireland replied on the 23rd March 2018 to a scoping request from MKO stating a link site within the study area and requested a 500m buffer to be applied to prevent potential interference. The buffer was applied to the final design layout which was sent to Tetra Ireland for approval on the 8th Nov 2019. Tetra Ireland responded on the 13th November 2019 that they do not anticipate impacts from the proposed turbine locations.

ESB Telecoms

ESB Telecoms replied on the 13th March 2018 to a scoping request from MKO stating no potential impacts from the proposed development. A further response was sent on the 16th March 2018 noting the location of a 1MW link and multiple point to point links which may be impacted. A buffer of 26m was applied to the link and the final design layout sent to ESB Telecoms on 8th November 2019.

Imagine Group

Imagine Group replied to scoping requests from MKO on the 8th of March 2018 and the 11th of November 2019. The first reply stated that Imagine Group had no microwave links in the vicinity of the site. The second reply stated that they had one link running from a mast near Banagher to a mast near Birr. This link is located approximately 200 metres from the nearest proposed turbine location. This was not highlighted as an issue by Imagine Group.

14.2.4.2.3 *Aviation*

Department of Defence - Aviation

In July 2018, a scoping response was received from the Department of Defence which set out lighting requirements for turbines, as follows:

1. *Single turbines or turbines delineating corners of a wind farm should be illuminated by high intensity obstacle strobe lights.*
2. *Obstruction lighting elsewhere in a wind farm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight.*
3. *Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (NM) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment.*

The final design layout was sent to the Department of Defence on the 8th November 2019 and a response restating item 3, as above, was returned on 7th December 2019.

In response to the lighting requirements requested by the Department of Defence, the turbines will be included on mapping, fitted obstruction lighting and entered into aircraft navigation databases to ensure they will be avoided during flight.

Irish Aviation Authority

The Irish Aviation Authority (IAA) replied on the 25th June 2018 to a scoping request from MKO outlining recommended conditions should the project be granted a consent:

1. *Agree an aeronautical obstacle warning light scheme for the wind farm development*
2. *Provide as-constructed co-ordinates in WGS84 format together with ground and tip height elevations at each wind turbine location*
3. *Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.*

All of the above requests will be complied with should the proposed development receive a grant of planning permission.

14.2.5 Likely Significant Effects and Associated Mitigation Measures

14.2.5.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, there would be no potential for direct or indirect effects on telecommunications or aviation.

14.2.5.2 Construction Phase

The potential for electromagnetic interference from wind turbines occurs only during the operational phase of the development. There are no electromagnetic interference impacts associated with the construction phase of the proposed development, and therefore no mitigation required. There will be no direct or indirect effects on telecommunications or aviation.

14.2.5.3 Operational Phase

14.2.5.3.1 *Telecommunications*

Pre-Mitigation Impact

Consultation regarding the potential for electromagnetic interference from the proposed development was carried out with the relevant national and regional broadcasters, fixed line and mobile telephone operators and other operators, which confirmed that no turbines are proposed within the areas requested to be left clear of turbines.

Mitigation Measures

It is standard practice of 2RN to produce a Protocol Document for wind farm developments, which will be signed by the developer. The Protocol Document ensures that in the event of any interference occurring to television or radio reception due to operation of the wind farm, the required measures, as set out in the document, will be carried out by the developer to rectify this. The Protocol Document ensures that the appropriate mitigation is carried out in the event of unanticipated broadcast interference arising to television or radio reception as a result of the proposed wind farm.

In the event of further scoping responses being received from the EIA consultees, the comments of the consultees and any proposed mitigation measures will be considered in the construction and operation of the proposed development, subject to a grant of planning permission.

Residual Impact

The proposed development will have no residual impact on the telecommunications signals of any other operator, due to distance from or absence of any links in the area.

Significance of Effects

There will be no significant direct or indirect effect on telecommunications from the proposed development.

14.2.5.3.2 *Aviation*

Pre-Mitigation Impact

The scoping response of the Department of Defence has requested that standard lighting requirements be used at the proposed wind farm, in line with Air Corps policy on tall structures.

Mitigation Measures

The scoping response from the Department of Defence and IAA set out lighting requirements for turbines as detailed above. These requirements will be complied with for the proposed development and any further details will be agreed in advance of construction with the Department of Defence, Air Corps and the Irish Aviation Authority (IAA). The coordinates and elevations for built turbines will be supplied to the IAA, as is standard practice for wind farm developments.

Residual Impact

The proposed development will have no residual impact on aviation as all lighting requirement will be met by the applicant.

Significance of Effects

There will be no significant direct or indirect effects on aviation operations due to the proposed development.

14.2.5.4 Cumulative Effect

There are three wind farms (2 constructed, 1 permitted-not-yet-constructed) within 5 kilometres of the proposed development. As the proposed development will not have any direct or indirect effects on telecommunications or aviation, there will be no cumulative impacts relating to the proposed development and surrounding projects in relation to the same.

During the development of any large project that holds the potential to effect telecoms or aviation, the Developer is responsible for engaging with all relevant telecoms operators and aviation authorities to ensure that the proposals will not interfere with television or radio signals by acting as a physical barrier. In the event of any potential impact, the developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise.

15. INTERACTION OF EFFECTS

15.1 Introduction

The preceding Chapters 5 to 14 of this EIAR identify the potential significant environmental effects that may occur in terms of Population and Human Health, Biodiversity (Flora and Fauna) Ornithology (Birds), Land, Soils and Geology, Water (Hydrology and Hydrogeology), Air and Climate, Noise and Vibration, Landscape and Visual, Cultural Heritage (Archaeological, Architectural and Cultural Heritage) and Material Assets (Roads and Traffic, Telecommunications and Aviation), as a result of the proposed development as described in Chapter 4 of this EIAR. All of the potential significant effects of the proposed development and the measures proposed to mitigate them have been outlined in the preceding chapters of this EIAR. However, for any development with the potential for significant environmental effects there is also the potential for interaction between these potential significant effects. The result of interactive effects may exacerbate the magnitude of the effects or ameliorate them, or have a neutral effect.

A matrix is presented in Table 15.1 below to identify potential interactions between the various aspects of the environment already assessed in this EIAR. The matrix highlights the occurrence of potential positive or negative effects during both the construction (C) and operational (O) phases. It is considered that the potential effects during the decommissioning phase will be similar to the construction phase effects but of a lesser magnitude. The matrix is symmetric, with each environmental component addressed in the chapters of this EIAR being placed on both axes of a matrix, and therefore, each potential interaction is identified twice.

Table 15.1 Interaction Matrix: Potential for Interacting Impacts

	Phase	Population and Human Health	Biodiversity, Flora and Fauna	Ornithology	Land, Soils and Geology	Water	Air and Climate	Noise and Vibration	Landscape and Visual	Cultural Heritage	Material Assets
Population and Human Health	C		No Interacting Effect	No Interacting Effect	No Interacting Effect	Negative Effect	Negative Effect	Negative Effect	Negative Effect	No Interacting Effect	Negative Effect
	O		No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	Positive Effect	Negative Effect	Neutral Effect	No Interacting Effect	Negative Effect
Biodiversity, Flora and Fauna	C	No Interacting Effect		No Interacting Effect	Negative Effect	Negative Effect	Negative Effect	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
	O	No Interacting Effect		No Interacting Effect	No Interacting Effect	Negative Effect	Positive Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
Ornithology, Birds	C	No Interacting Effect	No Interacting Effect		Negative Effect	Negative Effect	Negative Effect	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
	O	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	Positive Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
Land, Soils and Geology	C	No Interacting Effect	Negative Effect	Negative Effect		Negative Effect	Negative Effect	No Interacting Effect	No Interacting Effect	Negative Effect	No Interacting Effect
	O	No Interacting Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
Water	C	Negative Effect	Negative Effect	Negative Effect	Negative Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
	O	No Interacting Effect	Negative Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
Air and Climate	C	Negative Effect	Negative Effect	Negative Effect	Negative Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect	Negative Effect
	O	Positive Effect	Positive Effect	Positive Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect
Noise and Vibration	C	Negative Effect	Negative Effect	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect
	O	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect	No Interacting Effect
Landscape and Visual	C	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect	No Interacting Effect
	O	Neutral Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect		Negative Effect	No Interacting Effect
Cultural Heritage	C	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect		No Interacting Effect
	O	No Interacting Effect	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	Negative Effect		No Interacting Effect
Material Assets	C	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	
	O	Negative Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	No Interacting Effect	

Legend: **No Interacting Effect:** **Positive Effect:** **Neutral Effect:** **Negative Effect:**

The potential for interaction of effects has been assessed as part of the Impact Assessment process. While the work on all parts of the Environmental Impact Assessment Report (EIAR) were not carried out by MKO, the entire project and all the work of all sub-consultants was managed and coordinated by the company. This EIAR was edited and collated by MKO as an integrated report of findings from the impact assessment process, by all relevant experts, and effects that potentially interact have been assessed in detail in the individual chapters of the EIAR above and summarised in Section 15.2 below.

Where any potential negative impacts have been identified during the assessment process, these impacts have been avoided by design or reduced by the proposed mitigation measures, as presented throughout the EIAR.

15.1.1 Statement of Authority

This chapter of the EIAR was completed by Eoin McCarthy and Michael Watson. Eoin is a Senior Environmental Scientist with MKO with over 8 years of experience in private consultancy and has been involved in the preparation of EIARs for over twenty wind energy projects. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland. Impact

15.2 Interactions

15.2.1 Population and Human Health

Population and Human Health, Air and Climate, and Noise

As identified in Chapter 5 of this EIAR, the construction phase has the potential to create a short-term, negative effect on human health due to the nuisance caused by construction plant and vehicle noise emissions, should the mitigation measures outlined in Chapter 11 not be implemented.

During the operational phase the proposed development has the potential to generate noise but as identified in Chapter 11, this will be at acceptable levels.

During the operational phase, the energy generated by the proposed development will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate (i.e. slowing the rate of global warming). In doing so, there will likely be reduced effects from climate change on human health over the 'do-nothing' scenario and continuing to generate energy using fossil fuels.

Population and Human Health, Land, Soils and Geology Air and Climate

The excavation and movement of peat and spoil during the construction phase of the proposed development has the potential to create dust emissions which, consequently, have the potential to have a temporary, slight, negative effect on local air quality and human health. Mitigation measures to reduce dust emissions generated during the construction phase of the proposed development are presented in Chapter 10.

Population and Human Health and Water

As described in Chapter 9 of this EIAR, the construction phase of the proposed development has the potential to give rise to some water pollution as a result of site activities, and any water pollution could have a potential significant negative effect on the health of other users of that water within the catchment. Mitigation measures are presented in Chapter 9 to minimise the risk of any such issues.

Population and Human Health, and Material Assets

Chapter 14 of this EIAR discusses how the construction phase of the project will give rise to traffic movements of abnormal loads and increased traffic volumes on the local road network and, therefore, is likely to create some short-term inconvenience for other road users. In addition, construction of the underpass beneath the N62 will also potentially give rise to a short-term inconvenience to road users. A Traffic Management Plan will be in place to minimise all disruption insofar as possible, as described in the Construction and Environmental Management Plan (see Appendix 4.3).

Population and Human Health, and Landscape and Visual

The construction phase of the proposed development will see the temporary introduction of construction machinery and the erection of wind turbines into a natural, but already modified landscape. The erection of the turbines in particular will change the existing landscape. Whether the long-term change in landscape created by the erection of the turbines is deemed to be positive or negative is a subjective matter. What appears to be a positive visual effect to one viewer could be deemed to be a negative effect by another viewer. The landscape and visual impact assessment of the proposed development, included as Chapter 12 of this EIAR, concludes that, from 16 viewpoints assessed, the visual effect will be moderate from three locations and ranges from no effect to slight at the remaining locations.

15.2.2 Biodiversity

Biodiversity and Land, Soils and Geology

The removal of overburden and peat is likely to result in some disturbance of flora and fauna in non-designated areas surrounding the proposed works area thereby, potentially causing a long term, slight, negative effect on flora and fauna. Excavated peat and spoil will be permanently placed along access roads and used for landscaping.

Biodiversity and Water

Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects (such as disturbance and deterioration of habitat quality) on flora and fauna that use that water within the same catchment. The site activities during the construction phase, and continuing on for the operational phase, will give rise to additional localised drainage, which has the potential to have a significant, long term, negative effect on flora and their associated habitats should the appropriate measures not be implemented. These potential impacts have been assessed in Chapter 6 and Chapter 9 of this EIAR, and the relevant measures will be in place to avoid any water pollution and subsequent effect on flora and fauna.

Biodiversity and Air and Climate

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of global warming and a reduction in air pollution, consequently, could in combination with other renewable energy projects, have a long term, significant positive effect on flora and fauna.

Biodiversity and Noise and Vibration

Site activity during the construction phase could give rise to noise that could be a nuisance for fauna, thereby having a temporary, slight, negative effect.

Biodiversity and Landscape

The removal of some vegetation within the development footprint and surrounding areas is likely to result in a change to the visual landscape during the construction phase, which will become part of the normal landscape of the wider area for the duration of the operational phase. The visual effect of this change is considered to be long-term, localised and slight.

15.2.3 Ornithology

Ornithology and Water

Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects on birds and their prey species (such as disturbance and deterioration of habitat quality) that use that water within the same catchment. The site activities during the construction phase, and continuing on for the operational phase, are likely to give rise to additional localised drainage, which has the potential to have a significant, negative effect on the habitats of particular bird species and subsequently a long, term, negative effect on ornithology should the measures outlined in Chapter 9 of this EIAR not be implemented.

Birds and Air and Climate

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of global warming and, consequently, could in combination with other renewable energy projects, contribute to preventing the loss of bird species from Ireland as a result of climate change.

Birds and Noise and Vibration

Site activity during the construction phase could give rise to noise that could be a nuisance for birds that use the site, therefore, causing a temporary, slight, negative effect on ornithology. Best practice mitigation measures are included in Chapter 9 and Chapter 11 to minimise the potential negative effect of noise generated during the construction phase on ornithology.

15.2.4 Land, Soils and Geology

Land, Soils and Geology and Water

As identified in Chapter 9 of this EIAR, the movement and removal of peat and spoil during the construction phase has the potential to have a significant, negative effect on water quality. Mitigation measures to ensure there are no significant, negative effects on water quality are presented in Chapter 9.

Land, Soils and Geology and Archaeological, Architectural and Cultural Heritage

The removal of peat and spoil during the construction phase has the potential to have a permanent, significant, negative effect on previously unrecorded sub-surface archaeological site and artefacts. Mitigation measures outlined in Chapter 13 will reduce the potential for negative effects on unrecorded sites and artefacts during excavations.

Land, Soils and Geology and Landscape and Visual

The removal of peat and spoil and the subsequent replacement with crushed stone for the construction of site roads and hardstanding areas within the proposed development site has the potential to alter the local landscape. The visual effect of this change is expected to be long term, localised in nature and slight.

15.2.5 Air and Climate

Air and Climate and Material Assets

The movement of construction vehicles both within and to and from the site has the potential to give rise to dust nuisance effects during the construction phase. This is assessed further in Chapter 10 of this EIAR, and mitigation measures are presented to minimise any potential effects.

15.2.6 Landscape and Visual

Landscape and Visual and Cultural Heritage

As described in Chapter 13 of this EIAR, the proposed development has the potential to change the landscape setting of recorded sites and monuments in the wider area and, therefore, potentially having an indirect, long term, slight to moderate, negative effect on archaeological, architectural and cultural heritage.

15.3 Mitigation and Residual Impacts

Where any potential interactive negative impacts have been identified in the above, a full suite of appropriate mitigation measures has already been included in the relevant sections (Chapters 5-14) of the EIAR. The implementation of these mitigation measures will reduce or remove the potential for these effects. Information on potential residual impacts and the significance of effects, is also presented in each relevant chapter.

16. SCHEDULE OF MITIGATION

16.1 Introduction

All mitigation measures relating to the pre-commencement, construction and operational phases of the Proposed Development are set out in the relevant chapters of the EIAR submitted as part of the planning permission application.

It is intended that the CEMP will be updated where required prior to the commencement of the development, to include all mitigations measures, conditions and or alterations to the EIAR and application documents should they emerge during the course of the planning process and would be submitted to the Planning Authority for written approval.

All mitigation measures which will be implemented during the pre-commencement, construction and operational phases of the project are outlined in Table 15.1. The mitigation measures have been grouped together according to their environmental field/topic and are presented under the following headings:

- Construction Management
- Drainage Design and Management
- Peat, subsoils and bedrock
- Population and Human Health
- Biodiversity
- Ornithology
- Noise
- Air Quality/Dust
- Traffic
- Cultural Heritage

The mitigation proposals in the below format provides an easy to audit list that can be reviewed and reported on during the future phases of the project. The proposal for site inspections and environmental audits are set out in the Construction and Environmental Management Plan (CEMP) which is included as Appendix 4.3 of this EIAR. The tabular format in which the below information is presented, can be further expanded upon during the course of future project phases to provide a reporting template for site compliance audits.

Ref. No.	Reference Heading	Location	Mitigation Measure
Pre-Commencement Phase			
MM1	Environmental Management	EIAR Chapter 4	The Contractor will be responsible for implementing the mitigation measures specified throughout the EIAR and compiled in the Audit Report which is included in the CEMP. The Contractor will also be responsible for ensuring that all construction staff understand the importance of implementing the mitigation measures. The implementation of the mitigation measures will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.
MM2	Environmental Management	EIAR Chapter 4	The Environmental Clerk of Works will maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, an Environmental Clerk of Works or Project Ecologist, Project Hydrologist, Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office.
MM3	Environmental Management	EIAR Chapter 4	A Site Environmental Clerk of Works will oversee the site works and implementation of the Construction Environmental Management Plan (CEMP), and provide on-site advice on the mitigation measures necessary as necessary to ensure the project proceeds as intended. The level, detail and frequency of reporting expected from the Site Environmental Clerk of Works for the Construction Manager, developer's project manager, and any Authorities or other Agencies, will be agreed by parties where required prior to commencement of construction, and may be further adjusted as required during the course of the project.
MM4	Environmental Management- Invasive Species	CEMP Section 3	A baseline invasive species survey will be carried out at the site to identify the presence and location of any invasive species (listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) by a suitably qualified ecologist. If the presence of such species is found at, or adjacent to, the site, particularly in areas where excavation may be required, an invasive species management plan will be prepared for the site to prevent the introduction or spread of any invasive species within the footprint of the works. An invasive species management plan, if required, will set out best practice control methods.

MM5	Roads	CEMP Section 2	Prior to commencing road construction, movement monitoring posts should be installed in areas where the peat depth is greater than 1m.
MM6	Drainage	CEMP Section 2	Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.
MM7	Drainage	CEMP Section 3	Prior to commencement of works in sub-catchments across the site, main drain inspections will be competed to ensure ditches and streams are free from debris and blockages that may impede drainage
MM8	Biodiversity	EIAR Chapter 6	Pre-construction surveys for Badger and Otter will be undertaken prior to the commencement of works
MM9	Biodiversity	EIAR Chapter 6	On a precautionary basis, prior to the commencement of any site works, a badger sett disturbance licence will be sought from the National Parks and Wildlife Service.
MM10	Biodiversity	EIAR Chapter 6 and Chapter 4	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development
MM11	Biodiversity	EIAR Chapter 6 and Appendix 6.7	A Biodiversity Management Plan has been provided to avoid loss of uncut raised bog and natural woodlands and the ecological enhancement of areas of cutover bog through rewetting to promote the development of wetland vegetation.
MM12	Biodiversity	EIAR Chapter 6 and Appendix 6.6	A Lepidoptera Management Plan has been produced which outlines the areas of suitable marsh fritillary habitat that will be fenced off or clearly marked prior to the commencement of any site works under the guidance and supervision of a suitably qualified Ecological Clerk of Works (ECoW). - Pre-commencement surveys will be undertaken for marsh fritillary to determine long term trends of the population within the site. - Vegetation structure and suitability will be monitored following the NBDC survey methodology (NBDC, 2019). - Pollinator enhancement measures through habitat creation.

MM13	Traffic Management Plan, Delivery Programme, pre-commencement road works	EIAR Chapter 14	- **A Pre-Construction Condition Survey** – Where required by the local authority, a pre-condition survey of roads associated with the proposed development can be carried out immediately prior to construction commencement to record an accurate condition of the road at the time. Where required the timing of these surveys will be agreed with the local authority. - A detailed **Traffic Management Plan (TMP)**, will be provided specifying details relating to traffic management and included in the CEMP prior to the commencement of the construction phase of the proposed development. The TMP will be agreed with the local authority and An Garda Síochána prior to construction works commencing on site. The detailed TMP will include the following: o **Traffic Management Coordinator** – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management. o **Delivery Programme** – a programme of deliveries will be submitted to the County Council in advance of deliveries of turbine components to site. Liaison with the relevant local authorities and Transport Infrastructure Ireland (TII) will be carried out where required regarding requirements such as delivery timetabling. The programme will ensure that deliveries are scheduled in order to minimise the demand on the local network and minimise the pressure on the access to the site. - Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles - Construction of temporary improvements to the local highway network at locations
MM14	Information to Local Residents	EIAR Chapter 14	Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-Ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided

Construction Phase			
Construction Management			
MM15	Health and Safety	EIAR Chapter 5	During construction of the Proposed Development, all staff will be made aware of and adhere to the Health & Safety Authority's *'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013'*. This will encompass the use of all necessary Personal Protective Equipment and adherence to the site Health and Safety Plan which will include measures to exclude members of the public from certain areas of the site during construction.
MM16	Health and Safety	EIAR Chapter 5	The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006'. The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): - Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project; - Where possible, eliminate the hazards or reduce the risks; - Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan; - Ensure that the work of designers is coordinated to ensure safety; - Organise co-operation between designers; - Prepare a written Safety and Health Plan; - Prepare a safety file for the completed structure and give it to the client; and - Notify the Authority and the client of non-compliance with any written directions issued.

MM17	Health and Safety	EIAR Chapter 5	The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): - Development of the Safety and Health Plan for the construction stage with updating where required as work progresses; - Compile and develop safety file information - Reporting of accidents / incidents; - Weekly site meeting with PSCS; - Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out: - Induction of all site staff including any new staff enlisted for the project from time to time; - Toolbox talks as necessary; - Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date; - Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance; - Monitor the compliance of contractors and others and take corrective action where necessary; and - Notify the Authority and the client of non-compliance with any written directions issued.
MM18	Reinstatement	EIAR Chapter 4	Some overburden material will be stored temporarily adjacent to the works areas for reinstatement when the main construction activities are completed. Soil will be backfilled outside the drainage channels along track-sides and vegetated sods replaced over the surface, bedded-in, regraded, etc., to re-constitute a stable and settled ground surface on which the natural vegetation can recover and will be resistant to erosion.
MM19	Waste Materials	CEMP Section 3	A fully licensed waste contractor will be employed to remove waste from the site and will be required to provide documented records for all waste dispatches leaving the site of the proposed development.

Drainage Design and Management			
MM20	Earthworks	EIAR Chapter 9	Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.
MM21	Excavation Dewatering and Surface Water Quality	EIAR Chapter 9	- If required, pumping of excavation inflows will prevent build-up of groundwater in the excavation; - The interceptor drainage will be discharged to the existing drainage system or onto the bog surface; - 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 the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and, - Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.
MM22	Watercourse Buffers	EIAR Chapter 9	A self-imposed buffer zone for peat storage will be established around the existing field drains on site. Also, a buffer zone around field ditches and watercourses where no peat can be stored is being implemented. A 25 m buffer around field ditches and a 50m construction buffer from all watercourses is recommended as per industry best practice. With the exception of upgrading watercourse crossings.
MM23	Drainage Swales	EIAR Chapter 9, Appendix 4-5	Swales will be used to intercept and collect run off from construction areas of the site during the construction phase, and channel it to settlement ponds for sediment attenuation as per the drainage design.
MM24	Interceptor Drains	EIAR Chapter 9, Appendix 4-5	Interceptor drains will be installed up-gradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site. It will then be directed to areas where it can be re-distributed over the ground as sheet flow as per the drainage design.

MM25	Transverse drains	EIAR Chapter 9, Appendix 4-5	On steep sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/road side drains;
MM26	Check dams	EIAR Chapter 9, Appendix 4-5	Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be installed at regular intervals along interceptor drains to restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam as per the drainage design.
MM27	Level Spreaders	EIAR Chapter 9, Appendix 4-5	A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.
MM28	Vegetation filters	EIAR Chapter 9, Appendix 4-5	Vegetation filters, that is areas of existing vegetation, accepting drainage water issuing from level spreaders as sheet flow, will remove any suspended sediment from water channelled via interceptor drains or any remaining sediment in waters channelled via swales and settlement ponds.
MM28	Settlement ponds	EIAR Chapter 9, Appendix 4-5	Settlement ponds, placed either singly or a pair in series, will buffer volumes of run-off discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to water courses as per the drainage design.
MM30	Siltbuster	EIAR Chapter 9, Appendix 4-5	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 will apply for all of the construction phase.
MM31	Silt Fences	EIAR Chapter 9, Appendix 4-5	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 the existing drainage network 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.

MM32	Silt Bags	EIAR Chapter 9, Appendix 4-5	Silt bags will be used where small to medium volumes of water need to be pumped from excavations (e.g. the proposed underpass locations). As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.
MM33	Potential Release of Hydrocarbons	EIAR Chapter 9 CEMP Section 3	- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site; - 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 or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry 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; - Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction; - The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor; - An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM34	Release of Cement-Based Products	EIAR Chapter 9 CEMP Section 3	- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place; - Where possible pre-cast elements for culverts and concrete works will be used; - No washing out of any plant used in concrete transport or concreting operations will be allowed on-site; - Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to

			the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compounds. These temporary lined wash-out pits will be removed from the site at the end of the construction phase; › Will use weather forecasting to plan dry days for pouring concrete; and, › M*M35*Will ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event
MM35	Plant and equipment inspections	EIAR Chapter 8	Site plant will be regularly inspected for leaks and fitness for purpose; and, an emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM36	Wastewater Disposal	EIAR Chapter 8	Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.
MM37	Concrete Deliveries and Management	CEMP Section 3	No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products will be used and where possible, pre-cast elements for culverts and concrete works will be used.
MM38	Concrete Deliveries and Management	CEMP Section 3	No washing out of any plant used in concrete transport or concreting operations will be allowed on-site.
MM39	Concrete Deliveries and Management	CEMP Section 3	Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed into a dedicated lined washout area. This lined area will be removed from site once the construction phase is complete.
MM40	Concrete Deliveries and Management	CEMP Section 3	Weather forecasting will be used to plan dry days for pouring concrete. Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event
MM41	Concrete Deliveries and Management	CEMP Section 3	Where possible pre-cast elements for culverts and concrete works will be used

Peat, Subsoils and Bedrock			
MM42	Topsoil/Peat and Subsoil Excavation	EIAR Chapter 8	• The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation, temporary compounds and access roads; • The proposed development has been designed to avoid sensitive habitats within the application area; • A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design; • Excavated peat will only be moved short distances from the point of excavation and will be used locally for landscaping; and, • Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.
MM44	Peat Instability and Failure	EIAR Chapter 8	• Appointment of experienced and competent contractors; • The site should be supervised by experienced and qualified personnel; • Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement); • Prevent undercutting of slopes and unsupported excavations; • Maintain a managed robust drainage system; • Prevent placement of loads/overburden on marginal ground; • Set up, maintain and report findings from monitoring systems (as outlined in the Geotechnical and Peat Stability Assessment (Appendix 8.1)); • Ensure construction method statements are developed and agreed before commencement of construction and are followed by the contractor; and, • Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.
MM45	Erosion of Exposed Subsoils and Peat During	EIAR Chapter 8 and Appendix 4-2	• Peat removed from turbine locations and access roads will be used for landscaping close to the extraction area;

	Construction of Infrastructure		- Where possible, the upper vegetative layer (where still present) will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat storage areas; - Re-seeding and spreading/planting will also be carried out in these areas; - A full Peat and Spoil Management Plan for the development is shown as Appendix 4.2.
Biodiversity			
MM46	Marsh Fritillary	EIAR Chapter 6	Habitat condition monitoring will be undertaken to ensure that there are no negative effects on marsh fritillary habitat.
MM47	Badger setts	EIAR Chapter 4 and Chapter 6	- An exclusion zone around the sett will be maintained for the duration of the construction works. No works will be undertaken within 30m of the sett. - Following best practice, the proposed works within 50 metres of the sett will be undertaken outside of the badger breeding season (December to June) (NRA, 2005). - The proposed access track construction in close proximity to a badger sett will be constructed as a 'floating road' construction. This will avoid the requirements for the excavation of materials and therefore reduce both the construction time and intensity of the proposed construction works in this area. - To protect individual badgers during the construction phase of the proposed development, all open excavations on site will be covered when not in use and backfilled as soon as possible. Excavations will also be covered at night and any deep excavations left open will have appropriate egress ramps in place to allow mammals to safely exit excavations should they fall in.
MM48	Bats	EIAR Chapter 6	- Any loss of woodland habitat will be mitigated through replacement planting - Construction best practice will be employed to minimise general noise and disturbance potential. Plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).

MM49	Invasive Species	Appendix 4-5	• A designated wash-down area will be created, where power-washed material from machinery can be contained, collected and disposed of with other contaminated material. This area will contain a washable membrane or hard surface. • Stockpile areas will be chosen to minimise movement of contaminated soil. • Stockpiles will be marked and isolated. • Contaminated areas which will not be excavated will be protected by a root barrier membrane if they are likely to be disturbed by machinery. Root barrier membranes will be protected by a layer of sand above and below and topped with a layer of hardcore. • The use of vehicles with caterpillar tracks within contaminated areas will be avoided to minimise the risk of spreading contaminated material. • An ECoW/suitably qualified ecologist will be on site to monitor and oversee the implementation of invasive species management plans. • Personnel may only clean down if they are familiar with the plant and rhizome material and can readily identify it. • Decontamination will only occur within designated wash-down areas. Vehicles will be cleaned using stiff-haired brush and pressure washers, paying special attention to any areas that might retain rhizomes e.g. wheel treads and arches.
Ornithology			
MM50	Lapwing, Waterfowl and Wader Habitat	EIAR Chapter 7 and Appendix 7.8	• Lapwing, Waterfowl and Wader Habitat Enhancement Plan will be implemented to enhance potential habitats and minimise potential habitat loss. The plan focuses on the enhancement of supporting habitat for lapwing but its implementation will also benefit, redshank, black-headed gull, woodcock, ringed plover, whooper swan and snipe.
MM51	Ornithology	EIAR Chapter 7	• The removal of woody vegetation will be undertaken outside the bird breeding season which begins on the 1st day of March and ends on the 31st day of August in any year.

			- All woodland/scrub (c. 7.24ha) that is removed to facilitate the construction of the proposed development will be replaced with native tree species (c. 13ha). This will ensure there will be a net gain of woodland within the proposed development area. - During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds. - Plant and machinery will be turned off when not in use. - All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001) other relevant legislation. - An Ecological Clerk of Works (ECoW) will be appointed and will operate for the duration of construction works. Duties will include: o Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. o Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site. o Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise. o Provide guidance to contractors to ensure legal compliance with respect to protected species onsite. o Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.
Noise			
MM53	Best Practise Measures BS5528-1	EIAR Chapter 11	Best Practice Mitigation Measures from BS5528-1 standard will be implemented for the duration of the construction phase: - limiting the hours during which site activities likely to create high levels of noise or vibration are permitted; - establishing channels of communication between the contractor/developer, Local Authority and residents; - appointing a site representative responsible for matters relating to noise and vibration;

			- monitoring typical levels of noise and vibration during critical periods and at sensitive locations; - keeping site access roads even to mitigate the potential for vibration from lorries. A variety of practicable noise control measures will also 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.
Air Quality/Dust			
MM54	Dust Emissions	EIAR Chapters 5, 10 CEMP Section 3	- Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. - In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compound to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff. - All plant and materials vehicles shall be stored in dedicated areas (on site). - Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. - Turbines and construction materials will be transported to the site on specified haul routes only. - The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary. - The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.

			• A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4.3. The CEMP includes dust suppression measures.
MM55	Exhaust Emissions	EIAR Chapter 5, Chapter 10	• All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. • Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority. • Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.
MM56	Greenhouse Gas Emissions	EIAR Chapter 10	• All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. • Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority. • Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.
Traffic			
MM57	Traffic Management Co-Ordinator	EIAR Chapter 14	A competent Traffic Management Coordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
MM58	Liaison with the relevant local authority	EIAR Chapter 14	Liaison with the relevant local authority including the roads section of local authorities that the delivery routes traverse and An Garda Siochána, during the delivery phase.
MM59	Travel Plans for Construction Workers	EIAR Chapter 14	The construction company will be required to provide a travel plan for construction staff, which will include the identification of a routes to / from the site and identification of an area for parking.
MM60	Temporary traffic signs	EIAR Chapter 14	As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junction on the N15. All measures will be in accordance with the *"Traffic Signs Manual, Chapter 8 – Temporary Traffic Measures and Signs for Road Works"* (DoT

			now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at key junctions during peak delivery times.
Cultural Heritage			
MM61	Impact of excavation works on unrecorded potential sub-surface sites	EIAR Chapter 13	- Archaeological monitoring (under licence from the National Monuments Service) of any further geotechnical / engineering trial pits or investigations and a report detailing the results of same. - Pre-development Licensed testing in areas where peat depths allow a meaningful investigation. Testing should only be undertaken in areas where ground disturbance will take place as part of the development. Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken. - Archaeological monitoring of ground works during construction works. The National Monuments Service will be informed of such findings to discuss how best to proceed. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance).Once the project is completed, a report on the results of the monitoring will be compiled and submitted to the relevant authorities. - During the excavation of new proposed access routes, a known memorial plaque located along the proposed route from T21 to the proposed substation will be fenced off prior to construction works in this location. Fencing will be maintained for the duration of the construction works.

Operational Phase			
Health and Safety			
MM62	Health & Safety	EIAR Chapter 5	Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.
Biodiversity			
MM63	Bats	EIAR Chapter 6 and Appendix 6.2.	Ongoing monitoring of bat activity will be undertaken for at least three years' post construction of the wind farm. Full details of the proposed monitoring programme are provided in Appendix 6.2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions. If, following monitoring, there are significant effects recorded, a range of measures are proposed to ensure that any such effects are fully mitigated. These measures include blade feathering, curtailment of turbines during certain conditions and increase of buffers surrounding the turbines. Any or all of the above measures may be employed following actual monitoring of the impact of the operating turbines on bats.
Traffic Management			
MM64	Roads	EIAR Chapter 14	**A Post Construction Condition Survey** – Where required by the local authority, a post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers
Population and Human Health			
MM65	Shadow Flicker	EIAR Chapter 5	Where daily or annual shadow flicker exceedances are experienced at buildings, a site visit will be undertaken to determine the level of occurrence, existing screening and window orientation. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

			In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded.
Ornithology			
MM66	Bird monitoring programmes	EIAR Chapter 7 and Appendix 7.9	Post-construction Bird Monitoring Programme which includes: - Flight activity surveys: vantage point surveys - Breeding Bird surveys: O'Brien & Smith/Adapted Brown & Shephard. - Winter Distribution and Abundance Surveys: Winter Transects/Waterfowl Surveys (I-WeBS methods) (with an emphasis on wintering waterfowl). - Targeted bird collision surveys (corpse searches) will be undertaken with training dogs. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust. Surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 and 15 of the lifetime of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009).
Drainage Management Plan			
MM67	Drainage Inspection	EIAR Chapter 9, CEMP Section 3	- Monitoring the effectiveness of drainage measures installed during the construction phase will continue to be monitored into the operational phase. Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.
Noise			
MM68	Turbine Programming	EIAR Chapter 11	Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve the calculated attenuation required in the specific wind conditions (i.e. wind speed and direction). Operating the turbines in reduced noise modes is generally referred to as curtailment.

MM69	Noise Monitoring	EIAR Chapter 11	Commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IoA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) should be followed and relevant corrective actions will be taken. For example, implementation of noise operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind farm operations. For post-commissioning of the proposed turbine units, it is recommended that the noise monitoring detailed in Section 11.3.7 be repeated with consideration of the guidance outlined in the IoA GPG and Supplementary Guidance Note 5.

BIBLIOGRAPHY

Introduction

Department of the Environment, Community and Local Government (2013). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. DoEHLG, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Government (August 2018) Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. DHPLG, Dublin.

Department of Housing, Planning and Local Government (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, Dublin.

Department of Housing, Planning and Local Government (2013) Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review. DHPLG, Dublin.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements). EPA, Wexford.

Environmental Protection Agency (2003) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements. EPA, Wexford.

Environmental Protection Agency (2002) Guidelines on Information to be Contained in Environmental Impact Statements. EPA, Wexford.

European Union (2014). Directive 2014/52/EU. European Parliament and European Council.

European Union (2011). Directive 2011/92/EU. European Parliament and European Council.

Irish Statute Book (2018). European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

Irish Statute Book (2001). Planning and Development Regulations (as amended) S.I. No. 600 of 2001. Stationery Office, Dublin.

Irish Statute Book (2000). Planning and Development Acts 2000 to 2019. Stationery Office, Dublin.

Background to the Proposed Development

Council of the European Union (2014). 2030 Climate and Energy Policy Framework, Brussels.

Council of the European Union (2009). Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC), Brussels.

Climate Action Network Europe (2018). Off Target Report, Brussels.

Climate Change Advisory Council (2019). Annual Review 2019, ISBN: 978-1-84095-848-5
Eurostat- https://ec.europa.eu/eurostat/documents/2995521/10335438/8-23012020-AP-EN.pdf/292cf2e5-8870-4525-7ad7-188864ba0c29

Commission for Regulation of Utilities (2018) Enduring Connection Policy Stage 1 (ECP-1). Dublin

Department of Climate Change, Action & Environment (2019). Climate Action Plan 2019

Department of Climate Change, Action & Environment. Renewable Energy Support Scheme

Department of Climate Change, Action & Environment (2018). National Adaptation Framework - Planning for a Climate Resilient Ireland 2018.

Department of Climate Change, Action & Environment (2017) National Mitigation Plan 2017

Department of Climate Change, Action & Environment (2017). Fourth Progress Report on the National Renewable Energy Action Plan.

Department of Climate Change, Action & Environment (2016). Draft Renewable Electricity Policy and Development Framework.

Department of Climate Change, Action & Environment (2016). Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement 2016.

Department of Climate Change, Action & Environment (2014). National Policy Position on Climate Action and Low Carbon Development.

Department of Climate Change, Action & Environment (2015). Climate Action and Low Carbon Development Act 2015.

Department of Climate Change, Action & Environment (2012). National Climate Change Adaptation Framework.

Department for Communications, Marine and Natural Resources (2007). Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020.

Department of Communications, Energy & Natural Resources (2015). White Paper on Energy Policy in Ireland 2015-2030, Dublin.

Department of Communications, Energy and Natural Resources (2012). Strategy for Renewable Energy 2012 – 2020

Department of the Environment, Heritage and Local Government (2006). Wind Energy Guidelines 2006.

Department of Housing, Planning, Community and Local Government (2017). Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change.

Department of Housing, Planning, Community and Local Government (2017). Department Circular PL5/2017

Department of Housing, Planning, Community and Local Government (2019) Draft Revised Wind Energy Development Guidelines

Department of Climate Change, Action & Environment. Renewable Energy Support Scheme

Department of Agriculture, Food and Marine. Forest Service Guidelines.

EirGrid (2019) All Island Generation Capacity Statement 2019 – 2028, Dublin.

Environmental Protection Agency (2019). Irish Climate Futures: Data for Decision-making

Environmental Protection Agency (2008). Climate Change – Refining the Impacts for Ireland

European Commission (2010). Europe 2020 Strategy.

European Commission (2017). Report from the Commission to the European Parliament, the Council, the

European Economic and Social Committee and the Committee of the Regions, Brussels.

Environmental Protection Agency (2019). Ireland's Greenhouse Gas Emission Projections 2018-2040.

Eastern and Midland Regional Assembly (2019). Regional Spatial and Economic Strategy 2019-2031
Offaly County Development Plan 2014-2020

Government of Ireland (2000). Strategy for Intensifying Wind Energy Development', Department of Communications, Energy and Natural Resources, ISBN 0-7076-9225-3

Government of Ireland (2018). Project Ireland 2040 National Planning Framework

Irish Wind Energy Association (2015). Data-Centre Implications for Energy Use in Ireland

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry.

Irish Wind Energy Association (2013). Best Practice Principles in Community Engagement and Community Commitment 2013.

Irish Wind Energy Association (2018). IWEA Community Engagement Strategy 2018

Joint Committee on Climate Action (2019). Climate Change: A Cross-Party Consensus for Action.

Offaly County Development Plan 2014-2020. Offaly County Council Wind Energy Strategy

Sustainable Energy Authority of Ireland (2019), National Energy Projections

Sustainable Energy Authority of Ireland (2019), Energy in Ireland 2019 Report.

Sustainable Energy Authority of Ireland (2017), Energy in Ireland 1990 – 2016

United Nations (1992). United Nations Framework Convention on Climate Change

United Nations (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change

United Nations (2012). Doha Amendment to the Kyoto Protocol

United Nations (2015). COP21 Paris Agreement, Paris.

Consideration of Reasonable Alternatives

Department of Housing, Planning and Local Government (September 2017). Ireland 2040 – Our Plan. Dublin

Environmental Protection Agency (2017): Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Sustainable Energy Authority of Ireland (April 2013) Methodology for Local Authority Renewable Energy Strategies. RPS, Ireland.

Description of the Proposed Development

California Stormwater Quality Association (2003). Best Management Practice Handbook EC-9 Earth Dikes and Drainage Swales. CASQA, California.

CIRIA Construction Industry Research and Information Association (2006). CIRIA C648: Control of water pollution from linear construction projects -Technical guidance. CIRIA London.

CIRIA Construction Industry Research and Information Association (2001). CIRIA C532: Control of water pollution from construction sites - Guidance for consultants and contractors. CIRIA London.

City of Houston; Harris County; Harris County Flood Control District (2006). Stormwater Management Handbook for Construction Activities. Houston.

Department of Communications, Climate Action and Environment (2018) Renewable Electricity Support Scheme (RESS) 1. DCCAE, Dublin.

Department of Agriculture, Fisheries and Food, Kildare. Environmental Protection Authority (2007). ACT Environmental Protection Guidelines for Construction and Land Development in the ACT.

Department of the Environment, Heritage and Local Government (2006) Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Environmental Protection Agency Ireland (2009) Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses. EPA, Wexford.

Environmental Protection Agency Ireland (1999) Wastewaster Treatment Manuals - Treatment Systems for Small Communities, Business, Leisure Centres and Hotels. EPA, Wexford.

Institute of Geologists Ireland (2007) Guide for Drilling Wells for Private Water Supplies. IGI, Dublin.

Irish Statute Book (2007) Waste Management (Collection Permit) Regulations, 2007 as amended (S.I. No. 820 of 2007)

McAulay, I., TJP Envision Limited, Department of Trade and Industry, New and Renewable Energy Programme (1999) The Influence of Colour on the Aesthetics of Wind Turbine Generators (ETSU, London).

Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms Commissioned Report No. 591/ SNH, Stirling.

State of Oregon Department of Environmental Quality (2006). Best Management Practices for Storm Water Discharges Associated with Construction Activities. Oregon.

Siltbuster Concrete Wash Unit. Available at: http://www.siltbuster.com. Accessed 09.12.2019.

Population and Human Health

American Wind Energy Association and Canadian Wind Energy Association (2009). Wind Turbine Sound and Health Effects - An Expert Panel Review, USA and Canada.

Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health (2010). A Rapid Review of the Evidence. Australia.

Baringa (2019) Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020

BiGGAR Economics (2016). Wind Farms and Tourism Trends in Scotland. Midlothian, Scotland.

Centre for Economics and Business Research (2014) The effect of wind farms on house prices. Renewable UK, London.

Central Statistics Office Ireland (2018). Census Results 2011 & 2016. www.cso.ie

Central Statistics Office Ireland (2012). Census of Agriculture 2010 Detailed Results. www.cso.ie

Climate and Health Alliance (2012). Position Statement on Health and Wind Turbines. Australia.

Department of Communications, Climate Action and Environment (2019) Climate Action Plan (CAP).

Department of the Environment, Heritage and Local Government (2007). National Climate Change Strategy 2007 – 2012. Stationery Office, Dublin.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Government (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, 2017.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Discover Ireland www.discoverireland.ie

Offaly County Council, (2014) Natura Impact Assessment Report, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/County%20Development%20Plan%202014-2020.html, Accessed 05.01.2020

ESB (2017) EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland (https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0).

Fáilte Ireland (September 2019). Tourism Facts 2018. Fáilte Ireland. Available at: www.failteireland.ie

Fáilte Ireland (2012). Visitor Attitudes on the Environment - Wind Farms. www.failteireland.ie

Environmental Protection Agency (2017). Draft Guidelines on the Information to be Contained in Environmental Impact Statements. EPA, Wexford.

Helimax Energy (2008). Shadow Flicker Analysis. Stantec, Ontario.

Heblich, Dr. S. et al (2016) Impact of wind Turbines on House Prices in Scotland. Climate Xchange

House of Commons ODPM: Housing, Planning, Local Government and the Regions Committee (2004) ODPM Annual Report and Accounts. Available at: https://publications.parliament.uk/pa/cm200405/cmselect/cmodpm/58/58.pdf

HSE Public Health Medicine Environment and Health Group (2017) Position Paper on Wind Turbines and Public Health. Ireland.

Health & Safety Authority (2006) Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations.

Irish Wind Energy Association (January 2020) Interactions Opinion Poll on Wind Energy. Ireland

Irish Wind Energy Association (2014). "An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland, Siemens Limited, Dublin.

Irish Wind Energy Association (2009). Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy. Deloitte, Ireland

IWEA (2009) Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy'

Lawrence Berkley National Laboratory (2013). The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis. US Department of Energy

Lawrence Berkley National Laboratory (2013) A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States.

Massachusetts Institute of Technology (2014) Wind Turbines and Health, A Critical Review of the Scientific Literature, Journal of Occupational and Environmental Medicine Vol. 56 (11).

Massachusetts Departments of Environmental Protection and Public Health (2012). Wind Turbine Health Impact Study -Report of Independent Expert Panel. USA.

Massachusetts Institute of Technology (2014). 6. Wind Turbines and Health, A Critical Review of the Scientific Literature, USA.

Met Éireann (2013). 30 Year Averages. https://www.met.ie/climate/30-year-averages

Noble Environmental Power LLC (2006). Wind Fact Sheet #4: Shadow Flicker. Noble Environmental Power, Connecticut.

Pőyry (2014) The Value of Wind Energy to Ireland A report to Irish Wind Energy Association. Cambridge Economics.

Renewable UK (2010). Wind Turbine Syndrome - An independent review of the state of knowledge about the alleged health condition. London, UK.

Siemens (2014) An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland

Sustainable Energy Ireland (2003). Attitudes Towards the Development of Wind Farms in Ireland'. SEI, Dublin.

UK Department of Energy and Climate Change (2010). Update of Shadow Flicker Evidence Base. DECC, London.

Warren, C.R. et al (2005). Green on Green: Public Perceptions of Wind Power in Scotland and Ireland. Journal of Environmental Planning and Management 48(6): 853-875.

Biodiversity

Assessment Survey 2013. Irish Wildlife Manuals, No. 81. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.

Bord na Móna, 2016, Bord Na Móna Biodiversity Action Plan 2016-2021, Available online at: https://www.bordnamona.ie/wp-content/uploads/2016/04/Biodiversity-Action-Plan-2016-2021.pdf, Accessed 13.02.2020.

Bord na Móna (2015) Sphagnum farming on cutaway peatlands. Kilberry Sphagnum Growth Trial. Unpublished report. Bord na Móna

Bord na Móna, 2010, Bord Na Móna Biodiversity Action Plan 2010-2015, Available online at: http://www.bordnamona.ie/wp-content/uploads/2016/01/Biodiversity-Action-Plan-2010-2015.pdf, Accessed 13.02.2020.

British Bryological Society (2010) Mosses and Liverworts of Britain and Ireland - A field guide', ISBN-10: 0956131018

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2013) Technical Guidance Series – Competencies for Species Survey, Online, Available at: https://cieem.net/resource/competencies-for-species-survey-css/ Accessed: 06.01.2020

Commission of the European Communities (2007) Interpretation manual of European Union habitats. Eur 27. European Commission DG Environment.

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.

Curtis, (1988) The Irish Red Data Book, 1, Vascular Plants, Online, Available at: http://botanicgardens.ie/wp-content/uploads/2018/06/T.G.F.-Curtis-and-H.N.-McGough-1988-The-Irish-Red-Data-Book-1.-Vascular-Plants.-Wildlife-Service-Ireland.-.pdf, Accessed, 13.02.2020

Department of Culture, Heritage and the Gaeltacht (2017) National Biodiversity Action Plan 2017-2021, Available online at: https://www.npws.ie/sites/default/files/publications/pdf/National%20Biodiversity%20Action%20Plan%20English.pdf, Accessed 13.02.2020

Environmental Protection Agency (2003) Advice Notes on Current Practice (in preparation of Environmental Impact Statements), Online, available at: https://www.epa.ie/pubs/advice/ea/guidelines/EPA_advice_on_EIS_2003.pdf, Accessed 06.01.2020

European Commission (2013) Interpretation Manual of European Union Habitats –EUR28 http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

Fernandez, F., Connolly K., Crowley W., Denyer J., Duff K. & Smith G. (2014) Raised Bog Monitoring and

Foss, P.J. & Crushell, P. (2008) Guidelines for a National Fen Survey of Ireland, Survey Manual. Report for the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Fossitt, J. A. (2000). *A Guide to Habitats in Ireland*. Dublin: The Heritage Council.

Irish Statute Book (2015) E Flora (Protection) Order 2015 (S.I. No. 356 of 2015).

Irish Statute Book (2011) European Communities (Birds and Natural Habitats) Regulations 2011 (S S.I. No. 477 of 2011).

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Lintott, P. R., and Mathews, F., (2018) Basic errors may make ecological assessments unreliable, Biodiversity and Conservation 28-265-7

No. 69. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht,
NPWS (2013) 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.

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

NPWS (2019) The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report. Edited by Deirdre Lynn and Fionnuala O'Neill

NPWS (2019) The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report. Edited by Deirdre Lynn and Fionnuala O'Neill

NPWS (2019) Online map viewer; Flora Protection Order Map Viewer – Bryophytes. Online, Available at: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Accessed: 10/02/2020.

NPWS, (2019) Online map viewer; Flora Protection Order Map Viewer – Bryophytes. Online, Available at: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Accessed: 26/06/2019.

NPWS, (2020) Natural Heritage Areas (NHA), Available online at: https://www.npws.ie/protected-sites/nha, Accessed 13.02.2020

NRA, (2006) Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes'. Dublin: National Roads Authority

NRA, (2006b). Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes. Dublin: National Roads Authority.

NRA/TII, (2006) Environmental Assessment and Construction Guidelines, Available online at: https://www.tii.ie/technical-services/environment/planning/Environmental-Impact-Assessment-of-National-Road-Schemes-Practical-Guide.pdf, Accessed 13.12.2020

NRI/TII (2009) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes Online, Available at: https://www.tii.ie/technical-services/environment/planning/Ecological-

Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf, Accessed: 06.11.2019

Offaly County Council, (2014) Natura Impact Assessment Report, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/County%20Development%20Plan%202014-2020.html, Accessed 06.01.2020

Offaly County Council, (2014) Offaly County Development Plan 2014 – 2020, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/Volume-1.pdf, Accessed 06.01.2020

Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland

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

Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter & Bat Conservation Trust (BCT). (2019). Bats and Onshore Wind Turbines: Survey Assessment and Mitigation. Available online at https://www.nature.scot/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation, Accessed 06.01.2020.

Smith, G. F., O'Donoghue, P., O'Hora, K. and Delaney, E., (2011), 'Best Practice Guidance for Habitat Survey and Mapping', The Heritage Council.

Stace (2010), New Flora of the British Isles, Third Edition, ISBN: 9780521707725, Cambridge University Press

Triturus (2019). *Aquatic and Fisheries report for proposed Derrinlough wind farm, Co. Offaly.* Report prepared by Triturus Environmental Ltd. on behalf of McCarthy Keville O'Sullivan for Bord na Móna Powergen Ltd., December 2019.

Ornithology

Anon., (2003). Recommended methodology for assessment of impacts of proposed windfarms on breeding Hen Harrier within the known range of the species in Ireland. National Parks and Wildlife Service, BirdWatch Ireland, Irish Raptor Study Group.

Anon., (2005). Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance document. Scottish Natural Heritage.

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. DOI: 10.1371/journal.pbio.0050197

Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. and Fuller, R.J. (2013*). Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland.* BTO Books, Thetford, UK.

Band, W., Madders, M. and Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In: Birds and wind power: risk assessment and mitigation. M. De Lucas, G.F.E. Janss and M. Ferrer, Eds.: 259-275. Quercus, Madrid.

Barrios, L. and Rodríguez, A. (2004). Behavioural and environmental correlates of soaring bird mortality at on-shore wind turbines. Journal of Applied Ecology, 41(1): 72-81.

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

Beintema, A. & Visser, G.H. (1994). - Factors affecting growth and survival of lapwing Vanellus vanellus chicks. – Pp. 39-40 in: Tucker, G.M., Davies, S.M.& Fuller, R.J. (eds.) The ecology and conservation of lapwings Vanellus vanellus. – Joint Nature Conservation Committee (UK Nature Conservation No. 9).

Berg, Åke & Lindberg, Thore & Kallebrink, K.G. (1992). *Hatching Success of Lapwings on Farmland: Differences between Habitats and Colonies of Different Sizes.* Journal of Animal Ecology. 61. 469-476. 10.2307/5337.

Berg, Å. (1993). - Habitat selection by monogamous and polygamous Lapwings on farmland – The importance of foraging habitats and suitable nest sites. – Ardea 81: 99-105.

Bibby, C.J., Burgess, N.D. & Hill, D.A. & Mustoe, S. (2000) *Bird Census Techniques (Second edition).* Academic Press, London.

Birds Directive (2009/47/EC) http://ec.europa.eu/environment/naturelegislation/birdsdirective /index _ en.htm

BirdLife International, 2004. *Birds in the European Union: a status assessment*, Wageningen, The Netherlands.

Boland, H. & Crowe, O., (2012). Irish Wetland Bird Survey: Waterbird Status and Distribution 2001/02 -2008/09, Kilcoole, Wicklow.

Boland, H. et al., (2010). Whooper Cygnus cygnus and Bewick's C. columbianus bewickii Swans in Ireland: results of the International Swan Census, January 2010. Irish Birds, 9(1), pp.1–10.

Bord na Móna (2016) – Biodiversity Action Plan 2016 – 2021

British Trust of Ornithology (BTO) online BirdFacts. Available at https://www.bto.org/about-birds/birdfacts

Brazil, M. (2003) *The Whooper Swan*. First Edition. Poyser Monographs; T. & A.D. Poyser.

Brown, A.F.& Shepherd, K.B. (1993) *A method for censusing upland breeding waders.* Bird Study, 40: 189-195

Burke, B., Lewis, L. J., Fitzgerald, N., Frost, T., Austin, G. & Tierney, T. D. (2018) *Estimates of waterbird numbers wintering in Ireland*, 2011/12 – 2015/16. Irish Birds No. 41, 1-12.

CEC, The Council of the European Communities (1979). Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds. Official Journal of the European Communities No. L 103/1: 25.

Chamberlain, D., Freeman, S.N., Rehfisch, M.M., Fox & Desholm, M. (2005). *Appraisal of Scottish Natural Heritage's Windfarm collision risk model and its application.* BTO Research Report No. 401. 52pp.

Chamberlain, D.E., Rehfisch, M.R., Fox, A.D., Desholm, M., Anthony, S.J. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis 148: 198–202.

CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

Colhoun, K. and Cummins, S. (2013). *Birds of Conservation Concern in Ireland 2014 2019.* Irish Birds 9(4): 523-544.

Craig, G.R., White, G.C, Enderson, J.H. (2004). *Survival, Recruitment, and Rate of Population Change of the Peregrine Falcon Population in Colorado.* The Journal of Wildlife Management. Vol. 68, No. 4, pp. 1032-1038.

Cramp, S. (1993) *Handbook of the Birds of the Western Palaearctic*, Oxford University Press, Oxford.

Crowe, O., Coombes, R.H., O'Sulliavn, O, Tierney, T.D., Walsh, A.J. and O'Halloran, J. (2014). *Countryside Bird Survey Report 1998-2013*, BirdWatch Ireland, Wicklow.

Crowe, O. & C. Holt. 2013. Estimates of waterbird numbers wintering in Ireland 2006/07 – 2010/11. Irish Birds 9, 545-552

Crowe, O., McElwaine, J.G., Boland, H., Enlander, I.J. (2015). Whooper Cygnus cygnus and Bewick's C. columbianus bewickii Swans in Ireland: results of the International Swan Census, January 2015. Irish Birds 10(2): 151-158.

Dewitt, A. L. & Langston, R.H.W. (2008) *Collision effects of wind - power generators and other obstacles on birds.* Annals of the New York Academy of Sciences, 1134 (1): pp. 233 - 26 6(34).

DoEHLG (2013). Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. Department of the Environment, Community and Local Government (where relevant).

Drewitt, A. L. & Langston, R.H.W. (2006). *Assessing the impacts of wind farms on birds.* Ibis. 148: 29 – 42.

EPA (2002). Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency (where relevant).

EPA (2003). Advice notes on current practice (in the preparation of Environmental Impact Statements (where relevant).

EPA (2017). Draft revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency.

European Commission (2002). Assessment of plans and projects significantly affecting Natura 2000 sites.

European Commission (2011). Wind energy development and Natura 2000. Guidance document.

European Commission (2017). Environmental Impact Assessment of Projects.

Evans P.R., Pienkowski M.W. (1984). *Population Dynamics of Shorebirds.* In: Burger J., Olla B.L. (eds) Shorebirds. Springer, Boston, MA.

Fernández-Bellon, D., Wilson, M.W., Irwin, S., O'Halloran, J. (2018) Effects of development of wind energy and associated changes in land use on bird densities in upland areas.

Fernley, J., Lowther, S. & Whitfield P. 2006. *A Review of Goose Collisions at Operating Wind Farms and Estimation of the Goose Avoidance Rate.* Unpublished Report by West Coast Energy, Hyder Consulting and Natural Research.

Galbraith, H. (1988). - Effects of agriculture on the breeding ecology of Lapwings Vanellus vanellus. – J. Appl. Ecol. 25: 487-503.

Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The new atlas of breeding birds in Britain and Ireland: 1988-1991.

Gilbert, G., Gibbons, D.W. & Evans, J. (1998) *Bird Monitoring Methods*. RSPB

Gillings and Fuller (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, IP24 2PU, UK.

Hafner, Heinz & Kayser, Yves & Boy, V. & Fasola, Mauro & Prevot, Anne-Caroline & Pradel, Roger & Cézilly, Frank. (1998). *Local Survival, Natal Dispersal, and Recruitment in Little Egrets Egretta garzetta.* Journal of Avian Biology. 29. 216. 10.2307/3677103.

Hardey, J., Crick, H., Wernham, C., Riley, H. & Thompson, D. (2009): *Raptors: a field guide to survey and monitoring. 2nd Edition* Edinburgh: The Stationery Office.

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

Heery, S. (editor) (2018). *Birds in Central Ireland – Sixth Mid-Shannon Bird Report.* 2012-2016. BirdWatch Ireland.

Hötker, H., Thomsen, K.-M. & Jeromin, H., 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation, Bergenhusen, Germany.

Huntley, B., Green, R.E., Collingham, Y.C. and Willis, S.G. (2007). *A climatic atlas of European breeding birds.* Durham University, The RSPB and Lynx Edicions, Barcelona.
Irish Wildlife Acts 1976 to 2018.

Johnson, W.P., Schmidt, P. M and Taylor, D.P. (2014). *Foraging flight distances of wintering ducks and geese: a review.* Avian Conservation and Ecology 9(2)

Joys, A.C. & Crick, H.Q.P (2004). Breeding periods for selected bird species in England. BTO Research Report No. 352. British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, U.K.

Ketzenberg, C. et al., 2002. *Einfluss von Windkraftanlagen auf brütende Wiesenvögel.* Natur und Landschaft, 77, pp.144–153

Kunz, T.H., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D. and Szewczak, J.M. (2007). *Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document.* Journal of Wildlife Management 71(8): 2449-2486.

Lack, P. (1986). The atlas of wintering birds in Britain and Ireland. T & A.D. Poyser Ltd. (for the British Trust for Ornithology and the Irish Wildbird Conservancy), Calton.

Langgemach, Torsten & Bellebaum, Jochen. (2005). *Prädation und der Schutz bodenbrütender Vogelarten in Deutschland.* VOGELWELT. 126. 259-298.

Langston, R.H.W. and Pullan, J.D. (2003). Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. BirdLife International on behalf of the Bern Convention, Strasbourg, 58 pp.

Larsen, J.K. and Madsen, J. (2000). Effects of wind turbines and other physical elements on field utilization by pink-footed geese (Anser brachyrhynchus): A landscape perspective. Landscape Ecology, 15(8): 753 764.

Lauder, C. & Donaghy, A. (2008). Breeding Wader in Ireland 2008: A Review and Recommendations for Future Action. Unpublished report to the NPWS

Lusby, J., Corkery, I., McGuiness, S., Fernández-Bellon, D., Toal, L., Norriss, D., Breen, D., O'Donaill, A., Clarke, D., Irwin, S., Quinn, J.L., & O'Halloran, J. (2017): *Breeding ecology and habitat selection of Merlin Falco columbarius in forested landscapes,* Bird Study

Madden, B. and Porter, B., (2007). Do wind turbines displace Hen Harriers (Circus cyaneus) from foraging habitat? Preliminary results of a case study at the Derrybrien Wind Farm, County Galway. Irish Birds 8(2): 231-236.

Madders, M. & Whitfield, P.D. (2006). *Upland Raptors and the Assessment of Wind Farm Impacts.* Ibis (2006), 148, 43-56.

McCluskie, A. (2006). Hen Harriers and wind farms. Powerpoint presentation for Natural Research Ltd., U.K.
Meredith, C., Venosta, M. & Ressom, R. 2002. *Cordington Wind Farm Avian Avoidance Behaviour Report 2002.* Biosis Research Project.

McGuinness, D., 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. Guidance Document. Birdwatch Ireland.

McLoughlin, D. and Cotton, D. (2008). *The status of Twite Carduelis flavirostris in Ireland 2008.* Irish Birds 8(3): 323-330.

Murray, T., Clotworthy, C. & Bleasdale, A. (2013) *A Survey of Red Grouse (Lagopus lagopus scoticus) in the Owenduff/Nephin Complex Special Protection Area.* Irish Wildlife Manual, No. 77. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

National Biodiversity Data Centre Website (www.biodiversityireland.ie)

National Parks and Wildlife Services (2015). Hen Harrier Conservation and the Forestry Sector in Ireland.

Norriss, D.W., Marsh, J., McMahon, D. and Oliver, G.A., (2002). *A national survey of breeding Hen Harriers Circus cyaneus in Ireland* 1998-2000. Irish Birds 7(1): 1-12.

NRA (2009a). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2). National Roads Authority.

NRA (2009b) Environmental Impact Assessment of National Road Schemes –A Practical Guide

NRA (2009c) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. National Roads Authority.

Peach, W.J., Thompson, P.S. & Coulson, J.C. 1994. Annual and long-term variation in the survival rates of British lapwings Vanellus vanellus. J. Anim. Ecol. 63: 60–70.

Pearce-Higgins, J.W., Stephen, L., Dowse, A. and Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of multi-site and multi-species analysis. Journal of Applied Ecology 49: 386-394.

Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. and Bullman, R. (2009). *The distribution of breeding birds around upland wind farms.* Journal of Applied Ecology 46: 1323-1331.
Percival, S.M. (2003). Birds and wind farms in Ireland: A review of potential issues and impact assessment. Ecological Consulting.

Prévot-Julliard, A.C., Lebreton, J.D., Pradel, R. (1998). Re-Evaluation of Adult Survival of Black-Headed Gulls (Larus Ridibundus) in Presence of Recapture Heterogeneity, The Auk, Volume 115, Issue 1, Pages 85–95.

Renou-Wilson, F., Keane, M., and Farrell, E. P. (2008). Establishing oak woodland on cutaway peatlands: effects of soil preparation and fertilization. Forest Ecology and Management 255:728-737.

Ruddock, M. & Whitfield, D.P. (2007). *A review of disturbance distances in selected bird species.* A report from Natural Research (Projects) Ltd. to Scottish Natural Heritage.

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

Ruddock, M. et al., 2011. *Republic of Ireland Hen Harrier Survey, 2010*, Dublin, Ireland.
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.

Sandercock, B.K. (2003). Estimation of survival rates for wader population: A review of mark-recapture methods. Wader Study Group Bulletin 100:163-174.

Scott, D. (2000). Marking a decade of tree nesting by Hen Harriers Circus cyaneus in Northern Ireland, 1991-2000. Irish Birds 6(4): 586-589.

Scott, D. (2005). The diet of Hen Harriers Circus cyaneus in Northern Ireland 1991-2005. Irish Birds 7(4): 597-599.

Scott, D. and Clarke, R. (2007). Comparing the success of Hen Harrier Circus cyaneus tree nests and ground nests in the Antrim Hills, 1990-2006. Irish Birds 8(2): 315-318.

Scott, D. and McHaffie, P. (2003). What impact do Buzzard Buteo buteo and Goshawk Accipiter gentilis have on other raptors in coniferous forest? – preliminary findings. Irish Birds 7(2): 267-269.

Scott, D. and McHaffie, P. (2008). Hen Harrier Circus cyaneus killed at windfarm site in County Antrim. Irish Birds 8(3): 436-437.

Scott, D., Clarke, R. and Shawyer, C.R. (1991). *Hen Harriers breeding in a tree-nest. Irish Birds* 4(3): 415-417.

Sharrock, J.T.R. (1976). *The Atlas of Breeding Birds in Britain and Ireland.* British Trust for Ornithology, Tring.

SNH (2000). Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action. SNH Guidance Note.

SNH (2006). Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Sites. Scottish Natural Heritage.

SNH (2009). Monitoring the impact of onshore wind farms on birds. Scottish Natural Heritage.

SNH (2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments. Scottish Natural Heritage.

SNH (2014). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage.

SNH (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage.

SNH (2016) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK.

SNH (2018) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK. http://www.snh.gov.uk/docs/B721137.pdf].

SNH (2016) Wind farm proposal on afforested sites- advice on reducing suitability for hen harrier, merlin and short-eared owl. Scottish Natural Heritage.

SNH (2016). Assessing Connectivity with Special Protection Areas (SPAs). Scottish Natural Heritage.
Snow, D.W. & Perrins, C.M., 1998. *The Birds of the Western Palearctic Vol. 1: Non-passerines*, Oxford, UK: Oxford University Press.
Sovacool, B.K. (2009). Contextualizing avian mortality: a preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity. Energy Policy 37: 2241–2248.

Stewart, G.B., Coles, C.F. and Pullin, A.S. (2005). Effects of Wind Turbines on Bird Abundance. Effects of Wind Turbines on Bird Abundance. Systematic Review No. 4. Birmingham, U.K., Centre for Evidence-Based Conservation.

Thaxter, C. B., Lascelles, B., Sugar, K., & Cook, A. S.C.P., Roos, S., Bolton, M., Langston, R. H.W., Burton, N. H.K. (2012). *Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas.* Biological Conservation. 156. 10.1016/j.biocon.2011.12.009.

Thomas, P. S., Baines D., Coulson J. C. & Longrigg G. (2008) Age at first breeding, philopatry and breeding site-fidelity in the Lapwing Vanellus vanellus. Ibis 136(4):474 - 484

Thompson, Patrick & Baines, David & COULSON, JOHN & LONGRIGG, GEOFF. (2008). *Age at first breeding, philopatry and breeding site-fidelity in the Lapwing Vanellus vanellus.* Ibis. 136. 474 - 484. 10.1111/j.1474-919X.1994.tb01124.x.

Village, A. (1990). *The Kestrel.* First Edition. T. & A.D. Poyser.

Winkelman, J.E., 1992. *The Impact of the SEP Wind Park near Oosterbierum (Fr.), the Netherlands, on Birds*, Vol. 1: Collision Victims [in Dutch]. RIN-report 92/2, Arnhem, Netherlands.

Winkelman, J.E., 1989. Birds at a Wind Park near Urk: Bird Collision Victims and Disturbance of Wintering Ducks, Geese and Swans [in Dutch]. RIN-Rapport 89/15, Arnhem, Netherlands.

Whitfield, D.P. & Madders, M., 2006. Flight Height in the Hen Harrier Circus Cyaneus and its Incorporation in Wind Turbine Collision Risk Modelling. Natural Research Information Note 2, Banchory, Aberdeenshire.

Whitfield, D.P. and Madders, M. (2006). *A review of the impacts of wind farms on Hen Harriers Circus cyaneus and an estimation of collision avoidance rates.* Natural Research Information Note 1 (revised). Banchory, UK, Natural Research Ltd. 32pp.

Whitfield, D.P. & Urquhart, B. (2015) *Deriving an avoidance rate for swans suitable for onshore wind farm collision risk modelling.* Natural Research Information Note 6. Natural Research Ltd, Banchory, UK.

Wilson, M., Fernández-Bellon, D., Irwin, S., O'Halloran, J. (2015). *The interactions between Hen Harriers and wind turbines. WINDHARRIER Final project Report.* School of Biological, Earth & Environmental Sciences, University College Cork, Ireland.

Land, Soils and Geology

British Standards Institution (BSI). (2015) BS5930 - Code of Practice for Site Investigations.

Department of Housing, Planning and local Government (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements). EPA, Wexford.

Environmental Protection Agency (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements. EPA, Wexford.

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Fehily Timoney and Company (FT) (2020a) Geotechnical & Peat Stability Assessment Report - Derrinlough Wind Farm, County Offaly.

Fehily Timoney and Company (FT) (2020b) Peat & Spoil Management Plan - Derrinlough Wind Farm, County Offaly.

Geological Survey of Ireland (GSI). (2005) Geology of Galway - Offaly, 1:100,000 scale Bedrock Geology Series, Sheet 15.

Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements, (IGI, Dublin).

Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms SNH, Stirling.

Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Hydrology and Hydrogeology

CIRIA (2006) Guidance on ‘Control of Water Pollution from Linear Construction Projects’ (CIRIA Report No. C648, 2006).

CIRIA (2006) Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements). EPA, Wexford.

Environmental Protection Agency (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements. EPA, Wexford.

Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, Dublin.

Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements, (IGI, Dublin).

National Roads Authority (2005) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Dublin.

Scotttish Environmental Protection Agency (2014) Pollution Prevention Guidance (PPG) 5 – Works or Maintenance in or Near Watercourses (UK Guidance Note). www.Gov.UK.

Scotttish Environmental Protection Agency (2013) Pollution Prevention Guidance (PPG) 1 - General Guide to Prevention of Pollution (UK Guidance Note). www.Gov.UK.

Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland, Historic Environment Scotland, Marine Scotland Science, AEECoW (2019) Good Practice During Wind Farm Construction. Available at: www.gov.scot.

SNH, 2013: Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms Commissioned Report No. 59. SNH, Stirling.

Air and Climate

Burck et al., 2020 Results 2020. Climate Change Performance Index. Nex Cliamte Institue, Bonn.

Climate Action Network Europe (2018). Off Target Report, Brussels.

Council of the European Union (2008) Council Directive 2008/50/EC on ambient air quality and cleaner air for Europe. Official Journal of the European Union No. L152.

Council of the European Union (2004) Council Directive (2004/107/EC) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. Official Journal of the European Union No. L23/3.

Council of the European Union (2002) Council Directive (2002/3/EC) relating to ozone in ambient air. Official Journal of the European Union No. L67/14.

Council of the European Union (2000) Council Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air. Official Journal of the European Union No. L313.

Council of the European Union (1999) Council Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. Official Journal of the European Union No. L163/41

Department of Communications, Climate Action and Environment (2019) Climate Action Plan (CAP).

Department of the Environment, Heritage and Local Government (2007) National Climate Change Strategy 2007 – 2012. Stationery Office, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Department of Climate Change, Action & Environment. Renewable Energy Action Plan (NREA) Submitted under Article 4 of Directive 2009/28/EC

Department of Climate Change, Action & Environment National Energy Efficiency Action Plan (NEEAP)

Department of Public Expenditure and Reform (2018) National Development Plan 2018-2027. Dublin.

European Commission (2019) COP25 Climate Change Conference. Available at: https://ec.europa.eu/clima/events/cop25-climate-change-conference_en

European Commission (2015). COP21 Paris Agreement. Available at: https://ec.europa.eu/clima/policies/international/negotiations/paris_en

European Commission (2010) Europe 2020 Strategy A European strategy for smart, sustainable and inclusive growth. Brussels.

European Environment Agency (2019) Air Quality in Europe- 2019 Report. EEA

European Environment Agency (2017). Air Quality in Europe – 2017 Report. European Environment Agency, Denmark.

Environmental Protection Agency (2019) Air Quality in Ireland 2018. EPA, Ireland.

Environmental Protection Agency (June 2019) Ireland's Greenhouse Gas Emissions Projections 2018-2040. EPA, Ireland.

Environmental Protection Agency (2018). Ireland's Greenhouse Gas Emissions Projections 2017 – 2035. EPA, Wexford.

Environmental Protection Agency (2007) Ambient Air Monitoring at Ferbane, Co. Offaly 4th October 2006 to 29th March 2007. Available at: https://www.epa.ie/pubs/reports/air/monitoring/Ferbane%20Report.pdf

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Environmental Protection Agency (2017). Irelands Environment 2017 – As Assessment. EPA, Wexford.

Eurostat (2018), Smarter, greener, more inclusive? Indicators to Support the Europe 2020 Strategy. European Union, Luxembourg.

Met Éireann www.met.ie

United Nations (2015) Transforming our World: the 2030 Agenda for Sustainable Development. Available at: https://sustainabledevelopment.un.org/sdgs

United Nations (2012). Doha Amendment to the Kyoto Protocol. United Nations Framework Convention on Climate Change.

United Nations (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations Framework Convention on Climate Change, Bonn.

Wilson et al., (2016) Multiyear greenhouse gas balances at a rewetted temperate peatland.

Wilson et al., 2016; Greenhouse gas Emission Factors.

Wilson et al. (2015) Derivation of GHG emission factors for peatlands managed for extraction in the ROI and the UK.
Wilson, D. and Farrell, E.P., (2007) The Effect of Management Strategies on Greenhouse Gas Balances in Industrial Cutaway Peatlands in Ireland (The CARBAL Report

Noise and Vibration

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

BS 7385 (1993) Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration.

BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

Birgitta Berglund, B., Lindvall, T., Schwela, D. H., (1995) Community Noise. World Health Organisation (WHO), Geneva.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Environment Food and Rural Affairs, the Department of Business, Enterprise and Regulatory Reform and the Department of Communities and Local Government (2007) Research into Aerodynamic Modulation of Wind Turbine Noise.

Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication (1996) The Assessment and Rating of Noise from Wind Farms.

DIN 45680:2013-09 (2013) Draft Measurement and Assessment of Low-frequency Noise Immissions.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

Environmental Protection Agency (2011) Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3).

Health Canada (2014) Wind Turbine Noise and Health Study: Summary of Results. Government of Canada.
Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure (2019) Design Manual for Roads and Bridges (DMRB).

Institute of Acoustics (2016) Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise. IOA, Milton Keynes.

Institute of Acoustics document (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. IoA, Milton Keynes.

ISO 1996 (2017) Acoustics — Description, measurement and assessment of environmental noise.
ISO 9613 (1996) Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation.

McCunney et al (2014) Wind Turbines and Health: A Critical Review of the Scientific Literature. Journal of Occupational and Environmental Medicine. Vol 56, pp. 108-130.
National Health and Medical Research Council (2015) Evidence on Wind Farms and Human Health. Australian Government.

RenewableUK AM project (2013) Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect. Renewable UK

South Australian Environment Protection Authority (2013) Infrasound levels near windfarms and in other environments. Resonate Acoustics, Adelaide.

State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg (2016) Low Frequency Noise Incl. Infrasound from Wind Turbines and Other Sources.

Transport Infrastructure Ireland (TII 2004) (formerly National Roads Authority (NRA 2004)) document Guidelines for the Treatment of Noise and Vibration in National Road Schemes.
UK Health Protection Agency (2010) Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation.

Landscape and Visual

Carmarthenshire County Council (2013) Cumulative Impact of Wind Turbines on Landscape and Visual Amenity.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Galway County Council (2015) Galway County Development Plan 2015 to 2021. Available at: http://www.galway.ie/en/services/planning/developmentplansandpolicy/galwaycountydevelopmentplan2015-2021/

Galway County Council (2015) Landscape and Landscape Character Assessment for County Galway for the Galway County Development Plan 2015-2021.

Landscape Institute (2017) Visual Representation of Development Proposals. Guidance Note 02/17. London.

Landscape Institute (2011) Photography and photomontage in landscape and visual impact assessment. Advice Note 01/11. London.

Offaly County Council (2017) Tourism Strategy for County Offaly 2017-2022. Available at: https://www.offaly.ie/eng/Services/Community-Tourism-Sports/Tourism/Offaly-Tourism-Strategy.pdf. Accessed 14.01.2020

Offaly County Council (2014) Wind Energy Strategy for County Offaly - Methodology Statement.

Offaly County Council, (2014) Offaly County Development Plan 2014 – 2020, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/Volume-1.pdf, Accessed 12.01.2020

Scottish Natural Heritage (2017) Siting and Designing Wind Farms in the Landscape, Version 3a. SNH, Stirling.

Scottish Natural Heritage (2017) Visual Representation of Wind Farms: Version 2.2 SNH, Stirling.

Scottish Natural Heritage (2015) Spatial Planning for Onshore Wind Turbines – natural heritage considerations. SNH, Stirling.

Scottish Natural Heritage (2012) Assessing the Cumulative Impact of Onshore Wind Energy Developments. SNH, Stirling.

Scottish Natural Heritage (2002) Visual Assessment of Wind Farms: Best Practice SNH, Stirling.

Tipperary County Council (2016) Landscape Character Assessment of Tipperary 2016. Available at: https://www.tipperarycoco.ie/sites/default/files/Landscape%20Character%20Assessment%20for%20Tipperary%202016.pdf

Tipperary County Council (2015) North Tipperary County Development Plan 2010 – 2016 (As Varied) Available at: https://www.tipperarycoco.ie/planning/north-tipperary-county-development-plan-2010-varied-0. Accessed 13.01.2020

Archaeological and Cultural Heritage

Department of the Arts, Heritage and the Gaeltacht (2011) Architectural Heritage Guidelines for Planning Authorities. Dublin Stationary Office.

Bennett, I. (ed.) Excavations.ie, database of Irish excavation reports. Available at http://www.excavations.ie.

Department of Culture, Heritage and the Gaeltacht National Monuments Service. Available at: www.webgis.archaeology.ie/historicenvironment

Department of Culture, Heritage and the Gaeltacht Database of Irish Excavation Reports. Available at: www.excavations.ie

Department of Culture, Heritage and the Gaeltacht National Inventory of Architectural Heritage. Available at: www.buildingsofireland.ie

Department of Arts, Heritage, Gaeltacht and the Islands, 1999, Framework and Principles for the Protection of the Archaeological Heritage, 1999.

Guidance on Setting and the Historic Environment, Historic Environment Division, February 2018

Guidelines on the information to be contained in Environmental Impact Statements, EPA 2017.

Offaly County Council, (2014), Offaly County Development Plan 2014 – 2020, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/Volume-1.pdf, Accessed 10.12.2019

Record of Monuments and Places (RMP) for County Offaly. Available at: https://www.archaeology.ie/sites/default/files/media/pdf/Archaeology-RMP-Offaly-Manual-(1995)-0040.pdf. Accessed 10.11.2019, 02.12.2019; 03.12.2019, 10.01.2020.

Rialtas na hÉireann Irish Placenames database. Available at: www.logainm.ie

1st Edition 6-inch OS maps (1835)

2nd Edition 25-inch OS maps (1903)

Department of the Environment, Community and Local Government (2013). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. DoEHLG, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Government (August 2018) Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. DHPLG, Dublin.

Department of Housing, Planning and Local Government (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, Dublin.

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry.

National Roads Authority (2011). Project Appraisal Guidelines, Unit 5.5 Link Based Traffic Growth Forecasting. NRA, Dublin.

National Roads Authority (2011). NRA TD 41-42/11 Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads. NRA, Dublin.

National Roads Authority (2007). Traffic and Transport Assessment Guidelines. NRA, Dublin.

National Roads Authority (2003). Future Traffic Forecasts, 2002 to 2040. NRA, Dublin.

Offaly County Council, (2014), Offaly County Development Plan 2014 – 2020, Online, available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/Volume-1.pdf, Accessed 09.11.2019

TII (May 2019) Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections PE-PAG-02017, Transport Infrastructure Ireland.

TII (October 2016) Project Appraisal Guidelines for National Roads Unit 5.2 – Data Collection PE-PAG-02016, Transport Infrastructure Ireland.

TII (May 2014) Traffic and Transport Assessment Guidelines PE-PDV-02045. Transport Infrastructure Ireland.